BACKGROUND ON THE AIS SIGED YEARLY ICISER CONFERENCE

The Association for Information Systems Special Interest Group on Education (SIGED) is committed to fostering excellence in information systems education, practice, and research. Our primary goal is to create a platform where researchers and educators in information systems can share ideas, techniques, and applications. We achieve this through various activities and publications.

Each year, SIGED hosts an international conference in December, featuring competitively selected peer-reviewed papers, tutorials, and panel discussions. The conference also includes the announcement of Best Paper and Best Reviewer Awards. All presented papers are published in the conference proceedings, which are distributed for free to conference registrants and shared online with SIGED members. In 2023, we introduced a new award – the "Best Student Paper" – aimed at encouraging new members to join our SIG.

Attending our annual conference not only offers valuable opportunities for continued professional growth and development but also facilitates networking within the information systems community. For the latest information on AIS SIGED activities, please visit our website at www.ais-siged.org. We look forward to welcoming you to our vibrant community dedicated to advancing information systems education and research.

Dr. Tania Prinsloo, SIGED Research Director 2023, compiled the conference proceedings.

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At AIS SIGED, our unwavering commitment is to champion excellence in information systems (IS) education, research, and practice. Our fundamental objective is to create a welcoming space for IS researchers and educators to share ideas, techniques, and applications. This objective comes to life through a variety of initiatives, including hosting an annual pre-ICIS conference, advocating for and fostering IS education and pedagogy across the association, and coordinating education tracks at significant AIS-affiliated conferences.

Previously known as the International Academy for Information Management, our special interest group on IS education has been the driving force behind this pre-ICIS annual conference for over three decades. All submitted papers undergo a meticulous double-blind peer review process, resulting in the production of conference proceedings each year. Notably, the 2023 conference recognizes outstanding contributions with the Best Paper Award, Best Student Paper, and the Best Reviewer Award.

In recent years, education tracks have flourished in nearly all major AIS conferences. SIGED members play pivotal roles as track, mini-track, and session chairs, as well as dedicated reviewers at AIS conferences. This tradition of active involvement will persist in the future, coupled with the continuation of teaching and learning workshops at AIS conferences to enhance the teaching and curriculum development skills of our academic community.

Our leadership structure involves the annual election of a President-Elect, who assumes the role of President the following year. Additionally, the Secretary, Treasurer, and directors are elected for two-year terms in rotation. The board convenes at least twice a year, prioritizing the convenience and availability of board members.

To all IS educators, we extend a heartfelt invitation to join our special interest group and engage actively in our enriching activities. Members receive regular invitations to participate in and organize education tracks at affiliated conferences.

Welcome to the Hybrid Conference in 2023! Anticipation is high for an engaging and inspiring conference experience.
ACKNOWLEDGEMENTS

Gratitude is extended to the dedicated officers and directors of AIS SIGED for their commendable efforts. These individuals invested substantial time, energy, and resources to actively participate in board meetings, tirelessly working towards the upkeep and improvement of SIGED as a professional organization. The board meetings served as crucial forums for extensive program planning and decision-making. If you have an interest in becoming more involved with SIGED, please feel free to reach out to any of the listed officers – your enthusiasm and contribution would be warmly welcomed.

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- Vasso Stylianou, President, stylianou.v@unic.ac.cy
- Toon Abcouwer, Past-President, A.W.Abcouwer@uva.nl
- Tania Prinsloo, Research Director, tania.prinsloo@up.ac.za

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2023 SIGED Conference Digital Credential Partner
The meticulous process of curating top-notch papers, panels, and teaching cases for inclusion in the SIGED annual conference is indeed a demanding task. Heartfelt gratitude is extended to each individual who has played a role in this process. We genuinely appreciate the significant time and effort they dedicate to ensure a robust and well-rounded program, addressing the major pedagogical issues and concerns of IS educators, researchers, and other professionals integrating information technology in their disciplines. The outcomes of their hard work are prominently showcased in the papers featured on the following pages.

This year, manuscripts were submitted to the research director, who conducted a brief editorial review to ensure proper submission. Subsequently, each paper underwent a blind review by at least two reviewers. These reviewers meticulously assessed the submissions based on the relevance of the topic, the contribution of the approach, and the impact on pedagogy and/or curriculum. Acceptance recommendations were then forwarded to the research/track chair for the final decision. Authors of accepted papers (or extended abstracts) were promptly notified of their acceptance and provided with constructive feedback from reviewers, offering guidance for potential improvements and instructions for submitting the final revised/formatted articles.

In addition to their role in rating and commenting on papers, Board Members and track chairs were asked to recommend whether a paper should be considered for the Best Conference Paper Award. Two papers emerged as candidates for the honor, and the research director carefully reviewed the ratings to determine consensus on their quality. The results of the Best Paper Award, along with the newly introduced Best Student Paper Award, will be unveiled during the conference’s "Best Paper" award presentation.

The articles featured in the following pages are contributions from authors who met conference qualifications and completed their final drafts by the specified deadline.

It is important to note that authors retain full copyright of their work, and we kindly request them to acknowledge these proceedings when citing their work.
REVIEWERS

The recipient of the ‘Best Reviewer’ award is chosen through a thorough examination of all reviews. This distinguished individual is someone who has showcased expertise by offering insightful and knowledgeable feedback, provided high-quality reviews that prove beneficial to paper authors, demonstrated collegiality, and consistently delivered constructive feedback, all while adhering to timely completion of reviews. We extend our heartfelt thanks to the referees listed below, whose invaluable time and expertise significantly contributed to the blind review process for this year's conference:

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EFFICACY BELIEFS AND OUTCOMES: SOCIO-COGNITIVE PERSPECTIVES ON A FACULTY-LED COP

John Michael Muraski
muraskij@uwosh.edu

Donald H. Heath
heathd@uwosh.edu

Michael A. Eierman
eierman@uwosh.edu

Michael Patton
pattonm@uwosh.edu

1University of Wisconsin Oshkosh

Abstract:
This study documents the redesign of an introductory information systems course at a US University. Dual lenses of Communities of Practice [CoP] and Social Cognitive Theory are used to explore the impact on course improvement and the self-efficacy beliefs of members. The methodological approach involved participatory action approach and relied on semi-structured interviews, field notes, and student assessments as data sources to examine how participants’ self-efficacy beliefs evolved through the course redesign and the impact of the work on course quality. This paper contributes to the existing literature by identifying faculty participation in CoP to enhance instructors’ efficacy beliefs, bridging the sociocultural and social cognitive perspectives. Our study contributes a deeper understanding of the sources of self-efficacy within a CoP among well-trained and experienced instructors, each with significant mastery experience, and how vicarious experience and verbal persuasion within the CoP positively impacted their beliefs and motivations.

Keywords: Community of Practice, Self-Efficacy, Course Redesign

I. INTRODUCTION
Introductory courses can be critical in the growth and success of academic departments and the colleges where they reside. They provide students with the foundational knowledge of a specific discipline and often serve as a source of information to non-majors regarding offerings and degree programs. Therefore, academic departments must put their best foot forward. We must design and teach introductory courses effectively to fulfill the dual goals of teaching and recruitment. However, challenges can obstruct the achievement of these goals.

Many of these survey courses prioritize topical breadth over depth. Various faculty often teach these courses in multiple sections. Consequently, new faculty, instructional staff, or adjuncts frequently assume teaching responsibilities. While this is a common staffing strategy, it invites more variability in the quality of instruction. Departments may require that all instructors use a prescribed textbook and follow a single syllabus. However, this is often the extent of the coordination among instructors, with little collaboration regarding topical focus and appropriate depth of coverage, the rigor of assignments and grading, delivery methods, or other pedagogical concerns [Bosman and Vogl, 2019]. As used here, instructors refer to all faculty and instructional staff within an academic unit. Lack of coordination among instructors can pose challenges to course quality and consistency.

Instructors within an academic department possess the deep content knowledge, teaching, and technical expertise needed to develop genuinely effective introductory courses - lessons, lectures, lab exercises, vignettes, stories, thought experiments, assessments, or other tools honed over time through experience. However, formal or informal mechanisms often need to be included for identifying, sharing, evaluating, and cross-pollinating this knowledge and experience. How can this expertise be harnessed to improve course quality and teaching efficacy among those teaching these courses?
In this paper, we adopt dual lenses of Communities of Practice [Lave and Wenger, 1991] and Social Cognitive Theories (SCT) [Bandura, 1993] to investigate an instructor-created community of practice (CoP) in the Information Systems Department organized around the redesign of an introductory “Essentials of Information Systems” course and its impact on the beliefs and practices of individual instructors. Our investigation aims to understand 1) How did the work of the CoP impact course quality, and 2) How did participation impact the self-efficacy beliefs of CoP members? The CoP perspective frames our analysis of socially situated learning within the community. SCT extends our analysis of understanding how participation in the CoP impacts participants’ self-efficacy beliefs and their subsequent willingness to enact what they have learned.

The methodological approach taken is one of participatory action research [Sharma and McShane, 2008], where the authors of this paper are also members of the CoP. The research makes several contributions. It extends the existing literature by considering the social cognitive perspectives in the formation of self-efficacy beliefs of instructors. Second, it describes how instructor-organized CoP can serve as a vehicle for group training and professional development while fomenting greater consistency in courses taught by multiple instructors in multiple sections.

II. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The aim of our analysis is to explore how the collaborative redesign of an introductory “Essentials of Information Systems” [EIS] impacted the collective and individual efficacy beliefs of participating instructors and their willingness to implement that which had been negotiated within the group. Therefore, SCT and CoP were chosen as appropriate theoretical lenses.

Wenger, et.al. [2011] define CoP as a “learning partnership among people who find it useful to learn from and with each other about a particular domain. They use each other’s experience of practice as a learning resource” [p. 9]. This definition is well-aligned with the collaborative engagement which is the focus of this study and provides a useful framework with which to analyze group interaction. SCT has been used extensively by researchers to understand individual human development, motivation, and change. SCT provides a useful analytical lens with which to understand the willingness of individual instructors to implement that which is negotiated within the CoP. We begin the section that follows with a brief review of each of these theories and how they have been used by researchers in the context of higher education

COMMUNITIES OF PRACTICE

The CoP perspective put forth by Lave and Wenger [1991] is rooted in social constructivist theory [Vygotsky, 1978], which recognizes the social environment as an inextricable part of individuals’ identities and understandings, emphasizing the relational interdependency of agent and world, activity, meaning, cognition, learning, and knowing [Lave, 1991]. Individual and environment are mutually constitutive. Considerable researcher attention has been given to CoP as a vehicle for socially situated learning and collaboration where members participate and contribute to the growth and development of all partners [Bosman and Voglewede, 2019; de Carvalho-Filho et al., 2020; Green et al., 2013; McDonald and Star, 2008; Mullen and Schunk, 2010; Por and Scholar, 2014; Sánchez-Cardona et al., 2012; Takahashi, 2011]. The CoP perspective provides insight into learning and sharing processes that take place in the context of shared work activities and collaboration by a community of practitioners around a common interest. Wenger et al. [2002, p.4] describe CoPs as collectives who share a common concern, a set of problems, or are passionate about a topic, and who deepen their knowledge and expertise within their shared focal area on an ongoing basis.

Wenger et al. [2011] describe several concepts that are foundational to the CoP perspective. CoPs involve three requisite elements: a common domain of knowledge, a community of people invested in this domain who can create the social structure necessary for learning, and shared practice developed by the community which is responsive to its needs. Wenger [2004] describes the domain of knowledge as “the area of knowledge that brings the community together, gives it its identity, and defines the key issues that members need to address”. It is the locus of engagement. The community, in his view, is comprised of “the group of people for whom the domain is relevant, the quality of the relationships among members, and the definition of the boundary between the inside and the outside” [ibid]. Members of the community co-
engage on ideas or topics within their domain of interest to share and learn. Wenger [2004] defines practice as “the body of knowledge, methods, tools, stories, cases, documents, which members share and develop together” to address recurring problems in their specific contexts”.

Individuals’ engagement in a CoP always entails negotiation of meaning. Learning in the CoP is a social process, where individuals, interacting with one another and their environment, negotiating meaning through participation in social communities and the reification of tools and procedures relevant to their focal activities [Wenger, 1998]. Participation and reification are complementary aspects of the production of meaning. Identity, for individual members, is not simply a product of reification via social discourse between the self and of social categories but is also produced in lived experience through participation in specific communities. “What narratives, categories, roles, and positions come to mean as an experience of participation is something that must be worked out in practice. Identity is “a layering of events of participation and reification by which our experience and its social interpretation inform each other” [Wenger, 1998 p. 151].

Wenger et al. [2011] argue value creation within a CoP can be cast into five categories: immediate value; potential value, applied value; realized value; and reframed value. Immediate value involves learning that can be applied immediately to solve a problem. Potential value involves accrual of shared skills and knowledge that may have future benefit. Applied value concerns appropriation of shared skills and knowledge to new contexts. Realized value is that which, in the view of CoP participants, impacted their ability to achieve important goals. Finally, reframed value concerns the identification and definition of new criteria for success.

Learning within a CoP generally follows an apprenticeship model, where practice in the community enables the apprentice to move from peripheral to full participation [McDonald and Star, 2008]. Every member can serve as an apprentice or full participant depending on their familiarity with the ideas or content being discussed. The value-add is the generation and circulation of knowledge, productive capabilities, and in fostering innovation [Por and Scholar, 2014]. CoPs encourage active participation and collaborative decision-making by individuals, as opposed to decision-making by an “authority” figure. Hierarchical, authoritarian management is replaced by self-management and collective ownership of the work [Collier and Esteban, 2000]. Decision-making is a participatory and collaborative process [Johnson 2001]. Members can assume different roles, and hierarchical authoritarian management is replaced by self-management and ownership of work [McDonald and Star, 2008]. Participants generate knowledge as they interact, share information, experience, insight and advice and help each other solve problems. “Over time, this combination of action and discourse eventually represents communal approaches to understanding and solving problems, and the process of reification transforms this shared knowledge into the tools and artifacts that embody a CoP’s regime of competence“ [Smith et al., 2017, p.213].

Regarding research on CoP in academia, one study by Green et al. [2013] investigated a faculty-based CoP situated in a large, multi-disciplinary, multi-campus faculty. The aim of the study was to understand its potential to promote continuing professional learning among members. The authors found CoPs in their study could meet the needs of members in ways that formally structured programs could not. Similarly, a study by Sanchez-Cardona et al. [2012] examines a CoP involving the library system of a higher education institution in Puerto Rico, finding learning and collaboration among members was the principal benefit, with promotion of new practices which may contribute to the improvement of library services constituted an additional benefit.

A study by McDonald and Star [2008] focused on a CoP dedicated to redevelopment of a first-year course taught by first year course leaders in a business faculty. As is the case with this study, the CoP arose from collaboration between instructors and their plan to share ideas to regenerate the course with others. The case involved the collaborative redesign of an existing undergraduate business course to “embed graduate attributes, scaffold constructivist learning activities, and address student retention and progression issues“ [p.6]. The authors found the CoP “increased domain knowledge, intense discussion, reflection on and in practice of teaching first year students, which have supported changed teaching practice, and a strong sense of community that provides professional support for members”.

Takahashi [2011] offers one of the few studies that seeks to explore the role of CoP in the formation of individual self-efficacy beliefs. The focus of the research is on the evidence-based
decision-making practices of junior high school teachers cast through the lens of CoP. The findings support the relevance of a communities of practice perspective in making sense of how teachers’ participation in their social surroundings may shape their efficacy beliefs. The author calls for future research to “better understand how teachers co-construct efficacy beliefs, and how “information” is understood and used in this process” [p.740].

Widely subscribed learning theories such as social cognitive theory [Bandura, 1977], and sociocultural theory [Vygotsky, 1978], hold that there is a fundamental difference between acquiring new knowledge and skills and putting them into practice. Individual motivation is a key driver of behavioral change. “A full understanding of human adaptation and change requires an integrative causal structure in which socio-structural influences operate through mechanisms of the self-system to produce behavioral effects” [Bandura, 1997].

In this research, we operationalize the CoP perspective to analyze the collaborative activities associated with the EIS redesign that is the focus of this research. Responding to Takahashi’s [2011] call, we extend our analytical frame to include SCT and investigate how participation in a CoP impacts self-efficacy belief formation and practice consequent to participation in the CoP.

SELF-EFFICACY BELIEFS OF THE INDIVIDUAL

Social cognitive theory [Bandura, 1977] serves as the foundation for much of the research on teacher education and professional development. SCT posits that learning occurs in a social context consequent to dynamic and reciprocal interaction between the person, the environment, and behaviors. Behaviors are shaped by external and internal social reinforcement. Grounded in the principle of reciprocal determinism, SCT holds an individual’s past experiences, influences, reinforcements, expectations, and expectancies, all shape whether a person will engage in a specific behavior and help explain why a person engages in that behavior.

Bandura [1993] observes much of human behavior is purposive -- regulated by forethought involving cognized goals, and that personal goal setting is influenced by self-appraisal of one’s capabilities. The stronger one’s perceived self-efficacy, the higher the goals one might set for themselves. Self-efficacy is the product of a cognitive process in which people construct beliefs about their capacity to perform at a given level of attainment. These beliefs influence how much effort they are willing to put forth, how long they will persist in the face of obstacles, how resilient they are in dealing with failures, and how much stress or depression they experience in coping with demanding situations [Tschannen-Moran and Hoy, 2007].

As it relates to teaching, Bandura observes “the task of creating environments conducive to learning rests heavily on the talents and self-efficacy of teachers” [1993, p.140]. Teachers’ self-efficacy beliefs have shown themselves to be critical to the improvement of teaching and student learning [Maddux and Lewis, 1995; McKeachie, 1991; Takahashi, 2011; Tschannen-Moran and Hoy, 2007; Usher and Pajares, 2008]. Self-efficacy affects their choice of activities, effort, persistence, achievement [Bandura, 2006].

Four principal sources of information help inform self-efficacy beliefs of the individual; “performance accomplishments, vicarious experience, verbal persuasion, and physiological states.” [Bandura, 1997]. Mastery experiences, which for teachers come from actual teaching accomplishments with students, is believed to be the most influential. Perceived self-efficacy increases when a teacher perceives her or his teaching performance to be a success, which then cascades to future performances. Similarly, the inverse is true in the case of a bad performance. Verbal persuasion concerns the feedback a teacher receives regarding their performance from important others, such as administrators, faculty colleagues, parents, and students. Vicarious experiences are realized through the modeling of an activity by colleagues or relevant others. The impact of vicarious experiences on the observer’s efficacy beliefs depends on the degree to which the observer identifies with and respects the modeler. Psychological and emotional arousal also impact perceptions of self-efficacy. When working alone in the classroom, self-efficacy beliefs shape their courage and performative motivations of teachers to adopt new behaviors. Several researchers have called for additional research into the antecedents of teachers’ self-efficacy beliefs as well as the sources of efficacy information that would tap the relative weight of vicarious experiences, verbal persuasion, mastery experiences, physiological arousal and contextual factors [Takahashi, 2011; Tschannen-Moran and Hoy, 2007].
In one such study, Tschannen-Moran and McMaster [2009] examined four professional development interventions grounded in Bandura's sources of self-efficacy, each with increasing levels of self-efficacy-relevant input. All interventions generated modest increases in perceived self-efficacy, however mastery experiences were deemed the most effective. Despite this finding, the authors found there was no impact on implementation behavior, suggesting there may not have been confidence in the material to be implemented.

Goddard et al. [2004] found teacher self-efficacy was positively impacted when participants had input into curricular decisions. Sehgal et al. [2017] found the link between perceived self-efficacy and teacher effectiveness was strengthened by collaboration among teachers and academic leadership.

In some studies, Bandura's sources of self-efficacy information are augmented by other factors, particularly those related to the teaching environment. Tschannen-Moran and Hoy [2007] examined the impact of contextual factors such as available teaching resources and interpersonal support, finding they were much more salient in the self-efficacy beliefs of novice teachers. Among experienced teachers with an abundance of mastery experience to draw on, contextual factors were far less important.

Williams [2009] finds there is an emotional component of self-efficacy tied to personal accomplishment. The subjects in their study were teachers who earned an advanced degree while working as teachers. “The teachers’ feelings about themselves, their pride and satisfaction from gaining the degree, their confidence, the knowledge gained, and their consequent sense of personal self-efficacy contributed to enthusiasm about and, indirectly, reported changes to their practice”. This suggests accomplishments achieved throughout support/intervention sessions may be useful in creating a self-reinforcing mechanism to promote perceived self-efficacy based on emotion.

Recognizing the causal link between self-efficacy beliefs and behaviors, we recognize there is a fundamental difference between acquiring new knowledge and skills in a CoP and enacting them in the classroom. Individual motivation is a key driver of behavioral change. “A full understanding of human adaptation and change requires an integrative causal structure in which socio-structural influences operate through mechanisms of the self-system to produce behavioral effects” [Bandura, 1997]. In this study, we seek to complement the research on CoP by considering the socio-cognitive perspective and self-efficacy beliefs of individual instructors.

III. METHODOLOGY

CONTEXT OF THE STUDY

One of the courses taught by the Information Systems department in the College of Business at the University of Wisconsin Oshkosh is an Essentials of Information Systems course [EIS]. This course is not unlike those offered in other departments and colleges. In our case, the EIS was taught by a variety of instructors. The department refreshed the EIS course periodically, reviewing new textbooks and seeking those believed to best reflect the ever-changing technical landscape and imparting the right balance of technical and managerial coverage. However, available textbooks were often viewed as too heavily focused on management concepts. Others were more technical but often too esoteric.

Teaching responsibility for the EIS most often falls to new faculty, instructional staff, or adjuncts. While this is a common staffing strategy, this strategy invited greater variability in the quality of instruction. While we required that all instructors use the prescribed textbook and follow a single syllabus, this was the extent of the coordination among instructors, with little collaboration regarding topical focus and appropriate depth of coverage, rigor of assignments and grading, methods of delivery, or other pedagogical concerns. Over time, each instructor would slowly add their own content, topics, and activities grounded in their own specific interests, knowledge, and experience. The consequence of this was a high degree of variability in students’ experience across sections.

These concerns, and our desire to build a better and more consistent course, motivated the Information Systems department to strategize on how to collaborate and create a course that would deliver a more consistent student experience and more predictable student outcomes. Since the time to engage in a significant course redesign did not exist during the semester, the
instructors agreed to work together over the summer to undertake this project. An agreement was made to meet in person 2-3 times per month.

Early conversations revisited learning objectives for the course and asked what content would be most appropriate to teach the intended knowledge, skills, and abilities [KSA] to students. This was an important part of the revision process as it encouraged instructors to elaborate their visions of the purpose for the course. What emerged from these initial sessions was a set of ten key learning questions which would serve as a scaffolding for the course. They are as follows:

1. What are information systems?
2. How will technology impact my career and business?
3. How can I use IT to make business processes better?
4. How do I match business needs with IT solutions?
5. How can I determine whether to buy, build, or lease software?
6. How do I successfully manage projects?
7. What do I need to know about the Internet and networks?
8. How do I turn data into answers to business questions?
9. How can I protect my company, customer, and employee data?
10. How do ethics impact IT-related changes and decisions?

Once these questions were agreed upon, content leaders for each of the questions were nominated [or self-nominated] to build the initial shared content for their assigned sections. Members of the team each had significant experience teaching courses in the information systems discipline ranging from ten to thirty years, and multiple years of experience teaching this course. Three of the five also had significant prior industry experience in the areas of their specialization. Selection was based on instructors’ industry experience, teaching experience, and areas of research.

Dividing the effort, each “subject matter expert” [SME] assumed responsibility for 2-3 areas of the course content. See table 1 for participating instructors. In subsequent meetings, the SMEs would train others while receiving feedback and improvement ideas.

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Rank</th>
<th>Specialization</th>
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<tbody>
<tr>
<td>S1</td>
<td>Full professor</td>
<td>software development, analysis and design</td>
</tr>
<tr>
<td>S2</td>
<td>Associate professor</td>
<td>database, data analytics, strategy</td>
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<tr>
<td>S3</td>
<td>Assistant professor</td>
<td>project management, ERP</td>
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<tr>
<td>S4</td>
<td>Assistant professor</td>
<td>programming, IT infrastructure, web development</td>
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<tr>
<td>S5</td>
<td>Instructor</td>
<td>networking, security, IT ethics</td>
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Each instructor agreed to develop assigned modules which included all the materials necessary to teach and assess their given topic. The course was developed within a Learning Management System [LMS]. Initial ideas were shared via slide presentations which covered the content related to the relevant learning question. The activities and assessments were presented as well. All content, including the presentations, were vetted by the other instructors and recommendations and changes were determined by the group. Adjustments were made iteratively and sometimes involved multiple presentations.
Once the content was stable, responsible instructors recorded their presentation for use across multiple sections. Additional reading and video links were provided along with supporting resources and information. Additionally, instructors developed specific hands-on activities where appropriate that utilized relevant technologies. Activities were focused on the intended learning, with step-by-step instructions provided by the instructors. Assessments were provided for each key question to measure student learning. Once all sections were complete, SME’s contributed questions to be used in development of midterm and final exams.

METHODS
Our approach in this study is one of participatory action research [PAR] [Sharma and McShane, 2008]. Accordingly, the authors of this paper are also members of the CoP involved in the course redesign. The fundamental contention of the action research is that complex social processes can be studied best by introducing changes into these processes and observing the effects of these changes. Baskerville [1999] observes there are three unavoidable effects of the action research paradigm; adoption of an interpretivist viewpoint, adoption of an idiographic viewpoint, and acceptance of qualitative data and analyses. The interpretivist viewpoint follows from the allowance for social intervention by the researcher who, through their intervention, becomes part of the study. Action research therefore includes the observer’s values and a priori knowledge. The social meaning of action is shared between researcher-subject and other subjects, and forms part of the experimental data. The idiographic viewpoint follows from the acceptance that each social setting involves a unique set of interacting human subjects. Action research operationalizes an idiographic method by incorporating the subjects into their research as collaborators and always involves a team that includes researchers and subjects as co-participants in the enquiry and change experiences. Being interpretive and idiographic in nature, action research must also adopt qualitative data as a medium to be analyzed.

Following the approach of Green et al. [2013], data was collected from participating members where each was invited to tell their own story about their experience in the CoP in individual, in-depth, loosely structured interviews, each lasting between 60 and 90 minutes. Prompted by their interviewer, each interviewee reflected on the community’s impact on themselves, their courses, and their co-members. Each author conducted roughly equal numbers of these interviews. We saw these loosely structured interviews as an apt way to capture and facilitate reflective practice, and to make implicit aspects of learning about teaching visible for interrogation and analysis. Creswell notes that qualitative research is “an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. It builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting” [1998, p.18]. Qualitative analysis relies on methods such as interviews, observation of individuals, and controlled subjectivity to build an understanding of the meaning of events, situations, or actions as reflected by participants in the study. A small amount of quantitative data was collected in the form of pre- and post-assessment scores to help in the evaluation of course quality consequent to the CoP’s redesign activities.

We drew on the theories of SCT and CoP to inform our exploration of academics’ experience in a faculty-based teaching community of practice to which we, the authors of this paper, are members. Semi-structured interviews were recorded, transcribed, and analyzed first by each of us separately and then again collaboratively to allow triangulation and validation of the findings. These were augmented within the group with discussions on peer observations and member stories. Though informed by the themes of our referent theoretical frames, our approach was to the analysis was inductive and iterative; moving recursively back and forth between the transcripts, theory, and emerging themes until consensus about the ‘best fit’ was achieved [Polkinghorne, 1995, p. 12]. All interviewees were invited to give feedback on the emerging analysis.

DATA COLLECTION

Student Data
Data relating to student performance in the course was gathered from a pre-existing pre-test and post-test administered in each section of the course. The test includes 25 standard questions. Test questions are mapped to course objectives. A test is administered on the first day of class and again on the last day of class. Fall 2018 data was not included as this first semester of new content did not have a new post-test developed at time of offering. Spring
2019 data was not included given the COVID transition to emergency lock-down that occurred. All 25 questions are multiple-choice and required to be completed by students.

**Faculty Data**

Faculty were interviewed following the development and release of the course and were asked open-ended questions about their experience. These questions included:

1. Talk about the genesis of the project.
2. How did we approach updating the course?
3. Explain how the 10 big questions were developed.
4. Describe the process we followed over the course of the summer.
5. How did we decide who developed each section?
6. Is it your sense that the people with the most expertise were assigned to the right topics?
7. How was your experience teaching the course to colleagues?
8. How was your experience learning course material from other colleagues?
9. Talk about the group dynamic throughout the process?
10. Was there any conflict during the process?
11. What impact did these sessions have on your confidence in teaching the material?
12. Were there topics presented that did not match your teaching experience?
13. Could you identify specific areas where, of those 10 questions, you feel like the work changed your confidence and areas where it didn’t?
14. Are there any lessons from the group that you’re still not comfortable presenting
15. Were there topics you changed or altered when you taught them the following semester?
16. Do you think the CoP mechanism was effective and do you think it improved the course and its delivery?

**IV. RESULTS AND FINDINGS**

In this study, we explored how collaboration in a self-organized CoP around the redesign of an introductory course in information systems impacted course quality and the individual self-efficacy beliefs of participating members? The findings highlight the value of communities of practice as a vehicle for ground-up professional development where, through collaborative engagement, instructors developed a shared perspective toward the course and a deeper understanding of one another’s content and pedagogy. The findings also demonstrate the value of the CoP perspective in making sense of how socially situated learning may shape the self-efficacy beliefs of participants.

In the section which follows, we argue the collective negotiation of meaning was one mechanism by which faculty developed beliefs regarding their own efficacy, supporting the elevated role of active participation in one’s social surroundings and highlighting the limitations of a purely social cognitive perspective on the development of instructors’ self-efficacy beliefs.
The findings also support the positive impact of the CoP on course consistency across multiple sections and instructors and better per- and post-assessments.

**COURSE QUALITY**

The first research question raised in this study asks: *How did the work product of the CoP impact course quality?* One approach taken by this department to evaluate course quality is through assessment using a pre- and post-test which measures overall mastery of course content and its application. In table 2, the average results of the pre- and post-tests are shown over eight semesters, four of which are before the redesign and four after. Note, the pre-post exam was not conducted in Fall 2018 or Spring 2020. The expectation of the college is that student scores must exceed 60% on individual questions. Additionally, the expectation is that the pre- and post-test delta will provide sufficient evidence that satisfactory learning has occurred.

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<th>F16</th>
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<tbody>
<tr>
<td>&gt;60% Individual Questions Pre</td>
<td>11.98%</td>
<td>18.39%</td>
<td>14.80%</td>
<td>17.44%</td>
<td>2.54%</td>
<td>3.40%</td>
<td>4.11%</td>
<td>1.79%</td>
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<tr>
<td>&gt;60% Individual Questions Post</td>
<td>68.56%</td>
<td>58.52%</td>
<td>61.34%</td>
<td>61.46%</td>
<td>59.30%</td>
<td>74.75%</td>
<td>84.62%</td>
<td>83.93%</td>
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<tr>
<td>&gt;60% Individual Questions delta</td>
<td>56.58%</td>
<td>40.13%</td>
<td>46.54%</td>
<td>44.02%</td>
<td>56.76%</td>
<td>71.35%</td>
<td>80.51%</td>
<td>82.14%</td>
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<tr>
<td>Pre-Average</td>
<td>41.89%</td>
<td>46.18%</td>
<td>44.39%</td>
<td>42.12%</td>
<td>37.42%</td>
<td>36.82%</td>
<td>38.08%</td>
<td>37.93%</td>
</tr>
<tr>
<td>Post- Average</td>
<td>64.21%</td>
<td>61.24%</td>
<td>61.66%</td>
<td>61.25%</td>
<td>61.91%</td>
<td>64.93%</td>
<td>72.68%</td>
<td>71.57%</td>
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<tr>
<td>Average delta</td>
<td>22.32%</td>
<td>15.06%</td>
<td>17.27%</td>
<td>19.13%</td>
<td>24.49%</td>
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<td>N</td>
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<td>199</td>
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There are clear trends in the data that support better student performance on the individual questions in the pre and post-test as well as gains in the pre- and post-test delta after the redesign. The average delta post-revision is higher than before the redesign and has improved each semester since the launch. Similarly, correct responses to individual questions rose from the mid-40s prior to the redesign to 70+ post-implementation.

While there are numerous confounding variables which might help account for this steady increase, students are performing better on the assessment deemed important to this department. This supports their notion of better student outcomes.

A second finding regarding course quality was greater course consistency. The content and pedagogy negotiated within the CoP was adopted by all instructors and a master course was created from which all instructors downloaded the same material. One instructor commented, “I filled in for ‘instructor x’ today when they were away at conference. It was amazing. I walked into the class and knew exactly where he was in the content and the intended work for that day!” All interviewees indicated course consistency was a huge benefit that positively impacted the quality of the course.

The third finding regarding course quality was the consensus among members of the CoP that the course content and pedagogy was superior to that of the prior course and more closely aligned with the learning outcomes intended for by the department.

**FACULTY EXPERIENCE WITH REDESIGN**

The Second research question asks: *How did participation impact instructor self-efficacy beliefs?* The remainder of this section outlines the findings relevant to the analysis of this question.

Traditionally, instructors teaching a common course across multiple sections standardize around a textbook and core learning objectives. The content and depth of coverage is left to the instructors to format, deliver, and assess. Over the last several years, this department...
involved in this case flirted with several different textbooks. Some were deemed to be overly focused on business topics while others over-emphasized technology. The department was unable to identify a textbook believed to provide the right balance and depth. As one instructor commented:

We all agreed that the current book wasn't what we wanted. We were sort of dissatisfied, not only with that book but, that it was our second or third book in a few years, so we started looking at existing textbooks and decided none of them were quite what we had in mind. They were either too technical... this is an intro to IS book that you would give to future IS majors... or they were more of a business book that wasn't technical and taught business theory.

Over time, as instructors met in the hallways between classes and discussed the course, they grew frustrated and dissatisfied with the current course. One of the instructors noted, “we have all these content experts in our hallways, what if we each developed a section of the course. What would that look like? What would the modules be? What key questions should they address? What should students know after taking the course?”

At the end of the semester, the instructors decided to redesign the course themselves absent any textbook. They determined the redesign would take place after the final exams. The strategy chosen was to build the course around key learning objectives expressed in the language of business.

I think I came up with the initial dozen questions, and then we met as a team, and we went, OK... we don't like that one... let's reword that one... how about this one, and we bantered them around, until we ended up with 10

Responsibility for the questions and their underlying content were divided among the group. At first, self-selected experts voluntarily selected questions. The group discussed who would serve as the expert for the last few. There was an agreement to meet over the summer to listen to each of the 10 presentations. Each instructor was asked to provide the material that would be used for the class, including slide decks, content in our LMS, in-class activities, and assessments.

Community of Practice
As work began on the redesign, instructors described how they worked collaboratively with a common focus within a common domain of knowledge – a key tenet in the CoP perspective. Each member had a depth of knowledge regarding information systems on each of the 10 big questions. As a group, they had significant work experience in the discipline and/or significant research and publications. Dividing up the work and having the shared experience clearly motivated the department. One member noted, “It was great to share the responsibility of course development. In the past, I had always been responsible for developing content on my own. It was exciting to share my experience and knowledge and trust others to complete their sections.” In dividing up the work, it was noted, “I really saw each SME as the expert. I trusted them and took the approach that I would adopt their presentation and accept their expertise on the subject matter.” Simultaneously, there was a desire to be involved in influencing the final product: “We recognized the SME as the content owner and content expert, but we also wanted to tailor and shape what was being presented to ensure a quality product for our students.”

The collaborative engagement and topical focus of the instructors fostered the emergence of a natural social structure where teaching and learning within the group could occur. This is as expected within a CoP. Members agreed the community enabled collective learning and the development of shared practice. One member noted, “I felt like a student in the process. Except unlike how our students feel sometimes, I had a great team.” Similarly, “through this process, I felt like I was able to contribute to each of the big questions. While I owned three of them, I was still an active participant and contributor to the development of all 10 big questions.” One member highlighted the cohesive nature of the process, “we certainly are more cohesive and then probably you could make the case as a department we are a little more cohesive because we know where everybody's at.” In fact, members noted that they would feel confident working through issues once the material was finalized and being delivered as a class:

“The material is being developed by people who are literally across the hall from me if I run into a situation where like “that did not go the way I thought it would,” I can walk over and talk to them and say, “here is what happened what I miss?” There is a safety
net so that even if I drop the ball on the trapeze...it’s OK... they can coach me, and I can go up and do it again.”

Collectively and over time shared practices evolved regarding course content and pedagogy. Wenger [2011] argues the establishment of a group perspective and shared practices responsive to the needs of members. One member noted that the experience “bonded us tighter” and that “all of us would feel confident talking to anyone of the other instructor’s students and saying this is what is going on in your class.” One SME presented a topic that generated much feedback and discussion. The approach seemed unconventional to the community. After discussion and feedback, the community agreed to the approach. One of the members commented:

“I wasn't an expert in the topic, but I've performed the role in my career. I was somewhat confused by the approach the SME took. It's such a big topic and could have been approached in many ways. I trusted his approach as the expert.”

The SME stated:

“Deciding what to cover in an introductory class for an entire profession and approach to managing projects was challenging. I ended up providing an overview of the topic and a few basic skills that I felt every student in the College of business should use and understand.”

Similarly, one SME gave a presentation that was designed to be covered over two weeks. One of the members felt the content was too deep for the targeted audience. After much discussion and consideration, the SME agreed to update their presentation. One of the instructors noted:

“I was really enthralled with the content that was presented. My concern was that the depth of coverage was just too much for the introductory students. We had a heated exchange about the amount of rigor that should be included in the course. These types of discussions truly contributed to the building of consensus and consistency across all sections.”

The SME stated:

“Initially I felt very strongly about the depth of coverage that I created. It is my belief that the students needed to know all the information that I was presenting. As we discussed the topic as a group, I came to see the value of a lighter touch. Ultimately, we are trying to encourage these students to join our discipline and there was risk by being too technical during this foundational Essentials class.

Within the group, there was often intense discussion. There were several examples of this. One of the first presentations involved a presentation that did not match the expectations of the group:

This was the first time the group came together to hear a presentation from the assigned expert. We didn’t have a standard way of presenting the material or agreement on the depth of coverage. He wasn't quite booed off the stage, but we did have a considerable discussion on depth and format and asked the SME to take another stab at it.”

Another instructor noted that “we did butt heads a couple of times, sometimes significantly.” In discussing that incident, a different member of the department noted, “I think those conflicts we're in the interest of getting the best thing and it's not like either one of them threw up their hands after the fact and said I'm just going to do it the way I want to do it.”

By the end of summer, the department had presented or attended all ten presentations. Taking turns as SMEs across the topics allowed each member to prepare part of the class and teach others based on our expertise and knowledge. Similarly, each took part in all the presentations. This enabled members to learn about each module and see how the content owner presented their material.

Foundational elements of CoP a common domain of knowledge, a community of people invested in this domain who can create the social structure necessary for learning, and finally, a shared practice developed by the community which is responsive to its needs.
This approach allowed the CoP to coalesce around a common perspective toward the course. Each of the members of the department was invested in the redesign process and its outcome. Members built a shared practice and created a consistent course which could be delivered across multiple sections each semester. Participation also impacted individual members. As one participant noted, “It’s one thing to know the content and another to see the way other people present it. It’s another thing also to have the courage to present it yourself.”

**Self-Efficacy**

An important finding in this study involved the evolution of self-efficacy beliefs within the CoP, rather than the classroom. Mastery experience, as predicted by SCT, was gained by instructors when presenting to their peers. While all members had significant mastery experience prior to their work in the CoP, their comments support their beliefs that this activity increased their sense of mastery. The expectation was high regarding the material and delivery.

> Being the first presenter was a bit of a challenge. I had many more questions and requests for me to make changes than I expected. I see that going through the process resulted in a great presentation on the topic. That back and forth was valuable and really elevated my ability to present the material clearly.”

Other instructors hearing the presentation wanted to ensure the focus was on improving content:

> Providing this feedback to the first presenter was awkward. This was our SME on the topic. I want to honor their knowledge and expertise while still providing feedback to make the presentation appropriate for our students.

Other comments centered on confidence gained after delivering the content. It was noted, “presenting the material to the group, I felt very confident I would be able to present this material to students. This was a tough audience.”

Instructors were also impacted by verbal persuasion. Co-engaging on the material provided a sense of “camaraderie and encouragement” and helped the presenter believe their content was appropriate and delivered well. One member noted:

> I have great confidence in my colleagues. I look at what they do in the classroom and their presentation to our team and place myself at the bottom of that hierarchy. I trust the feedback they gave me in my presentations and know if they validate my content my material is good.

Verbal persuasion was described multiple times in the interviews as all participants though the group was supportive and provided lots of praise for good work.

There were instances where vicarious experiences were described by instructors which clearly impacted their self-efficacy beliefs and confidence. For example, one member noted “seeing and hearing the presentations and doing the hands-on activities allowed me to feel confident that I could successfully deliver this material in my own class.” Another instructor described the impact of being involved in the session as follows:

> But in cases where other people have more experience, or we believe they have more expertise with the topic...I yield to that every time. When I watched them do it - I think our delivering the lessons to each other in the sessions – watching each other teach the slides that were part of their development work allowed us to hear how they presented the material - how they organized it - how they put it in the minds of the audience - how they reinforced what they wanted the students to learn with examples and stories. That was very important I thought.

One instructor commented, “without hearing some of the stories that were shared I would not have felt comfortable giving this lecture.”

The entire experience was generally seen to boost confidence:

> It wasn't just the content but rather the ideas they shared when they talked about it...the stories and metaphors that were included as they taught us their material. I really felt I would be able to use these when I taught the material. You just can't get that from the slide deck or a textbook.
Watching how the expert presented the material, how they talked about it, and brought the audience along to understand it helped me think about how to present the material. I felt like I could do it.

Another instructor in the department participated and contributed through each session but did not act as a SME for any topic. They stated, “It was good content. Everyone did a great job in preparing an approach to teach each topic. I was comfortable that I could teach all the material without edits.”

Self-efficacy beliefs informed by vicarious experience are a product of observation. In the case of this CoP, they were a product of peer observation within the group, where trusted others presented their entire lectures and materials and took feedback and earned validation from the group. Validation increased confidence in the content and pedagogy.

V. DISCUSSION

This study offers several important findings. We find evidence to support the value of the CoP as a vehicle for professional and course development where instructors gained a shared perspective toward the course and adopted shared content and pedagogy. Importantly, the CoP also provided a performative stage where instructors could get constructive feedback from their peers and positive reinforcement when the material was deemed sufficient to the group. This was linked to shifts in the self-efficacy beliefs of members. The dual lenses of CoP and SCT provided greater insight into the course and instructor transformations that either theoretic lens would in isolation.

While our study finds support for the social cognitive perspective on faculty efficacy beliefs and their formation, we find the dominant sources of self-efficacy beliefs are different than those identified in other studies. For example, Bandura [1993, 1997] identified mastery experiences as the strongest contributors to self-efficacy beliefs for both beginning and career teachers. This was not the case within the CoP, where all members held strong beliefs in their own mastery prior to joining. Mastery experiences were boosted or reinforced by presenting successfully to expert peers. However, among these ‘experts’, verbal persuasion and vicarious experience played the more dominant role. This is likely attributable to the make-up of the membership. There were no novice faculty in this group. All had significant training and teaching experience in the domain and mastery experiences on which to draw in forming their own self-efficacy beliefs.

Across multiple sessions, members of the CoP made presentations, observed presentations by their peers, and vigorously negotiated pedagogy and content. Observation of peer presentations within CoP afforded observers vicarious experiences with impacted their own self-efficacy beliefs. The CoP could be understood as an expert panel who observed and critiqued all aspects of each presentation. Once content was settled and presented successfully to the group, observers gained confidence in their own self-efficacy toward the material and their ability to present it. This comports with Wenger’s [1998] view that learning in the CoP is a social process, where individuals, interacting with one another and their environment, negotiating meaning through participation in social communities and the reification of tools and procedures relevant to their focal activities [Wenger, 1998].

Verbal persuasion, according to Bandura [1977], concerns the feedback a teacher receives regarding their performance from important others, such as administrators, faculty colleagues, parents, and students. The CoP provided a rich environment for sharing and receiving this feedback. Members’ beliefs were strengthened by the affirmations of their peers.

While all participants brought their own mastery experiences to the CoP, activities within the CoP provided new evidence in the form of vicarious, verbal and mastery experiences on which to build new confidence in their own teaching self-efficacy. This suggests self-efficacy beliefs remains fluid, even among faculty with significant training and mastery experience.

A second finding concerns the potential of CoP as a continual improvement strategy for course and instructor development. Albeit subjective, one measure of improved course quality is the instructors’ opinion. Participants in the study believed the quality of the course was significantly improved by virtue of instructor collaboration and engagement. Perhaps less subjective was the assessment of student learning. Since the introduction of the standardized content and assessments developed with the CoP, end of semester assessments have shown steady
consistent improvement. This may be attributable to the increased familiarity and confidence of the instructors.

Common professional development activities in academia, such as seminars, conferences, workshops, and mentoring each intend to improve individual teaching efficacy by sharing best practices, competencies, and skills believed to improve teaching. Sharing is typically grounded in “mastery” philosophies that tacitly aim mentoring at less-experienced peers [Ponce et al., 2005, p.1159]. A common mentoring strategy is a one-on-one approach where more senior faculty members pass knowledge and advice down to junior faculty [Darwin and Palmer, 2009]. They note this dyadic approach tends to stigmatize junior faculty members and promotes the view that senior faculty do not need mentoring. In rapidly changing fields such as information technology, course content can have a limited shelf life. Colleagues more recently trained, or with more recent industry experience, might have much to share with their more senior colleagues. For example, a recent PhD may be more familiar with recent technical and teaching innovations than their more senior colleagues. Teaching and learning practices often fail to incorporate new and emerging concepts in ever-evolving fields such as information technology. Faculty members struggle to modernize their content and pedagogy. One of the benefits of the CoP that we observed in this study was greater democratization of content and a shift toward newer ideas, topics, and technologies, such as AI and machine learning, each an area of interest to instructors in their own research.

Work within the CoP produced a common set of slides, lesson plans, lab activities, assessments, and content weighting. It is important to note that while all instructors teaching the EIS course adoption of this material uniformly, instructors still exercise freedom to extend the content with their own anecdotes, vignettes, and additional materials that draw on their own mastery experiences. For example, one instructor augments the material on networks to include a discussion of certificate authorities and public key infrastructure. The negotiated content serves as a floor rather than a constraint.

VI. CONCLUSION

In this study, we have explored the social cognitive perspectives to examine the that takes place within a CoP and the efficacy belief developments of participants. Our study is not unique in that regard, as others have begun to bridge the gap between these two theories as well [Eun, 2019; Takahashi, 2011]. However, in doing so, our study contributes a deeper understanding of the sources of self-efficacy within a CoP among well-trained and experienced instructors, each with significant mastery experience, and how vicarious experience and verbal persuasion within the CoP positively impacted their beliefs and motivations.

We extend the literature on CoP in academia, finding faculty-led CoPs may be an important and underutilized vehicle for professional development among highly skilled educators. Further, we extend the literature on SCT by finding different weightings of the sources of self-efficacy beliefs than suggested in other studies for this category of professionals.

The study also contributes to practice by elaborating a ground-up process for course improvement in team-taught courses which promotes greater consistency in the student experience across multiple sections and instructors and allows for better alignment of pedagogy and content with student assessments. One of the benefits of this approach is the emergence of a shared perspective on the course, the content, and its relative importance which is tightly bound to the intended student learning objectives.

An obvious limitation in this work is that the research involves a limited sample. The participants in this study were highly motivated to craft a better course and committed to working outside the classroom to accomplish this redesign. Ironically, none of us understood at the outset that the CoP would be a vehicle for our own professional development.
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ABOUT THE AUTHORS

John Michael Muraski is an assistant professor of information systems in the University of Wisconsin Oshkosh College of Business. After 20 years of working and consulting in industry, he transitioned into higher education and earned his DBA at the University of Wisconsin Whitewater. Over the last 12 years, he has taught at both the undergraduate and graduate levels and led the development of several new programs, including the ERP and Business Analysis programs. Muraski researches two main areas: (a) the evolution of ecosystems and maturity models centered on regional affiliations and collaboration and (b) challenges and opportunities relating to high school and college student reluctance to explore technology-related educational pathways. John serves on the board of the Association for Information Systems Special Interest Group on Education (SIGED) and is co-chair for the Education Track at the Americas Conference on Information Systems (AMCIS).

Donald R. Heath is an Associate Professor and Chair of the Information Systems at the University of Wisconsin Oshkosh. He received his Ph.D. from the University of North Carolina Greensboro. In addition to his role at UW Oshkosh, Dr. Heath is the past president of the Association for Information Systems Special Interest Group on Ontology-Driven Intelligent Systems. His research interests include mobile technologies as vocational tools for people with different abilities, organizational strategy, and curricular design. He has published his work in journals such as Information and Organizations, MIS Quarterly Executive, the Journal of Information, Communications, and Ethics in Society, the Journal of Information Technology in Education: Research, the Assistive Technology Journal, and others. Prior to joining academia, Dr. Heath worked extensively as an applications developer and software architect and has industry experience in a variety of leadership roles.

Michael A Eierman is a Professor of Information Systems at the University of Wisconsin Oshkosh. He received his Ph.D. from the University of Minnesota. Dr. Eierman is also the Academic Director for two online collaborative degrees: The BS of Applied Computing and the MS of Information Technology Management. He has published a textbook on IOS and Android Development as well numerous peer reviewed articles in the information systems discipline. Dr. Eierman teaches courses ranging from introductory programming to information systems strategy and management.

Michael Patton has over 20 years of private industry experience as an IT leader and consultant. During his career he has managed the networking and cybersecurity needs for multiple nation-wide companies and was the lead consultant on the VDI project for the Army National Guard’s Arlington Hall Readiness Center in Arlington, VA. As an educator at UW Oshkosh, Mr. Patton was instrumental in creating the curriculum for the Cybersecurity emphasis within the Information Systems BBA as well as the Cybersecurity Minor and Cybersecurity Certificate for the UW Oshkosh College of Business. In addition to cybersecurity courses, Mr. Patton also teaches courses in Network Communications and Design, ERP systems, IT Ethics, and Strategy and Management at the undergraduate and graduate levels. In addition to his role at UW Oshkosh, he is an instructor and has developed courses for the UW Extended Campus BS in Applied Computing, MS in Cybersecurity, and MS in Information Technology Management.
INCREASING THE VALUE-IN-INTERACTION WITH ADAPTABLE LEARNING COMPANIONS

Ricarda Schlimbach
Department MV
Hochschule Heilbronn (DE)
ricarda.schlimbach@hs-heilbronn.de

Meike F. Spill
Susanne Robra-Bissantz
Chair of Service Information Systems
TU Braunschweig (DE)

Abstract:
Learning Companions (LCs) are bonding conversational agents designed to facilitate learning through natural communication. The heterogeneity of students requires adaptable LCs that can better match their individual needs. In this paper, we propose a value-oriented perspective on LC adaptation, focusing on enhancing the learner’s value-in-interaction (ViI) with LCs to establish a strong companionship in the long term. We conceptualize a model that centers around an adaptation-enhanced ViI and translate it into design requirements with incorporated adaptable specifications. In an online experiment (within-subject design) with 48 students, we compared an adaptable and a non-adaptable LC instantiation teaching digital literacy. Results indicate that the adaptable LC significantly improves the perceived ViI across all introduced value layers (relationship, matching, service). Our findings highlight the importance of (currently underrepresented) value-oriented LC adaptation and its potential to enhance the learning experience.

Keywords: Learning Companion, Conversational Agent, Value, Interaction, Education.

I. INTRODUCTION

Learning Companions (LCs) are naturally communicating agents in educational contexts that form close relationships with their human interactors (Khosrawi-Rad, Rinn, et al. 2022). As socially bonding chatbots or voicebots, they provide social companionship as virtual, knowledgeable peers to accompany the human student in learning. In this course, they explore learning content interactively with the student. Due to their scalability, location independence, and permanent availability, they offer a great potential to support learners continuously and individually by interacting as encouraging and trustworthy learning facilitators (Schlimbach et al. 2022; Skjuve et al. 2021). In doing so, they can impart knowledge, motivate and empower others to study, while collaborating as teammates (Elsah and Ebel 2020; Hobert and Meyer von Wolff 2019). As an emerging research field, LCs have been gaining strong attention for several years both in science (Diederich et al. 2022) and in practice (Wollny et al. 2021), where technology-enhanced learning with modern digital technologies and learning strategies is becoming more relevant, especially in remote settings (Çeken and Taşkin 2022). Likewise, detecting and responding to individual user abilities, preferences, and needs, as well as contextual adaptation, become more critical for their design (Schlimbach et al. 2022). This demand is even intensified by the idea of companionship aligning with the envisioned potential that builds upon adaptivity and adaptability in modern, digital learning technologies (Plass and Pawar, 2020).

In their literature review, Schlimbach et al. (2022) consider the current state of research on pedagogical conversational agents (PCAs) and their adaptation (PCAs is a general term that describes conversational agents in education such as LCs, tutors, or organizers). Prevalent adaptation aspects include cognitive, affective, motivational, as well as socio-cultural aspects as suggested in the taxonomy of Plass and Pawar (2020). PCAs adapt to personality (e.g., Davies et al. 2021; Dennis et al. 2016), individual learning styles (e.g., Adel et al. 2016; Crockett et al. 2017), or offer a customizable avatar (Gamage and Ennis 2018). Nevertheless, the current state of research proves to be fragmented and single-layered, mostly just looking at an isolated variable to be adapted instead of taking a multi-layered view in the interplay of the variables in the four mentioned adaptation dimensions (Plass and Pawar 2020; Schlimbach et al. 2022).
Despite recent publications that highlight the relevance of PCA adaptation (Slavuj et al. 2017; Wolny et al. 2021), studies that explore the impact of adaptable or adaptive features on the perceived value-in-interaction (Geiger et al. 2020), are missing. The predominant functional and agent-centric view of conversational agents overshadows any value-driven considerations (Schlimbach et al. 2023). While published taxonomies (e.g., Nißen et al. 2021; Weber et al. 2021) and morphological boxes on PCAs in the literature (e.g., Wellnhammer et al. 2020) demonstrate how the bots can be differentiated and classified (e.g., based on roles or technologies used), they do not touch on the created value for the users in interacting (Geiger et al. 2020). Moreover, publications do not discuss whether and how adaptation empowers PCAs in general and bonding LC roles in particular beyond factual knowledge transfer, such as social value in collaboratively learning with students (Schlimbach et al. 2023). Based on these shortcomings in current scientific literature, we aim to answer the following overarching research questions (RQs):

**What (conceptual) role does adaptation play from a value-oriented perspective on the human-agent interaction in the learning context (RQ1)?** How does the LC’s adaptability affect the learners’ perceived value-in-interaction (RQ2)?

To answer these RQs, we first set a foundation on the concept of adaptation and a more value-oriented view on interacting with LCs, to then design two similar LC instantiations that look identical and teach the same learning content but are manipulated in terms of their adaptability. We then conduct a within-subject designed online user experiment with 48 students to measure the impact of adaptation on the perceived value-in-interaction operationalized by relationship, matching, and service value as originally proposed by Geiger et al. (2020) and detailed for LCs by Schlimbach et al. (2023) (see next sections).

### II. RESEARCH BACKGROUND

**CAs, PCAs, LCs, and their Adaptation**

First concepts of LCs as naturally communicating dialogue systems to facilitate learning with their key competence of establishing a close, almost friendship-like social bond with their human interactors (Krämer et al. 2011) emerged more than 50 years ago (e.g., Correia et al. 1970), but have matured recently by the progress of artificial intelligence (AI) and machine learning (Khosrawi-Rad, Schlimbach, et al. 2022). LCs communicate intelligently and proactively, remember learning status and progress, and continuously engage in supporting the student’s individual needs (Khosrawi-Rad, Schlimbach, et al. 2022; Lee et al. 2021; Skjuve et al. 2021). Like virtual companions in other domains, LCs prioritize a long-lasting and bonding relationship and are therefore committed to matching commonalities. According to Rawlins (2017), the “potential of peer friends (…) begins to emerge with the mode of equality and reciprocity” (p.46). Consequently, adaptation plays a major role in the formation of a friendship-like bond with an LC (Schlimbach et al. 2022). For example, independent researchers have demonstrated that anthropomorphic design and AI-supported interaction promote trust building between a human user and its artificial interlocutor (Wald et al. 2021; Zierau et al. 2020), whereby the time horizon of usage plays a major role (Nißen et al. 2021). Not only thanks to the growing technical possibilities but also due to the increased research activities (Diederich et al. 2022), the opportunities in adaptation for educative purposes are growing as summarized in the taxonomy of adaptivity for learning by Plass and Pawar (2020).

The flexible design of information systems includes diversification represented in variants for equivalent system functionality or adaptation to its user. The latter is further subdivided into adaptivity and adaptability. Adaptivity is characterized by active or automatic self-adaptation initiated by the machine and based on the data-driven assumptions the system makes about its user. Adaptability, on the other hand, is the adaptation of the system initiated manually by the learners themselves. In this context, the system provides the users with customizable settings (Oppermann and Simm 1994). The concepts of adaptivity and adaptability are subsumed under the umbrella term of adaptation and are sometimes used as synonyms for individualization (Oppermann and Rasher 1997). Adaptation ranges from static, over dynamic to live scenarios (Schlimbach et al. 2022). Adaptivity and adaptability run on a dichotomous spectrum (Oppermann and Rasher 1997) as illustrated in Figure 1 with corresponding definitions and examples.
Following Vandewaetere et al.’s (2011) model, adaptation decomposes into three core elements: the source (e.g., student’s learning preferences), the goal (e.g., adapted difficulty level or content tailored to learning style), and the path of adaptation (e.g., data collection and decision making). The former describes the variables for which adaptation is to be performed. Different requirements emerge depending on how these are defined. In turn, these determine which system elements, such as the content or presentation of learning material, must be specifically tailored (goal of the adaptation). The adaptation method describes how the system elements adapt as a result of the source for adaptation. Although Vandewaetere et al. (2011) do not apply their model to LCs, their proposed structure allows for a more detailed understanding of the process behind LC adaptation and serves as the grounding for our value-driven perspective on LC interactions.

Several literature reviews and publications (e.g., Nakic et al. 2014; Plass and Pawar 2020) deal extensively with characteristics of learners that should be considered in terms of the source of adaptation, outline which elements of learning systems are intended to be adapted (goal of adaptation), and how adaptation can be eventually realized (path of adaptation). Although these publications do not deal specifically with LCs, they touch upon related adaptive learning systems (e.g., intelligent tutoring systems, hypermedia learning systems, or adaptive learning environments), so that we assume the transferability to our use case. Since the ultimate goal of LCs is to provide each learner with an individual, positive, and bonding learning experience, adaptation through both user-initiated (adaptable) and system-initiated (adaptive) mechanisms are crucial (Khosrawi-Rad, Schlimbach, et al. 2022). Schlimbach et al. (2022) highlight aspects of adaptability and adaptivity eventually implemented in PCA instantiations. The authors exploit personality traits, embodiment, emotions, learning styles, skill level, or learning styles as dominating variables, and find in their analysis that adaptive aspects appear roughly twice as frequently as adaptable features in the reviewed PCA literature. They ascribe this finding to technological progress due to its growing focus on the technical feasibility of adaptivity (Schlimbach et al., 2022). Regarding Plass and Pawar’s (2020) aforementioned four categories of cognitive, motivational, affective, and sociocultural variables, implemented PCAs with adaptational aspects most frequently consider cognitive characteristics (27 out of 31 analyzed publications). In 11 of these 31 contributions, motivational characteristics are examined, whereas affective and sociocultural variables remain underrepresented (Schlimbach et al. 2022). Despite the longstanding research in the fields of PCAs (Weizenbaum 1966) and adaptive learning (Davies et al., 2020), PCA and even more LC design remains fragmented, heavily touching on social cues (Seeger et al. 2021) and other agent-centric characteristics (Lembcke et al. 2020; Wellnhammer et al. 2020) while almost ignoring the value in and interplay of variables for adaptation (Schlimbach et al. 2022).
Value-oriented View on Interacting with LCs

When looking at LCs as social actors (Nass et al. 1994) combined with the lens of service-dominant-logic (SDL), reciprocal value creation between the human user and the data-driven LC through mutually advantageous resource integration takes place (Vargo and Lusch 2004). The value-oriented perspective on LCs decomposes to two dimensions (Schlimbach et al. 2023): First, the human dimension, which is defined by the individual user’s needs, values, and goals in the given context and second, the LC itself. The agent has no influence on this level, but communicates within that context and serves as a proxy for the person or company it is operated by. Moreover, a more user-centered view of the interaction describes its duration, depth, and intensity, in terms of how much space the conversation captures between the interlocutors (here: LC and learner) for the given application area (here: learning). From that viewpoint, students do more than just consume learning content from an LC as a product; since they also actively participate in the value-co-creation process with the interaction-as-a-service (Paukstadt et al. 2019; Vargo and Lusch 2004). LCs emphasize social companionship and thus go far beyond the pure assistance of chatbots e.g., in customer care. Therefore, an LC’s value is more than its assisting role in education since it stronger highlights added value in forming a close relationship (aiming for recurring and long-term usage) and therefore matching individual needs in learning.

Each conversation depends on mutually working on a (learning) topic while increasing the knowledge base on both sides. In contrast to a product-centered viewpoint, SDL regards services as the key pillar for economic exchange rather than goods (Lin et al. 2015). SDL prioritizes “value-in-use” (ViU) over “value-in-exchange” (Azkan et al. 2020; Vargo and Lusch 2008). That view suggests that the value of a service is defined not primarily by its (functional) qualities (e.g., the LCs’ adaptation features), but by the individually perceived value when using it (Schüritz et al. 2019; Vargo and Lusch 2004). For instance, the joy of learning in a virtual interaction or increased learning efficiency related to adaptation may add value to the student (Schlimbach et al. 2023). Value co-creation, which emphasizes collaborative and reciprocal value creation between actors and entities through mutually advantageous resource integration (e.g., students providing data for learning analytics and the LC as learning facilitator), is an important element in SDL (Blaschke et al. 2019; Schüritz et al. 2019). Blaschke et al. (2019) enhance this perspective of SDL by adding another pillar that incorporates design aspects to support digital value co-creation networks enabled by service thinking (Azkan et al. 2020).

Interaction is considered an essential aspect to create value (Geiger et al. 2020). According to the value-in-interaction model from Geiger et al. (2020), the value-in-interaction (ViI) decomposes to the value in relatedness (on the relationship layer), the matching value (on the matching layer) and the value in use of the interaction itself (on the service layer) and has already been applied to the interaction between students with an LC (Schlimbach et al. 2023). The relationship layer is linked to the emergence, influence, and maintenance, as well as the quality of the relationship as influenced by interactions between involved stakeholders (Geiger et al. 2021). On the matching layer, actors mutually choose the proper resources and competencies for the current demands. Consequently, the matching value is the actors’ capacity to foresee the needs of other actors and match them with their abilities and competencies. Finally, the service layer specifies how the interaction affects the actual service and whether the service value develops immediately at first contact or throughout the concurrent interlocutors’ activities in the value co-creation (Geiger et al. 2020). In this approach, all three levels within the interaction space and their resulting values are interconnected and impact one another. To achieve meaningful interactions and develop worthwhile valued service interactions, actors in any service system (here: when interacting with the LC) must be empowered to exhibit competencies at all three tiers (Geiger et al. 2021). The ViI includes, in particular, collaboration and social competencies (relationship layer), adaptation skills (matching layer), and the provision of useful services (service layer) (Geiger et al., 2020). Otherwise, if the LC interaction is not perceived as beneficial by its human user, it will harm value co-creation, also known as value co-destruction (Li and Tuunanen 2022), causing service beneficiaries to be negatively affected (Fyrberg and Jüriado 2009; Grönnroos 2011). A poor ViI leads to the LCs failure, i.e., if the technology is not adopted, so that no recurring usage applies (Janssen et al. 2021). Thus, social companionship does not evolve (Schlimbach et al. 2023).
III. A VALUE-DRIVEN MODEL ON ADAPTATION

Figure 2 links the role of adaptation with the intertwined value components.

![Conceptualizing a Model for Value Arising from Adaptation](image)

The depicted conceptualized model responds to **RQ1** in contextualizing adaptation in a multi-layered process of generating value in interacting with LCs. We regard the ViI as the core of our conceptual model and plan to empirically explore how it is affected by adaptable elements embedded into an LC. The level of adaptation forms the foundation for our value-driven model on LC interaction. The **source of adaptation** consists of socio-cultural, motivational, cognitive, or affective variables (Plass and Pawar 2020) and aims to adjust the learning process and content to the learner's context and needs. Interaction with the LC serves as a medium (**path of adaptation**) to achieve a high matching value in the interaction space (**place of adaptation**). In addition to characterizing the relationship between human and artificial interactors (e.g., regarding their role), the service itself is also located on the interaction level as a rather functional aspect. The **result of adaptation** leads to the perceived ViI according to Geiger et al. (2020). On this level that covers emerging values during the interaction, adaptation also has a core function, ensuring that value is jointly generated on all layers. It thus closely relates to the learner's needs and the learning context.
Different target groups or context factors may require to weight of the layers differently, for example, in a socially-oriented interaction (as intended with an LC), the value in relatedness is much more important than in a situation where factual knowledge needs to be effectively and selectively queried from the agent (e.g., in the case of ChatGPT). Culture also moderates the subjectively perceived ViI in LCs (Schlimbach and Zhu 2023). For our RQ, the friendship-like and long-term-oriented relationship plays an important role – valued companionship does not result from short-term interactions, as it evolves after recurring interactions (Nißen et al. 2021). Therefore, we define Value in Companionship (ViCo) as a vision layer that describes value created subsequently in long-term and recurring interactions between students and the LC. As a result, the vision level in our model expands on the ViI. Despite building upon the same constructs (relatedness, matching, service), ViCo is based on greater conversational depth and relationship quality compared to the ViI. For example, an LC can co-create a strong ViI as a temporary advisor (Nißen et al. 2021) after a short interaction on a specific learning unit, but numerous and recurring adaptive and value-maximizing individual interactions are necessary to establish a close bond that the ViCo builds upon. It may thus change over time in the process of learning collaboratively.

IV. RESEARCH DESIGN

For the planned experiment, we designed two expository LC instantiations as level 2 artifacts (Gregor et al., 2013) that we manipulated concerning its adaptability for its comparative evaluation in an online user experiment. With the unconventional SDL perspective and our value concept model in mind (cf. p. 5), we synthesized adaptation features for LCs from literature with ideas from students as potential future users, to combine rigor with relevance (Hevner 2007). We had three student teams conceptualize adaptation features for LCs relevant to them to explore what they come up with in a half-day creative workshop (teaching concepts like personas or human-centered design) with bachelor’s and master’s students from different disciplines. We also conducted six interviews with students from a German university who had some prior experience in designing LCs and interacting with them to derive design requirements (DRs) for LC adaptation from potential users. Within the interview analysis, we first transcribed, paraphrased, and coded each interview with a focus on the relevant software features mentioned therein to then subsequently derive user needs. We followed the guidelines for qualitative content analysis after Mayring (2015) and clustered students’ ideas on adaptation accordingly. We then synthesized DRs with adaptable specifications related to the student and the learning and application context. Our resulting DRs guide us in designing LCs with embedded adaptation aspects that students claim to value. We instantiated the DRs as expository artifacts with the help of the tool Figma in two graphical LC user interfaces to be then tested and evaluated by students in our experiment. We made sure to cover at least one characteristic for each adaptation category in learning (Plass and Pawar, 2020). After evaluating and improving the artifacts’ usability in a workshop with four external usability experts from a German Mobility Lab, the eventual experiment with potential future users took place. Both LC prototypes are identical in content as they cover information on how to be certified in digital literacy at our university. We visually designed the Figma prototypes as similar as possible, but manipulated the criterion of adaptation, with one instantiation pushing adaptation elements while the other does not include any options for adaptation. To comparatively evaluate the manipulations’ impact on the perceived ViI of the LC, we conducted an online experiment in a within-subject design with 48 students from various study programs at TU Braunschweig (Germany). In randomized order, students first interacted with the prototype they were initially attributed to before switching to its manipulated counterpart. They subsequently evaluated the perceived ViI after each of the two interactions. We measured the ViI operationalized by validated constructs along the three value layers in the German language following the proposed survey by Geiger et al. (2022). We thus measured Relationship Value decomposing to Relatedness Value (RRV), Trust (RTR), Relationship Satisfaction (RRS), and Commitment to the relationship (RCR), as well as Matching Value represented by Access Convenience (MAC) and Benefit Convenience (MBC), and Service Value as a compound of perceived Service Value (SSV), Service Quality (SSQ), and Perceived Sacrifice (SPS) (see all items listed in Geiger et al., 2022, p. 101).

Since we assume that adaptation forms the grounding for valuable interactions by linking all three layers together as illustrated in our concept model, we anticipate positive effects of the adaptable LC and thus formulate the following hypotheses:
**HRV:** Adaptable LC features positively impact its perceived relatedness value towards the interacting student compared to a non-adaptable LC with the same learning content.

**HMV:** Adaptable LC features positively impact its perceived matching value towards the interacting student compared to a non-adaptable LC with the same learning content.

**HSV:** Adaptable LC features positively impact its perceived service value towards the interacting student compared to a non-adaptable LC with the same learning content.

To ensure the internal validity of each construct, we chose the cutoff value of 0.6 for Cronbach's alpha (Gefen and Straub 2005). If an increase in internal consistency could be achieved by eliminating an item, it was removed from the respective data set. We then determined the factor loadings of each remaining item on the associated constructs using exploratory factor analysis (Backhaus et al. 2016). We set the cutoff value at 0.7, as suggested by Cohen (2013), thus ensuring a strong correlation between the items and the associated constructs. We conducted a principal component analysis with a varimax rotation that resulted in the elimination of one item, suggesting that the correlation between the individual items and the associated constructs were high throughout the sample. As further quality criteria, we checked the indicator reliability, the average extracted variance (AVE), and the Fornell-Larcker criterion. The indicator reliability describes the reliability of the observed item as the square of the factor loadings. We did not find an item that exceeds the fixed limit of 0.4 and therefore no further elimination of items resulted. Concerning AVE, the determined values of all constructs are above the threshold value of 0.5 (Bagozzi and Yi 1988), which is why no further constructs were eliminated. When applying AVE for the Fornell-Larcker criterion, it should not exceed the squared correlation of all other constructs (Fornell and Larcker 1981). The correlation matrices tested discriminant validity and resulted in the elimination of the MAC construct for all data sets. Our experiment thus allowed us to comparatively measure the adaptations' effect on each ViI layer to detail its impact on the perceived value in the interaction. After eliminating data sets that did not meet the statistical prerequisites, we conducted paired t-tests to analyze whether the three aforementioned hypotheses are rejected or supported at the significance level of p < 0.05.

**V. RESULTS**

**Designing the LC Instantiations for the Experiment**

We extracted user-, context-, and situation-specific design requirements from the coded interviews, workshop prototypes, and the literature review on PCA adaptation (Schlimbach et al. 2022), which we synthesized into nine categories (DR1-9).

We clustered adaptation specifications (S#) to these dimensions to consider the varying interviewees' expectations towards adaptation as illustrated in Figure 3.
These DRs implicitly cover learning adaptation dimensions from literature (Plass and Pawar 2020; Schlimbach et al. 2022) as they touch on socio-culture elements by the LC's embodiment (DR8) and affective variables regarding power distance (DR7) (Schlimbach and Zhu 2023), distinguish between motivational and critical communication modes (DR4) and adapt to cognitive aspects of the user (DR3) (Slavuj et al. 2017), while also considering contextual elements for an adaptation like notification settings (S2), situational instructions (S3.4) or availability (DR6) and compatibility (DR9) related to the given context.

The two LCs that we designed in Figma look like a mobile application that provides students with information about a digital literacy certificate that is offered to all students at the university where the experiment takes place. Both prototypes represent an LC with identical learning content, differing only in the degree of adaptation (adaptable vs. non-adaptable). Therefore, they share anthropomorphic design elements (Feine et al. 2019) as they reinforce their human interactors to exhibit social behaviors towards the LC (Nass et al. 1994). These social cues (Seeger et al. 2021) are represented in an embodied avatar (Gong 2008) in both prototypes. This gives the LC a personal appearance, which can positively affect the user's perceived social presence (Kim et al. 2013; Lester et al. 1997) of the LC and is motivational (Baylor 2011). Additionally, each LC was given a common name to support the human identity and acceptance of the LC (Cowell and Stanney 2005). An informal language style (Gnewuch et al. 2018; Kuttal et al. 2020) was chosen for both prototypes to create an eye-to-eye interaction and to convey the LC's role as a friend or peer student (Khosrawi-Rad, Schlimbach, et al. 2022). Both prototypes started the interaction with a personal introduction and app tutorial. The first impression of the LC conveyed in this way was intended to convey the LC's friendly, helpful personality and social behavior (Nass and Moon 2000). In addition, we incorporated conversational elements like small talk to create trust (De Medeiros et al. 2019). Furthermore, both LCs act self-referentially (Schuetzler et al. 2018), e.g., in sharing their personal study experiences. In addition, we used emojis in the text messages to strengthen the emotional connectedness for the perception of a pleasant interaction (Seeger et al. 2021). As another social cue, deliberate time delays for the text messages displayed in the chat were implemented as three animated dots to simulate typing the messages (Gnewuch et al. 2018).

In addition to these joint design elements, the adaptable prototype was supplemented with specification elements from the design requirements (DR1-9) to achieve a high degree of adaptation in comparison to the non-adaptable LC. During this process, we instantiated each DR in the form of features for adaptability or simulated adaptivity. Since low-fidelity prototypes
in Figma are not linked to a data backend, we were unable to code eventual adaptivity features fed from real data, so we mocked these only visually. Figure 4 exemplifies adaptation features on selected sample screenshots of the LC (in German) to get a first visual impression. We provide further details below.

![Figure 4. Sample Screenshots of the Adaptable LC](image)

The adaptable LC proactively asks for the preferred language setting, with the implication that an English variant will be provided soon. For avatar selection, the user chooses between a non-human avatar (Leo the lion) or either a male (Edin) or female (Clara) human avatar representing two different ethnicities (Guo et al. 2016; Schuetzler et al. 2018). The language and avatar are chosen with the user’s socio-cultural background and preference for an anthropomorphic or zoological design in mind (DR 1, S1.1.c). Furthermore, avatar selection allows for the user’s embodiment preferences to be addressed (DR 8, S8.1.1.a & S8.1.1.b). During the interaction, students might switch between a text-based and a visual-based communication mode (DR 4.1, S4.1.a & S4.1.c). Furthermore, the adaptable LC inquires about the user’s emotional state (Haefner et al. 2021; Ranjbartabar and Richards 2018) and well-being (DR1, S1.1.c). When being compared to the non-adaptable LC, Leo asks more questions (DR3, S3.1), such as their learning style preferences (visual vs. textual presentation) to then adapt the content accordingly (DR 1, S1.1.b & DR3, S3.1 & S3.2) (Crockett et al. 2017). The user’s interests are also taken into account by allowing the learner to select subject areas of interest to then suggest matching modules that count towards the Digital Literacy Certificate (DLC) (DR1, S1.1.d, DR3). Situational awareness (Burgoon and Dunbar 2000) (DR 1, S1.3) as well as adaptive availability of the service (DR6) do not apply to the setting and scope of our experiment. Furthermore, we decided to not implement DR9 (compatibility) to maintain consistency in the interaction experience and to limit the experiment’s manipulation to differences in the LCs’ design.

Findings from the Experiment

48 students participated in the experiment in November 2022; among those 47 fully completed the survey. In scenario 1, the adaptable prototype was tested first, and in scenario 2, the non-adaptable one. Participants ranged in age from 19 to 66 years (mean 25.81, median 25, including 2 retired senior students). 44 (93.6%) participants were studying at TU Braunschweig (Germany), plus three (6.4%) being enrolled at another university. Among the participants, 15 (31.9%) are undergraduates enrolled in a bachelor’s program and 32 (68.1%) study in a master’s program covering a great variety of majors. 20 (42.6%) participants classify themselves as female and 27 (57.4%) as male. Among the 47 participants, 24 (51.1%) had prior experience using LCs, whereas 23 (58.9%) interacted with an LC for the first time. We did not find significant differences in LC perception between novice and experienced users within our experiment.

Because the total data set contains 46 samples after eliminating incomplete data, we ran the paired t-test on all constructs that met the pre-tests (see the section on research design). For scenarios 1 (testing the adaptable LC first) and 2 (testing the non-adaptable LC first), the group...
size resulted below 30. For that reason, we tested the residuals of the data sets for a normal distribution using the Shapiro-Wilk test at the significance level of 5%. Thereupon, we decided whether to examine each construct in scenarios 1 and 2 either with the Wilcoxon test (RRV; SPS; RRS; RCR) or with the student’s paired t-test (all other constructs). We conducted an exploratory data analysis for both scenarios and the overall data set using descriptive statistics to gain an overview of the results. Table 1 reveals that except for SPS, the adaptable LC gathered higher mean values across all constructs.

Table 1. Descriptive Statistics

<table>
<thead>
<tr>
<th>Construct</th>
<th>Prototype</th>
<th>Full data set</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
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<tr>
<td></td>
<td>N</td>
<td>X</td>
<td>SD</td>
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<td>RCR</td>
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</tr>
<tr>
<td>SPS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>adaptive</td>
<td>46</td>
<td>3.913</td>
<td>1.112</td>
<td>28</td>
</tr>
</tbody>
</table>

N = Number of participants; (X̅) = mean value; SD = standard deviation; Relationship Value: Commitment to the Relationship (RCR); Relationship Satisfaction (RRS); Value in Relatedness (RRV); Matching Value: Benefit Convenience (MBC); Service Value: Service Quality (SSQ); Satisfaction with Service (SSV), Perceived Sacrifice (SPS).

To test our hypotheses, we performed paired t-tests. In addition to reporting the differences in mean value (X̅), standard deviation (SD), and standard error of the mean (SEM), we calculated effect sizes for each construct involved, represented through Cohen’s d for the paired student’s t-test. A value between 0.2 and 0.5 indicates a weak effect, between 0.5 and 0.8 a medium effect, and above 0.8 a strong effect (Cohen 2013). Because of the group size of N = 46 > 30 in our data set, the paired student’s t-test resulted applicable without testing further prerequisites, and let to the results depicted in Table 2 on the next page.

On the relationship layer, the three remaining constructs after eliminating trust (because the Fornell-Larcker criterion was not met), all show highly significant differences (p < 0.001), whereby the adaptable LC elements had a medium effect (d = 0.53) on the commitment to the relationship (RCR) and strong effects on the perceived relationship value (RRV; d = 0.952) and the relationship satisfaction (RRS; d = 0.804). Thus, regarding the hypothesis H_RV, our results indicate that the average perceived relationship value of an adaptable LC is significantly greater than that of the non-adaptable LC. On the matching layer, we had to eliminate the construct access convenience (MAC) due to a weak Cronbach’s alpha, so testing the hypotheses H_MV was exclusively operationalized by the construct benefit convenience (MBC). Users perceive a significantly higher benefit convenience (MBC) for the adaptable LC compared to the non-adaptable LC (t (45) = 7.235; p < 0.001) showing a strong effect size of d = 1.067. Thus, H_MV is supported, indicating that the average perceived matching value of an adaptable LC is greater than that of a non-adaptable LC. On the service layer, the adaptable elements in the LC showed highly significant (p < 0.001) strong effects on service value (SSV; d = 1.351) and service quality (SSQ; d = 1.037) compared to the non-adaptable LC. However, the effect of
adaptation on perceived sacrifice (SPS) was marginal in size ($d = 0.161$) and not significant ($t (45) = 1.089; p = 0.141 > 0.05$). Combined, these results indicate that the average perceived service value of an adaptable LC is greater than that of a non-adaptable LC. For that reason, we assume $H_{IV}$. Adaptation showed the strongest effects on the matching and service value in our experiment, potentially because relationship value needs more time to evolve and might be further catalyzed by dynamical adaptivity.

<table>
<thead>
<tr>
<th>Paired Differences (adapt. - non adapt.)</th>
<th>Mean</th>
<th>SD</th>
<th>SEM</th>
<th>95% Confidence Interval of the Difference</th>
<th>T</th>
<th>df</th>
<th>Significance (one-tailed)</th>
<th>Cohen's d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X̅</td>
<td>SD</td>
<td>SEM</td>
<td>Lower</td>
<td>Upper</td>
<td>p</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RRV</td>
<td>0.924</td>
<td>0.97</td>
<td>0.143</td>
<td>0.636</td>
<td>1.212</td>
<td>45</td>
<td>&lt;0.001</td>
<td>0.952</td>
</tr>
<tr>
<td>RRS</td>
<td>0.826</td>
<td>1.027</td>
<td>0.151</td>
<td>0.521</td>
<td>1.311</td>
<td>45</td>
<td>&lt;0.001</td>
<td>0.804</td>
</tr>
<tr>
<td>RCK</td>
<td>0.44</td>
<td>0.83</td>
<td>0.122</td>
<td>0.194</td>
<td>0.687</td>
<td>45</td>
<td>&lt;0.001</td>
<td>0.53</td>
</tr>
<tr>
<td>MBC</td>
<td>1.261</td>
<td>1.182</td>
<td>0.174</td>
<td>0.81</td>
<td>1.612</td>
<td>45</td>
<td>&lt;0.001</td>
<td>1.067</td>
</tr>
<tr>
<td>SSV</td>
<td>1.199</td>
<td>0.888</td>
<td>0.131</td>
<td>0.936</td>
<td>1.463</td>
<td>45</td>
<td>&lt;0.001</td>
<td>1.351</td>
</tr>
<tr>
<td>SSQ</td>
<td>0.986</td>
<td>0.951</td>
<td>0.14</td>
<td>0.703</td>
<td>1.268</td>
<td>45</td>
<td>&lt;0.001</td>
<td>1.037</td>
</tr>
<tr>
<td>SPS</td>
<td>0.261</td>
<td>1.525</td>
<td>0.24</td>
<td>-0.222</td>
<td>0.744</td>
<td>45</td>
<td>0.141</td>
<td>0.161</td>
</tr>
</tbody>
</table>

Table 2. T-test Results

$X$ = mean value; $SD$ = standard deviation; $SEM$ = standard error of the mean; **Relationship Value**: Commitment to the Relationship (RCR); Relationship Satisfaction (RRS); Value in Relatedness (RRV); **Matching Value**: Benefit Conveniency (MBC); **Service Value**: Service Quality (SSQ); Satisfaction with Service (SSV); Perceived Sacrifice (SPS).

The ViI is a combination of the relationship value, matching value, and service value. Overall, answering RQ2, our statistical analysis has proven that the adaptable LC reached significantly higher average perceived values on each of the three value layers compared to the non-adaptable LC prototype. In summary, we conclude that the average perceived Value-in-Interaction of an adaptable LC is greater than that of a non-adaptable LC. In summary, we conclude that the adaptability of an LC significantly improves the ViI compared to a non-adaptable LC and might contribute to building a stronger Value in Companionship in the long term.

As mentioned before, probands randomly either first tested the non-adaptable prototype (scenario 1) or started with the adaptable LC (scenario 2). To investigate how users’ perceptions change when they switch between both instantiations, we conducted exploratory data analysis with descriptive statistics and compared the mean values depending on the probability distributions of their residuals (normally distributed versus not normally distributed) using the paired student’s t-test and the Wilcoxon Rank Test, respectively. In scenario 1, the addition of adaptability to the LC has a fundamentally positive effect. Except for the construct SPS ($p = 0.076 > 0.05$), the change from the non-adaptable LC to the adaptable LC leads to a significantly higher perceived value in all measured constructs. Effect sizes vary from medium to very strong. In scenario 2, switching from the adaptable to the non-adaptable prototype results in a significant decrease in the perceived value of all constructs. Here, the effect size on all constructs is very high. Overall, the comparison shows that all effect sizes on the individual constructs are significantly stronger when switching from the adaptable to the non-adaptable prototype than when switching vice versa.

VI. DISCUSSION

Taking a value-driven perspective, we interpret LCs as service providers for valuable interactions both as temporary learning facilitators and for establishing a high value in companionship in the long-term (Nißen et al. 2021). Our study revealed statistically significant that adaptable features incorporated into an LC increased the perceived ViI that decomposes to a significantly higher relationship value, matching value, and service value (Geiger et al. 2021). With regards to future conversational agents, which will be working for and collaborating with humans not only in education but in almost every domain, the adaptable and adaptive characteristics of conversational agents and their ability to co-create value in interacting, will be vital in their acceptance by users (Brinkschulte et al. 2022; Schlimbach et al. 2023). As human designers, researchers and software engineers are their creators and operators, it is
our responsibility to ensure that they fit into our world and that their adaptation behavior aligns with society's values (Brinkschulte et al. 2022). Our obligation to future generations requires visionary thinking about the responsible use of technology and a healthy balance between technology-driven adaptivity and user-initiated adaptability (Schlimbach et al. 2022).

Our instantiated prototype incorporates a range of adaptation features that have been previously explored in the literature, such as the customizability of agents (Paul et al. 2021), reactions to the student’s emotional state (Becker et al. 2007), or adaptable agent personalities (Ahmad et al. 2021). Moreover, context-aware and context-adaptable agents are perceived as more social (Rato et al. 2021), emphasizing the importance of context-related acting and enculturation. To facilitate the development of conversational agents for mobile applications, frameworks have been proposed (e.g., Griol and Callejas 2016). Our study is based on a text-based LC, whereas video data and voice command analysis have been demonstrated to help adapt conversational agents to people's behavior in other domains (Mavropoulos et al. 2019).

However, none of the mentioned studies takes up a value-oriented view, which we contributed to the study at hand. Adaptation plays a crucial role in generating value in the interaction (Geiger et al. 2021). We found that the incorporation of socio-cultural, motivational, affective, and cognitive adaptation elements together exerts a strong influence on the perceived service value, while also better matching needs and establishing a rapport between the bot and its human user. This aspect is particularly important given the relationship-oriented nature of LCs (Schlimbach et al. 2023). The evolution of conversational agents from mere assisting learning agents to bonding companions is evident not only in the literature on technology-enhanced learning but also in the growing emphasis on virtual companionship across diverse research domains (e.g., Khosrawi-Rad, Schlimbach, et al. 2022; Strohmann et al. 2022). Adaptable mimicry and embodiment have been identified as effective ways to enhance a virtual agent's perceived intelligence and increase rapport (Kaptein et al. 2011), while customizability has been found to improve an agent's perception and compliance with recommendations (Paul et al. 2021). Proactivity in conversation management is seen as a vital foundation for learning companionship (Khosrawi-Rad, Schlimbach, et al. 2022). In this course, the human-agent relationship requires adaptability in particular. For instance, a recent study shows that cultural preferences for power distance in pedagogical conversational agents differ, as evidenced by Chinese students who prefer conversational agents to act as hierarchical superior instructors, whereas German students value learning companionship significantly stronger (Schlimbach and Zhu 2023). Thus, designers must adapt their designs to the target group to ensure successful interaction. It is striking in this course, that adaptation is primarily addressed as a minor feature in published design knowledge on these dialogue systems (e.g., Khosrawi-Rad, Schlimbach, et al. 2022), indicating that their critical role in relationship building and value generation has not received adequate attention. Nevertheless, numerous research contributions, recognize the importance of adapting learning applications to individualize education, with benefits ranging from personalized learning to higher inclusion in academia to the potential of revolutionizing education (Gupta and Chen 2022; Plass and Pawar 2020; Wolny et al. 2021). In contrast, consistency is seen as a critical characteristic for conversational agents but likewise challenging to maintain with multiple adaptation features. Allbeck and Badler (2001), in contrast, recommended consistent agent behavior as a means to prevent mixed messages and miscommunication. Balancing the benefits of adaptation with the potential threat of deconstructing value in the conversation is thus a crucial consideration for designers, as they seek to create LCs that provide high value to their human interaction partners.

Implications for Research and Practice

We (1) contributed a conceptual model, which implies that by emphasizing the critical role of adaptation in human-agent interaction, we should think about the adaptation of information systems in a more versatile way and prioritize added value in interaction. Second (2), our study implicitly brings in design guidance for adaptive and adaptable LCs at various abstraction levels. The design requirements and instantiated features are based on recent adaptation research literature, particularly in the learning context, but they also react to the target group's expectations for the practical use of LCs, which we gleaned via interviews and creativity workshops with students. As a result, our contribution goes beyond previous research that categorizes learning adaptivity without offering design advice or that often addresses only one component of agent adaptability (e.g., learning style adaptation or emotion regulation). Instead, we (3) contribute a practice-oriented and holistic perspective and empirically measure an
increased ViI in our experiment arising from adaptation. As a consequence, we help to unveil the potential of LC adaptation in research intending to realize it in practice. Besides, we (4) introduce adaptation as the foundation for a long-term value connection that has the potential to intensify. Thus, adaptability may be considered as a major component of the envisioned Value in Companionship, which embodies the long-term goal of a positive value-in-interaction with LCs that leads to recurring usage and social bonding. Consequently, our contribution (5) encourages a value-driven view on designing dialogue systems, in which the interactors in general, and LCs in particular interact as value-co-creators rather than as digital goods.

Limitations and Outlook
While our study provides new insights into the design impact of adaptable features in LCs, we admit certain limitations. Firstly, the study's findings are based on a relatively homogenous sample of students from Germany and may not generalize to other populations. Additionally, the design knowledge we instantiate in our prototypes is intended as a starting point that must continue to evolve. We advocate for a shift away from strong functional thinking in practical implementation and toward a more user-centric and value-driven design of LCs as suggested by Schlimbach et al. (2023). Guiding research questions to facilitate this process might be such as, "What factors contribute to a deep relationship value towards the LC and a willingness to utilize it in the long run?" and "What adds value to learning companionship beyond its primary objective?" While our analysis found that adaptable elements had a substantial influence on all three examined value layers, our graphical prototype could only simulate genuine adaptivity. A high-fidelity prototype, particularly a coded version used in long-term experiments, could further investigate the impact of adaptation on value perception over time. We recommend that future research investigates the interdependence of different adaptation components and explores the applicability of our findings to other information systems. Ultimately, our study is meant to initiate discussion on the progressing development and adaptation of LCs to meet the changing needs of students and also their shifting expectations that are sparked by new disruptive technologies like ChatGPT. Lastly, it is crucial to recognize that adopting LCs does have moral implications. While they may provide advantages like improved representation of minorities and increased learning opportunities, there is a possibility of harm when AI characteristics result in crossover effects that reinforce bias and dehumanization. Therefore, it is crucial to address the ethical obligations of LC adaptation within a socio-ethical framework.

REFERENCES


Ricarda Schlimbach is a teaching professor for Business Information Systems at Heilbronn University of Applied Sciences and is funded by the Gerhard and Ilse Schick Foundation. She has coordinated the research project ‘StudyBuddy’ for the development of AI-based Learning Companions to facilitate learning in higher education at TU Braunschweig. Ricarda has been working for 10 years in the Automotive industry and is passionate about bridging research and practice by teaching courses such as Introduction to Business Information Systems or Digital Business Management.

Meike F. Spill graduated with a Master of Science in Technology-oriented Management from TU Braunschweig. She derived design knowledge for adaptable LCs in her final master thesis project and conducted the empirical study of this paper including the design of both LC
prototypes. She is now working as a User Experience Engineer in the mobility sector in Germany.

Susanne Robra-Bissantz has been head of the Institute for Business Information Systems and the Chair for Service Information Systems at Technische Universität Braunschweig since 2007. She actively works on new forms of teaching like GamEducation or Flipped Classroom concepts and has implemented numerous third-party-funded projects in cooperation with industry. Her work on eServices, Collaboration Technology, eLearning, and context-aware Information Systems has been published in international conferences and recognized journals.
ENHANCING GRADUATE SKILLS THROUGH BOOTCAMPS

Richa Awasthy
Information Technology and Systems, Faculty of Science and Technology, University of Canberra, Australia
Richa.Awasthy@canberra.edu.au

Solomon Tegabala
Information Technology and Systems, Faculty of Science and Technology, University of Canberra, Australia
Solomon.Tegabala@canberra.edu.au

Blooma John
Information Technology and Systems, Faculty of Science and Technology, University of Canberra, Australia
Blooma.John@canberra.edu.au

Zeena Alsamarra’I
Information Technology and Systems, Faculty of Science and Technology, University of Canberra, Australia
Zeena.Alsamarrai@canberra.edu.au

Anatoli Kovalev
Akkodis Academy, Australia
Anatoli.Kovalev@akkodis.com

Rod Dilnutt
William Bethwey and Associates & University of Melbourne, Australia
rpd@unimelb.edu.au

Abstract:
Universities are facing challenges to prepare industry-ready graduates with knowledge and skills in demand for the workforce. One of the ways to overcome these challenges is through a University-industry collaboration for innovations in teaching. This paper presents the experience of such collaboration in the form of a bootcamp by industry partner Microsoft at the University of Canberra to deliver intensive theory and practical knowledge sessions for the students. The purpose of the bootcamp is to extend graduate skills and prepare students for industry certification, which in turn has the potential to increase their employability. Experienced practitioners from Microsoft and Akkodis presented sessions during two bootcamps over three weeks each, in the most sought-after areas of Artificial Intelligence, Cloud-computing, Cyber Security, Machine Learning, and Data Science. More than 150 undergraduate and postgraduate students participated in these bootcamps to gain job-ready skills and knowledge. These bootcamps have been received well by students as indicated in their encouraging responses. The initial response to these bootcamps indicates that such bootcamps will be valuable in the future.

Keywords: Bootcamp, graduate skills, University-industry collaboration, industry certification.

I. INTRODUCTION

In recent years technology has undergone rapid advancements, reshaping various aspects of our lives and industry. Higher education institutions are facing challenges due to rapid technological advancements, increasing global competition, and the gap between graduate skills and industry expectations (Howells et al., 2014; Mukerjee, 2014). In Australia, the Australian Computer Society (ACS) accreditation process assures the quality of IT/IS programs whilst the Australian Qualifications Framework (AQF) assures levels of graduate capability. There is lot of constructive collaboration between the ACS and AQF accreditation expectations for institutions towards constructive alignment of course design and delivery. ACS and government accreditation processes and associated conversations have become drivers for program architectures that align curriculum and industry needs. The ACS requires institutions to prepare graduates for Skills for the Information Age (SFIA) roles. For example, SFIA 8, released by the SFIA foundation on 28 September 2021, has an additional 21 skills and is restructured to highlight the need for deeper skills in areas like security, data and analytics, and computational science. Despite the detailed process of institutional course quality assurance
and longer accreditation cycles, the level of complexity of curriculum design reflects rapidly changing technologies, the nature of service across a diversity of business domains, and the need for soft skills to apply technical knowledge successfully (Topi, 2019). In addition, the Higher Education Support Act 2003 (The Federal Register of Legislation, 2023) suggests engagement with industry as one of the ways to enable graduates to thrive in the workforce. To add on, it is imperative for higher education institutions to ensure that education meets industry expectations. One of the ways to meet such expectations is to increase University-industry collaboration that augments the theoretical foundation gained through formal education and adds value by reflecting current technology competency (Randall and Zirkle, 2005). Such initiatives can include industry-based capstone projects, industry placements and certifications.

University-industry collaboration has become inevitable for resources, research, and reach. Recently, University-industry collaboration for education has increased to a wider extent because the curriculum should mirror the training needs of the industry (Bean and Dawkins, 2021). Traditionally, curriculum development processes involve course advisory groups involving academics, accreditation bodies, students, as well as industry partners. Academics and industry partners work together in many initiatives, typically through an agreement, towards rendering students with investigatory skills to solve practice-based problems. They work together towards helping to keep the curriculum relevant to industry expectations, provide guest lecturers to share their professional expertise, mentor and guide students in work-integrated learning activities, as well as evaluate curriculum as part of the advisory committee. While teaching facilitates knowledge and capabilities development of future professionals, this knowledge can be further enhanced with exposure to additional learning and skilling activities that are integrated with industry. Industry-focused professional development opportunities then become an avenue for incorporating the needs of employers and complex demands of the workforce (Lang, 2023). Embedding industry certification in the curriculum and promoting students towards industry certifications is a new transforming way that academics work with industry on as they prepare students to be job-ready. Thus, while graduating with their bachelor's degree qualifications, students will also gain industry provider certifications in their area of interest. This paper presents a descriptive case study of a series of successful University-industry collaborative bootcamps at the University of Canberra (UC) to prepare students towards their certification.

II. LITERATURE REVIEW

As earlier studies highlight, the benefits of University-industry collaborations include contribution to education and training skill development, acquisition of knowledge through innovation and technological knowledge transfer, increase labor mobility between private and public sector organisations, and present opportunities to start a career path with the firms involved in the collaboration (Wang et al., 2016). Engagement or industry involvement through University-industry collaboration is part of the third mission for Universities that aim to incorporate industrial innovation into the primary activities or missions that include teaching and research. Based on a study of 61 Universities from 2009 to 2013 on the relationship between University-industry collaboration and teaching performance, Wang et al. (2016) assert that University-industry collaboration has a positive impact on teaching.

The continuous changes brought about by automation, globalisation, and changes in technology have led to task change (changes in the amount of time spent on existing tasks and the addition of new tasks), which in turn has led to considerable growth in demand for data and digital skills (National Skills Commission, 2021). The state of Australia’s skills in 2021 identified computer and electronics skills as one of the fastest growing skills cluster families. In addition, the 2022 Skills Priority List released by the National Skills Commission (National Skills Commission, 2022) shows many Information and Communications Technology (ICT) jobs having a fill rate lower than 50%. This indicates a growing shortage of ICT skills that need to be filled. However, occupations in high demand are more likely to be specialised and require higher level skills and formal qualifications (National Skills Commission, 2021). Recent graduates enter the workforce for the first time with a basic set of skills and the ability to learn. The degree to get a job is only the starting point, however, learning must continue for a lifetime through continuous upskilling (Christensen, 2020). In addition, the Australian aging population means that there are fewer people to do jobs, and those who are looking for jobs may not necessarily possess the skills. Further, the pace of business and technology change
continuously creates demand for depth in skills not programmed into the current University curriculum (e.g., current demand for Artificial Intelligence (AI) skills was not programmed into most University degrees developed/updated in the last 6 months). Collaboration and partnership with employers and industry technology providers are a win-win endeavor for all as the linkages created are a source of ready talent for employers and inform Universities’ course design decisions by helping to identify the skillsets industry may be looking for at any given point in time.

Researchers have proposed several models to improve the effectiveness of collaborations. These models primarily aim to encourage University-industry Collaboration (UIC) and offer guidance for establishing effective UICs. Philbin (2008) proposed a process model that can be utilised by academics and industry practitioners to develop and effectively manage research collaborations. The model is based on the findings of a literature review and an empirical study involving 32 stakeholder interviews. The main components of the model are a central linear process and enabling features such as social capital, knowledge factors, and collaboration agent. Schubert and Fisher (2009) proposed a generic model for Collaborative Basic Research (CBR) model for collaborative empirical research with the primary aim of increasing the relevance and rigor of research. The model is based on real-world experience derived from a case study of a specific collaboration over a period of eight years in Switzerland. The model considers four basic aspects of funding, topic, cooperation, and interpretation. Perkmann and Salter (2012) presented four models of collaboration based on findings from action research projects in which the author of the model engaged in surveys of collaborating industries and academics, interviews with company executives, entrepreneurs, and academic scientists, and secondary material identified through a literature review. Among the four models, deep exploration is a model in which a company creates long-term relationships with Universities to tackle fundamental business challenges, gain access to new areas of expertise, gain access to an array of discoveries by University researchers and hire talented graduates.

The Cambridge-MIT Institute (CMI) formulated a Knowledge Integration Community (KIC) model (Acworth, 2008) for the UK as a more effective approach to knowledge sharing and enhancing the effectiveness of University-industry linkages. Its objective is to increase competitiveness, enhance productivity, and encourage entrepreneurship. Sandberg et al. (2011) proposed a collaboration model for setting up collaborative practice research projects that bring together practitioners and reflecting researchers. The Sponsored Research Interaction Process (SRIP) model (Burnside and Witkin, 2008) is designed to help Universities and businesses handle the complexity of negotiations related to IP contracts. The model is based on collaborative efforts between UC Berkeley and industry. These representative University-industry collaboration models focus primarily on the research aspect. In addition to the various models for specific types of University-industry collaborations described so far, there are some proposed conceptual frameworks that aim to improve understanding of University-industry collaborations in general (Alexander et al., 2018; Ankrah and Omar, 2015; Galan-Muros and Davey, 2017). Further, we identified a framework (Awasthy et al., 2020) to improve the effectiveness of University-industry Collaboration (UIC). This work offers insights regarding concrete steps to be taken for effective collaboration between Universities and industries. The UIC Framework (Awasthy et al., 2020) identified a comprehensive list of factors operating in a broad and wide context within the collaboration system as described in Table 1.

<table>
<thead>
<tr>
<th>Factors of UIC Framework</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Understand the variety of interactions</td>
<td>As a starting point, we need to understand the importance of the diverse UICs, which have different extents of involvement, varied duration, and specific associated benefits. An understanding of such details about UICs</td>
</tr>
</tbody>
</table>
enables the stakeholders to make an informed decision about selecting a partnership suitable to the context.

2. Identify the stakeholders

Assess the stakeholders to ensure that the selected partners have genuine interest and commitment, adequate resources to support the intended outcomes of the collaboration (Barnes et al., 2002), relevance of the problem to the stakeholders, complementary nature of resources, and established capacity of the firm in the area of interest. Prior experience with stakeholders is also a consideration as earlier short-term successful partnerships can lead to long-term strategic partnerships.

3. Identify the motivation of UIC

UIC offers several benefits, which will motivate stakeholders to collaborate. It is important to identify motivations and common areas before collaborating as it will lead to increased commitment.

4. Appoint suitable people, and involve leadership

Motivated individuals play an important role in establishing collaborations and determining their outcomes. Appointing the right and capable people is important for the success of a UIC. Universities and industry should identify and appoint staff and faculty who are suitable for UIC.

UIC partners should ensure leadership involvement. The success of a collaboration is influenced by leadership involvement through encouraging engagement, creating a conducive environment, and demonstrating commitment.

5. Ensure basic partnership characteristics

UIC partners must consider everyone’s perspective and ensure fair contributions. There should be clear articulation of the amount of active contribution expected from the partners at the beginning of the UIC.

6. Establish effective communication

Communication among participants is critical in order to coordinate work and manage UIC effectively. Stakeholders should adopt measures to improve communication between them, such as regular contact to meet and talk, encouraging bidirectional flow of information, and using virtual meeting tools.
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<tr>
<td><strong>7. Strengthen the dissemination strategy</strong></td>
<td>Universities must work towards strengthening their dissemination strategy and using elements of marketing for sharing collaboration results, and their relevance in order to attract new partners. They should use a variety of channels to enhance the dissemination of results.</td>
</tr>
<tr>
<td><strong>8. Address IP concerns</strong></td>
<td>Intellectual property rights are an important factor in many UICs. The process of identifying possible IP, decisions to protect it, and patent portfolio management is challenging. All UIC stakeholders must develop a common understanding around Intellectual Property (IP).</td>
</tr>
<tr>
<td><strong>9. Adopt policies and strategies to encourage collaboration</strong></td>
<td>Policies are important in sustaining collaboration. Long-term development of industrially relevant academic R&amp;D resources, communication, reduction of the financial/material costs of interaction, the resolution of organisational conflicts, and filling roles, which can facilitate collaborations at the University-industry interface have been identified as key policy areas for Universities to overcome barriers to UIC.</td>
</tr>
<tr>
<td><strong>10. Focus on social capital resources</strong></td>
<td>Social capital resources include trust, mutual obligations, common understanding, access to information and opportunities. Each collaborator should focus on these aspects.</td>
</tr>
<tr>
<td><strong>11. Rewards and incentives</strong></td>
<td>A new system of incentives should be created in Universities to recognize the efforts of the academics participating in partnerships with industry.</td>
</tr>
<tr>
<td><strong>12. Management of collaboration</strong></td>
<td>It is important to manage UICs to ensure success. Adopting a framework to manage the collaboration process will help in monitoring, course-correction during the collaboration process, and achieving the set goals.</td>
</tr>
<tr>
<td><strong>13. Alumni association</strong></td>
<td>Universities should maintain a connection with their graduates working in industry. Through these connections Universities can discuss industry problems and understand ways of working together to solve them. In addition, these alumni can become mentors for the present cohort of students, which will influence the future workforce.</td>
</tr>
</tbody>
</table>
We find this UIC Framework applicable in mapping the steps involved in hosting bootcamps – in our case – hosting a bootcamp at the University of Canberra in collaboration with our industry partner Microsoft which will be presented next. This study will be one of the first attempts to present bootcamps using the UIC Framework.

III. BOOTCAMP – A CASE STUDY

A bootcamp is a learning program where content is aggregated or bundled into short, intensive, and rigorous learning program. It is an accelerated learning strategy that compresses material that would normally be covered over an extended period (e.g., a semester or more into 2 days to 3 weeks of intensive learning). The term bootcamp itself is borrowed from the 1800s American military basic training where strict discipline, rigorous physical training, and unquestioning obedience are emphasized (MacKenzie and Gover, 2014). It has now, however, come to mean as focused intensive curriculum delivery and assessment. This innovation is meant to take someone from having little to no understanding to becoming a fully trained person in a fraction of the time (Anita Maharani, 2022).

In this section, we elaborate on our experience of running a bootcamp at the University of Canberra and reflect on the student experience as they attend the bootcamp as a case study. To present our experience in hosting a series of bootcamps – both in November 2022 and July 2023, we apply the University-Industry Collaboration (UIC) Framework proposed by Awasthy et al. (2020) to describe the steps involved in hosting bootcamps.

1. Understand the Variety of Interactions: University-industry collaboration commences with a series of interactions and agreements. The ‘Microsoft Learn for Educators’ program gives an overview and the steps towards organizing a bootcamp or embedding Microsoft curriculum in courses. Considering the extent of involvement and the available time, we selected bootcamp, which is an intensive short-term UIC to facilitate skills development. Bootcamp is akin to block mode of teaching where a study unit is condensed into a short time. It is intense but encourages students to focus. While the bootcamp lasts for 2 weeks, the variety of interactions between the University and industry is a continuous process starting from planning, agreeing to the terms and conditions, marketing, enrolling before the bootcamp starts, feedback and reflections, organizing certifications exams, and recruitment of students for job opportunities – an interaction that follows the bootcamp.

2. Stakeholder Identification: We identified Microsoft corporation as our collaborative industry partner as it is an established leading provider of in-demand technologies such as Cloud Computing, Cybersecurity, and Artificial Intelligence. Having an established industry partner ensured the capability and resources required for the bootcamp. In addition, the resources within the University and industry are complimentary for the bootcamp, which include industry experts, academics, content, and computer labs. This is critical for the success of the initiative as the higher complementarity of capabilities between partners is believed to increase the level of trust and mutual commitment (Chartered Accountants Australia and New Zealand and RMIT, 2017; Das and Teng, 2000).

In addition to Microsoft, other partners included the Akkodis Academy, one of Akkodis’ four specialised divisions which closes essential skill gaps by delivering cutting-edge upskilling and reskilling solutions in IT and Engineering to progress transformation, future-proof organisations’ talent, and drive performance in the ever-evolving smart world. With a global reach and academies in 10 countries, Akkodis provides hands-on and expert training content. One of its most defining features is the integration of practical knowledge with theoretical learning. Backed by two decades of experience and a wealth of cross industry expertise, Akkodis Academy is uniquely positioned to bridge the skills gap hindering transformation in modern organisations. It achieves this through a practitioner-led training curriculum that is not only dynamic but also consistently updated to reflect emerging trends and technological demands. In doing so, the Academy provides its participants with both hands-on and expert training content. In terms of recruitment outcomes, Akkodis Academy is working with Akkodis Consulting, a world leader in IT and Engineering services. This affiliation allows the Academy to integrate industry interactions into its program design, ensuring a smooth transition from education to employment opportunities. By establishing early engagements with Universities and forging partnerships for
experiential learning, the Academy creates a continuous pipeline of young professionals who are primed for immediate effectiveness and long-term career satisfaction. In close partnership with Microsoft, Akkodis Academy has developed the certification bootcamp program and served as the facilitator, connecting the University and Microsoft Corporation.

3. Identify Motivation: The identified industry partner, Microsoft Corporation, along with the Akkodis Academy, had motivations similar to our University – improving graduate skills. The bootcamp is aimed at providing students with an opportunity to easily access industry certification. It is to extend and consolidate what students learn during the semester to a certification level. It is designed to provide students with comprehensive resources and guidance to enhance their skills and gain valuable certifications. Thus, the bootcamp is a quick way to certification. At the end of the bootcamp, students should be ready to sit and pass the certification exam compared to less than 4 weeks taken by majority who sit the fundamentals exam (Heintzkill, 2022). Certification fills the graduates’ skill gap by providing tailor made learning programs that equip participants with in-depth skills and tool sets to deliver the outcomes required by the employers. These certifications (micro credentials) which enable learning in small chunks can be delivered in a variety of ways, including online courses, apprenticeships, or bootcamp training (Christensen, 2020).

Bootcamp is the delivery of choice towards rendering a fast-paced certification for students. The micro credentials are very attractive to learners as they provide a clear career pathway. In this case, the opportunity of certification at the end of the bootcamp creates motivation for the students (Ghapanchi, 2022). For instance, in 2021, an Atlassian company survey found that 86 per cent of Atlassian certified workers reported that certification “increased their professional credibility”, while 73 per cent said it lifted “their job prospects”, 57 per cent reported it raised “their earning potential”, and 52 per cent “had grown their professional network” (Collins, 2023).

With certification in mind, we had to decide on the focus areas that need to be considered towards enhancing graduate skills for our students. Therefore, the following certification opportunities were offered in the bootcamps with Microsoft:

1. **AZ-900: Microsoft Azure Fundamentals**: Designed for individuals who are new to cloud computing and Microsoft Azure and want to demonstrate foundational knowledge of cloud concepts and Azure services. It covers basic cloud computing concepts such as the benefits of cloud services, different cloud deployment models, and cloud service models. It also covers core Azure services, pricing and service level agreements, and governance and compliance. This will be particularly useful for students taking Enterprise and Cloud Computing (9281).

2. **SC-900: Microsoft Security, Compliance, and Identity Fundamentals**: Designed for individuals who are new to security and compliance concepts in Microsoft's cloud services, particularly in Azure. It covers fundamental topics related to security, compliance, and identity within the Microsoft ecosystem. This certification will be useful for students taking Introduction to Cyber Security (11906).

3. **DP-900: Microsoft Azure Data Fundamentals**: Designed for individuals who are new to data-related concepts in Microsoft Azure and want to demonstrate their foundational knowledge in data services and data storage solutions within the Azure cloud ecosystem. It covers fundamental data concepts including data types, data storage, and data analytics. It includes Azure SQL database and other relational data services including provisioning, querying, and managing relational databases. One of the relevant units to this certification offered at our University is Database Systems PG (6681).
4. **AI-900: Microsoft Azure AI Fundamentals**: Designed for individuals who want to demonstrate their foundational knowledge of Artificial Intelligence (AI) and Machine Learning (ML) concepts and their application within the Microsoft Azure ecosystem. It covers AI concepts such as common AI workloads, ethical and responsible AI practices, and considerations for AI solutions. It also includes machine learning concepts such as Azure Machine Learning, data preparation, training models, and evaluating model performance. Image and video analysis, text mining, and natural language processing are exclusively covered. This certification will be relevant to students taking Artificial Intelligence Techniques PG (6685) unit at our University.

5. **PL-900: Microsoft Power Platform Fundamentals**: This certification includes Power BI, Power Apps, Power Automate, and Power Virtual Agents. The content is designed for understanding the components of Power platform and its importance in solving business problems.

Following the completion of the semester, most of our University students have a semester break from their studies. Involving them in additional learning towards their career is very attractive to them and gives them the opportunity to intentionally learn or enhance skills they may have missed or not delved deep into during their study. Since the bootcamp is a compressed learning delivery mode, it fits well within the time students have during the semester break. It provides highly interactive, customised, activity-based fast paced learning with a clear target of certification at the end of the exercise. This fosters focus, engagement, and intentionality for these students. It makes learning organic, collaborative and hands-on, which in turn positively impacts information retention and increases learning satisfaction, making the participants more likely to engage in further learning (Wu et al., 2015).

With these certifications in mind, our University organized bootcamps with industry partner Microsoft, facilitated by Akkodis Academy, to deliver intensive theory and practical knowledge sessions for the students. The University sponsored the first 100 students who enrolled in the bootcamp to promote participation and ensure that students who need funding can take this opportunity to be included in the bootcamp for free. Students were offered vouchers to attend the bootcamp and to do the certification exam. The total value proposition was $49 AUD. In addition, the bootcamp compressed the certification study period from an average of 3 months to 14 days. This worked out very well for students who were on semester break and could spare that time before going off to engage in other activities. The bootcamp was spaced out over two weeks which allowed plenty of time for students to work through the learning materials, practice new-found skills, and complete the certification exam. Coupling this with experts who were available at various points in time created a supportive and engaging environment that enabled students to make the connections between the theoretical concepts and real-world applications, which is a foundation to significant learning.

4. **Identify and Appoint Suitable People and Involve Leadership**: As a step towards progressing with the bootcamp, we identified the academic program advisor to take up the leadership role in organizing the bootcamp. Figure 1 shows the initial communication with the appointed program advisor and steps towards initiation of the collaboration. The program advisor works with Akkodis and Microsoft to engage in Faculty onboarding and training events and opportunities, and plan towards using shared resources, bootcamp dates, marketing materials, content, and agreements. The program advisor must agree to the business terms on behalf of the Institution.
The academic program advisor works with the management, communications and marketing team, IT labs technical team, academics expert in the respective certifications, as well as students, to make sure that the bootcamp is organized effectively.

5. **Ensure Basic Partnership Characteristics:** The amount of active contribution expected from the industry partners at the beginning of the bootcamp was clearly articulated which helped in the successful organisation of the bootcamps. As we established the partnership, we enrolled in the bootcamp by filling in the form and ensured that we mutually agreed to the terms and conditions. The basic commitments of different stakeholder groups are listed below in Table 2.

### Table 2: Commitments of Stakeholders in the UIC Towards Hosting Bootcamps

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Commitment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student</strong></td>
<td>Enrolment into bootcamp (49 AUD per student)</td>
</tr>
<tr>
<td></td>
<td>Completion of curated Microsoft Learn online learning path/s and practice tests</td>
</tr>
<tr>
<td></td>
<td>Synchronous engagement with bootcamp facilitators &amp; Microsoft experts</td>
</tr>
<tr>
<td></td>
<td>Completion of online certification exam(s)</td>
</tr>
<tr>
<td><strong>University – Program Advisors</strong></td>
<td>University marketing plan &amp; activation to promote bootcamp to target student audience</td>
</tr>
<tr>
<td></td>
<td>Provision of University brand guidelines and assets to bootcamp delivery partner (Akkodis) to enable creation of the white-labelled bootcamp experience</td>
</tr>
<tr>
<td></td>
<td>Educator engagement in live events</td>
</tr>
<tr>
<td></td>
<td>Entering of bootcamp courses into MSLE CRM</td>
</tr>
<tr>
<td><strong>Industry Partner – Microsoft</strong></td>
<td>Create University branded landing page and bootcamp learning experience</td>
</tr>
<tr>
<td></td>
<td>Collaborate with University and bootcamp delivery partner (Akkodis)</td>
</tr>
<tr>
<td></td>
<td>Create the industry relevant content</td>
</tr>
<tr>
<td></td>
<td>Oversee the management of bootcamp</td>
</tr>
</tbody>
</table>
Industry Delivery Partner – Akkodis

Create University branded landing page and bootcamp learning experience

Connect students to career opportunities (WIL, Internships, contract, part time and full-time work)

Project management of bootcamp experience

6. Establish Efficient Communication: Efficient and planned communication is a key element in successful collaboration. From an academic perspective, Akkodis rendered a very planned communication and delivery pattern for the University and Microsoft to effectively communicate during the bootcamp and organise it systematically. Figure 2 illustrates the planned communication and delivery organised by Akkodis and Microsoft.

![Figure 2. Bootcamp Project Timeline](image)

7. Strengthen the Dissemination Strategy: University strengthened the dissemination strategy by sharing the bootcamp website as planned to reach students not only in the School of Information Technology and Systems, but to the University as a whole. We used Instagram, Facebook, LinkedIn, University mailing lists, Canvas, and students’ portal to advertise and spread the message to interested students as illustrated in Figure 3.

![Figure 3. Dissemination Strategy for Marketing Bootcamp in Instagram](image)

The marketing and promotion of bootcamp resulted in a total of 159 students participating in the bootcamps hosted in November 2022 and July 2023 as listed in Table 3.

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATES</td>
<td>DATES</td>
<td>DATES</td>
<td>DATES</td>
<td>DATES</td>
<td>DATES</td>
</tr>
<tr>
<td>Approval By Microsoft</td>
<td>Kick Off Call Logistics Project Team</td>
<td>Build Landing page, Content, EOT &amp; Marketing Promo</td>
<td>QA/Testing Learner experience Journey</td>
<td>Review Call Institution final review</td>
<td>Marketing (W1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week 7</th>
<th>Week 8</th>
<th>Week 9</th>
<th>Week 10</th>
<th>Week 11</th>
<th>Week 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATES</td>
<td>DATES</td>
<td>DATES</td>
<td>DATES</td>
<td>DATES</td>
<td>DATES</td>
</tr>
<tr>
<td>Marketing (W2)</td>
<td>Marketing (W3)</td>
<td>Marketing (W4)</td>
<td>Learn</td>
<td>Revise &amp; Certify</td>
<td>Retro</td>
</tr>
</tbody>
</table>
### Bootcamp Certifications Offered

<table>
<thead>
<tr>
<th>Certification</th>
<th>Number of students participated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Azure AI Fundamentals (AI-900)</td>
<td>40</td>
</tr>
<tr>
<td>Microsoft Azure Data Fundamentals (DP-900)</td>
<td>26</td>
</tr>
<tr>
<td>Microsoft Azure Fundamentals (AZ-900)</td>
<td>56</td>
</tr>
<tr>
<td>Microsoft Power Platform Fundamentals (PL-900)</td>
<td>13</td>
</tr>
<tr>
<td>Microsoft Security, Compliance, and Identify Fundamentals (SC-900)</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>159</strong></td>
</tr>
</tbody>
</table>

The second dissemination strategy followed for the University-industry collaboration was to promote students to share their success stories in their social media network. They shared their posts with hashtags such as #go1, #microsoft, #proudtobecertified, #akkidostechacademy, and #MSBootcamp etc. They also tagged the program advisor and industry advisors whom they met during their bootcamp and who guided them towards their certifications (Figure 4).

![Figure 4. Dissemination Strategy for Sharing Student Success Stories in LinkedIn](image)

The remaining six factors of the UIC framework are focused on continuous medium- and long-term University-industry collaboration. Adopting policies and strategies to encourage/facilitate collaboration should be the first step that needs to be taken by a University so that hosting bootcamps and embedding industry curriculum in the courses will be much easier. Focusing on social capital resources with the establishment of the existence of mutual trust is an important factor, leading to effective knowledge sharing between various stakeholders and contributing to the success of the collaborative venture. Setting up rewards and incentives are expected to influence the motivations and level of engagement of individuals, leading to more effective collaborations. Hence, a University needs to plan towards systematic ways in which such initiatives can be recognised as future collaborations continue. Effective management of future collaborations by adopting a framework to manage the collaboration process in a similar manner will help in monitoring and course correction during the collaboration process and
achieving the set goals. The main aspects of management are related to objectives, roles and responsibilities, planning and execution, risk management, and progress monitoring. Finally, forming an alumni association to maintain connection with the students who experienced certification process and received employment opportunities and who can become mentors for present cohort of students. It is through the development of ‘long-term relationships with the University, graduates help the University to re-learn’ (Leung, 2017).

IV. BOOTCAMP BENEFITS

The bootcamps form of University-industry collaboration is believed to lead to many benefits and positive outcomes to the stakeholders involved as will be outlined next.

Benefits for Students: These 2- or 3-week accelerated bootcamps are designed to skill up and certify students, offering industry-recognized certification opportunities in a short period of time. Bootcamps offer students a pathway to future employment opportunities that will help accelerate the start of their career, both at a domestic as well as at a global level. Bootcamps also lead to other benefits including staying up-to-date with current technologies, a chance to learn with other peers who are also undertaking the bootcamp, and improved commitment to the certification process. Bootcamps offer students an avenue to access apprenticeship and mentorship but also a chance to network with other peers, practitioners from the industry, and future employers. The dissemination strategy adopted for the bootcamp results in a positive impact on the students' profile.

Benefits for Educators: For educators at the higher education institute involved in the bootcamp such as academic staff, the collaboration and hosting of bootcamps can be a rewarding experience. Bootcamps provide an opportunity for academics to network with industry partners who could potentially become partners in future research, inspire ideas for other collaborations, and who can potentially come as guest speakers in relevant units, adding value to the student's experience. For academics who are also involved in the organisation and facilitation of the bootcamp, this experience contributes towards their professional development and can be grounds to demonstrate collaboration and leadership. Material from the courses can contribute to continuous curriculum improvement by incorporating certification content into University units to enhance their relevance to practice. Demonstrating many of these efforts can potentially improve the likelihood of academic promotions for the educators.

Benefits for the University: Through industry connections, bootcamps provided students with palpable insight into their future jobs (Azzone and Soncin, 2020). For a University to extend its teaching activities to incorporate bootcamps, this can lead to an enhanced reputation for being responsive to industry requirements and better connected and affiliated with industry partners and renowned multi-national leading IT organisations. This form of engagement further contributes to the growth of the institution’s third mission activities in addition to teaching and research, and its overall reputation and global ranking. A University-industry collaboration where students gain access to experts in a renowned IT organisation enhances the perceived and real value of the units offered, hence the University's reputation (Valentin, 2000). Some of the drivers of students' choice of University and course of study include the reputation of the University and future job prospects of those who attend those Universities (Azzone and Soncin, 2020).

Benefits for Industry: For industry partners, the collaboration creates access to some of the smartest and most talented potential employees/customers. In fact, the bootcamp gives the industry partners an opportunity to evaluate the potential effectiveness of some of their approaches to solving problems. In these instances, this opportunity was in the technology, in the delivery methods used by the delivery partners, and in the students’ responses. With further collaboration and development, these opportunities can be developed into new products or services.

Benefits for Employers: Certifications are indicative of improved technical skills. Therefore, for employers, one of the key benefits of bootcamps is gaining access to graduates who are job-ready and who possess technical skills in the most demanded IT areas. This accelerates the volume of available technical talent in the market.

Benefits for Delivery Partner: For bootcamp delivery partners such as the Akkodis Academy, facilitating the delivery of the certification course presents more opportunities to bring in
revenue to the academy and improve its reputation and marketability within the higher education industry.

V. DISCUSSION

The Australian Government Department of Industry, Science and Resources has listed Artificial Intelligence and Advanced Information and Communication Technology among the critical technologies that can impact Australia’s national interest (Australian Government, 2023). This recognises the arrival of the fourth industrial revolution in which the physical, digital, and biological worlds blur with the application of technologies like AI, Machine Learning, Security and Cloud Computing (Microsoft Corporation, 2017). In addition, numerous surveys of the private sector indicated that the skills deficits in these areas is a significant challenge to economic growth (Australian Information Industry Association, 2023). Thus, bootcamps resulted in clearly defined outcomes with the students gaining intensive learning experience with Microsoft and taking certifications along with them. Such experience and certifications open possibilities for students’ career.

We identified some challenges to overcome in future bootcamps. We observed that the number of students enrolled in the second bootcamp is less than those in the first bootcamp. We can attribute this lower participation to the cost and timing of the bootcamp. In the first bootcamp, the University offered to pay for the students’ registration which was not the case in the second bootcamp. The second bootcamp was organised during the middle of the semester break during which most of the students might have traveled back home. In future, we would like to experiment with organising the bootcamp immediately after the end of the semester or during the orientation week early in the semester. Further, not all the participants took the certification exam. Therefore, we would further like to explore the possibility of embedding participation in the certification exam in the unit to encourage a larger number of students to get certified. Finally, given that not all participants took the certification exam, and as part of our future plan, we would like to establish a system to collate various data about the cohort of participants as to the reasons why some students pursue the certification exam and others do not, their success in the workplace, and other performance indicators for measuring the effectiveness and success of the bootcamp, which ultimately, would result in students getting the certification and formalise knowledge and skill acquisition.

VI. CONCLUSION

In this paper, we presented the experience of organising a bootcamp in our University – University of Canberra – in collaboration with an industry partner, Microsoft Corporation, with the aim to improve graduate skills. The bootcamp strongly emphasises the value of intensive content delivery and practical training in preparing graduates for industry certifications that have the potential to increase their employability. The increased employability is attributed to the value of industry certification and the focus on skills that are in demand. Such bootcamps create a win-win situation for all the stakeholders, students, academics, the University, and industry alike. Students gain skills required for the workforce, and academics gain support in enhancing students’ learning experience and employability while demonstrating leadership and collaboration initiatives. Industry plays its role in developing industry-relevant content aimed at creating an industry-ready workforce that helps in addressing the demand for a skilled workforce. In addition, the networking during these bootcamps has the potential to create future collaborative opportunities. Our bootcamp experience confirms and extends earlier works that establish the value of University-industry collaboration in education. It presents an effective experience that can be adopted by other higher education academics and institutions. Moving forward, we will continue to work closely with our industry partners to explore and deepen our collaboration for improving graduate skills.

VII. REFERENCES


Australian Information Industry Association (2023) “AIIA Survey - Digital State of the Nation 2023”, AIIA.


Chartered Accountants Australia and New Zealand and RMIT (2017) “Improving collaboration and innovation between industry and business schools in Australia”.


Abstract:
This paper presents a descriptive case study of a unit embedding an innovative pedagogical approach that incorporates industry-collaboration interventions of different extent to work towards the goal of improving graduate skills and creating industry-ready graduates at the University of Canberra. In collaboration with Amazon Web Services (AWS), one of the largest Cloud providers, the Enterprise and Cloud Computing unit experimented with embedding industry-developed content in one of the units. The approach demonstrates that incorporating education, industry-relevant active learning, and certification will help enhancing student learning experience, improving graduate skills, preparing our students for success in the job market, and increasing employability. It is an example for higher education academics of a transferable approach for designing effective programs for other popular Information Technology (IT) specialisations such as Artificial Intelligence (AI) and Data Science, and disciplines collaborating with industry.

Keywords: university-industry collaboration, industry-relevant education, bootcamp, industry certification, graduate skills, industry readiness

I. INTRODUCTION
There is a widely acknowledged gap between Information Technology (IT) education and the requirements of industry (Simmons and Simmons 2010, Almi, Rahman et al. 2011, Malik and Venkatraman 2017, Garousi, Giray et al. 2019). Many initiatives are being taken globally to close this gap (Kapil 2014, Awasthy, Flint et al. 2017, Vijayalakshmi, Patil et al. 2018, Haamann and Basten 2019). These include collaboration between universities and industry to provide students with professional experience. Within the Australian higher education context, there has been a long-standing commitment to encouraging such collaboration to improve the performance of business and higher education (Dunne and Rawlins 2000, Winterton and Turner 2019). Despite these commitments, a serious shortage of skilled graduates continues (Prikshat, Montague et al. 2020). Employers express dissatisfaction regarding the graduate skills (McGunagle and Zizka 2020) citing that Computer Science courses primarily focus on theoretical concepts. Often, academics may lack resources for providing practical hands-on experience to a diverse group of students with different levels of skills. This can result in students graduating without the skills and experience required to be successful in industry. Given the current and emerging challenges that higher education sector is facing with the rapid growth in student numbers and an increasingly diverse student cohort, there is an increasing need to focus on teaching practices in collaboration with industry for effective student learning outcomes (James, Baik et al. 2015), and bridging the gap in demand and supply of skilled IT graduates. Higher education institutions continuously need to develop curriculums that are relevant to contemporary technological advancements and industry practices for graduates to be future ready. Such curriculum development to address the concern regarding graduate skills is possible by involving industry experts in design and development of curriculum.

This paper presents the experience with the designed pedagogical approach for improving graduate skills and enhancing student learning through industry collaborations for formal education and certification. The piloted approach aims to create future-ready graduates, and help addressing the outlined concerns regarding skilled graduates. The approach has its foundation in the teaching philosophy that learning takes place through the active behaviour of the student. In developing this approach, the researcher has employed scholarly evidence relevant to learning and teaching, her own research results related to
university-industry collaboration, diverse experience in industry, and unit-convening experience in higher education. The approach has evolved to its current form based on the observations and experiences with past offerings of the unit, student involvement through feedback, and high impact and effective practices recognised in the existing literature. The independent components within the approach provide flexibility for it to be implemented in different units. However, we will discuss the approach primarily in the perspective of the Enterprise and Cloud Computing unit as the most relevant case study.

The approach has been implemented in the Enterprise and Cloud Computing unit in partnership with Amazon Web Services (AWS) to embed different forms of industry collaboration interventions in the unit, which led to holistic experience for the students undertaking IT degrees at the university. The curriculum for the unit was redesigned to integrate the collaborative interventions, lab activities, and assessments in the unit delivery to provide required skills and experience to students for future-ready workforce. The benefits of the approach are multi-faceted including increased student engagement, enhanced learning experience, opportunity for students to work closely with industry experts for gaining skills in the Cloud Computing field, mentoring, networking, and access to job opportunities specific for the students attending the specialised bootcamp sessions.

The potential impact of the pedagogical approach is equipping our students with future-ready skills, meeting the industry expectations from our graduates, increasing their employability, and enhancing the university's reputation as an institution with a focus on creating future-ready graduates.

This paper presents the processes and results of implementing this approach for integration of collaborative interventions. It provides example for higher education academics of how collaborative interventions can be integrated at various stages of a unit to enhance student learning experience, improve their skills, and increase their employability.

The structure of this paper is as follows: Section II outlines the purpose of the approach; in Section III we describe the design, delivery and implementation of the approach in the Enterprise and Cloud Computing unit at the University of Canberra; Section IV discusses the benefits of the approach; in Section V we present the preliminary evaluation of the approach; in Section VI we discuss the implications of our work; and finally, we present the overall conclusions and future work in Section VII.

II PURPOSE OF THE PEDAGOGICAL APPROACH

The main purpose of the approach is to improve skills and industry-readiness of graduates by enhancing student engagement and learning through industry collaboration for embedding industry-relevant content in course-curriculum. The objectives towards this aim are:

- Creating an application-oriented unit by integrating industry collaboration and industry-relevant content into the Enterprise and Cloud Computing unit at various stages.
- Introducing students to state-of-the art technologies using the theoretical and practical content created by AWS, largest Cloud Service provider (Richter 2023).
- Capitalizing on existing enthusiasm around applied aspects of Cloud Computing on campus with students by integrating it into a formal unit offering.
- Providing students with an experience that is closely related to real-world industry experience, and thus enhancing their learning experience and future work-readiness.
Investigating the impact of industry-collaboration interventions in enhancing student-learning.

Investigating the impact of the approach in preparing students for industry certifications and increasing student employability.

Identifying the possibility to provide recommendations for an impactful-teaching practice that has been designed, implemented, and tested.

III DESIGN, DELIVERY, AND IMPLEMENTATION OF THE APPROACH

The Enterprise and Cloud Computing unit is offered to the Bachelor of Information Technology students. The unit delivery involves the following: A semester consists of twelve weeks of course delivery. Each week a two-hours lecture is delivered on-campus to the enrolled students. Recording of the lecture is available for later reference by the students or the students who could not attend the live session. During the week, there is a practical computer lab session to facilitate deeper understanding of the topics covered during the weekly lecture. These practical sessions are of one-hour duration for a group of twenty students. Each week there are assessments associated with the concepts covered so far to enable continuous learning among the students. In addition to the weekly assessments, helping students to gauge their progress, there is an end of semester assessment for students to demonstrate the knowledge, critical thinking, and analytical skills. The Cloud Computing platform in use for the unit is Amazon Web Services (AWS).

Through iterative design of the pedagogy, the approach has evolved over the years to its current form as depicted in Figure 1. As depicted in the figure, the approach consists of three forms of collaborative interventions and associated assessments grounded in scholarly practices. These interventions of various degrees integrating industry collaboration are described below.

INTERVENTION 1: INTRODUCTION OF SPORADIC INTERVENTION

The traditional lectures based on the theories in textbooks may lack the alignment with contemporary advancements in technology and practices in industry (Chew, Ng et al. 2023). There is an increased emphasis on utilising the networks with industry to support the universities’ role in training the graduates to be future-ready (Chew, Ng et al. 2023). Guest lectures have potential to enhance students’ learning experience (Goldberg, Cariapa et al. 2014). As a first and simple step, the approach utilises the industry practitioners and experts as guest lecturers, and investigates its impact on enhancing student learning. Guest lecturer in the context of this paper is a subject matter expert or experienced practitioner from an external organisation such as IT industry or Australian Government. We term this intervention as sporadic as the guest lectures can be organised at any week of unit delivery during the semester. This intervention has been implemented in the Enterprise and Cloud Computing unit with external stakeholders including AWS, Google, IBM, and Australian Government as depicted in Figure 1. The number of guest lectures varies from unit to unit according to the relevance of the topic to the unit and availability of the industry expert. Table 1 provides the examples of the guest lectures and the collaborating organisations. During the semester maximum two guest lecturers were invited to deliver the unit-related content with its relevance to industry practices. The remaining content was delivered by the unit convenor, who also facilitated the computer labs/tutorials discussed further. Such an arrangement provided flexibility to introduce the industry-relevant perspective and experience in the unit while maintaining the unit-delivery aligned with the unit outline and learning outcomes. The Canvas site of the unit was used to inform the students about the guest lectures, and reminding them through announcement closer to the scheduled day. Students were also informed that there is an assessment item associated with the delivered guest lectures.
Table 1: Guest lectures under sporadic intervention 1

<table>
<thead>
<tr>
<th>Topic</th>
<th>Collaborating industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software Systems Architecture</td>
<td>Google</td>
</tr>
<tr>
<td>Data visualization</td>
<td>ACT Government</td>
</tr>
<tr>
<td>Cyber-security in operations</td>
<td>ACT Government</td>
</tr>
<tr>
<td>Leadership</td>
<td>IBM</td>
</tr>
</tbody>
</table>

The purpose of the guest lectures was to introduce the students to the practical and real-world relevance of the topics being covered in the unit. Students were encouraged to maintain the sessions interactive by asking questions or clarifications, if any, with the guest lecturer during the sessions. The industry experts guide the students regarding the applied side of the knowledge they are gaining in the unit, and what other skills are required to solve real-world problems in industry. For example, the session ‘Cyber-security in Operations’ introduced students to practical application of IT and Cloud security concepts. The guest lectures emphasized the industrial and application-oriented perspective to the theoretical IT concepts.

It is to be noted that during COVID, we included e-guests or virtual guest lecturer to overcome the disruption to face-to-face teaching. This had potential for enhancing student learning by bringing expertise from a different geography to virtual classroom, which would not have been possible otherwise due to logistics reasons.

Assessment method

Reflective practice is effective in continuous learning (Schon 1984, Moon 2013, Dybå, Maiden et al. 2014). Hence, in order to assess the learning associated with the guest lectures, a reflective piece of assessment was introduced in the unit. Students needed to submit a reflection on the value of the guest lectures for their learning and enhancement of perspectives. The weightage of the assessment is 10%.

INTERVENTION 2: APPLICATION OF CONTINUOUS INTERVENTION -
INTEGRATION OF INDUSTRY-RELEVANT CONTENT DEVELOPED BY INDUSTRY EXPERTS

It is important for academics to ensure that course-curriculum is updated to incorporate relevant advancements in technology by discussing with industry experts and employers (Milke, Paul et al. 2015, Lase 2019). There is an increased engagement from industry in designing curriculum to improve the alignment of learning outcomes with the demands and requirements of the employers (Khuong 2016, Ha 2022). Participation of industry in designing the curriculum of the unit can enhance the quality of education, skills development, and graduate-employability significantly (Chen, Lu et al. 2020, Borah, Malik et al. 2021). One way to achieve such engaging curriculum design is by integrating the content developed by industry into university course.

University of Canberra experimented its first integration of industry-developed applied Cloud Computing content in the Enterprise Cloud Computing unit by embedding the lecture and lab material developed by Amazon Web Services (AWS). With Cloud Computing gaining more popularity, relevance and interest among the students, this unit was the most relevant candidate for application of continuous intervention over the semester. Taking advantage of the flexibility of the program content being organized in the unit, the convenor built upon the base curriculum to add more practice using a variety of real-world problems as applications for the unit’s cloud computing foundations.

Industry provided access to industry-relevant content to the academic and the students

The academic designed and developed an industry-relevant Cloud Computing unit using the Applied Cloud Computing content that was developed by industry partner, AWS, to be delivered over the semester. The following learning outcomes are intended from the unit.

- Understanding the fundamental concepts of Cloud Computing and its applications;
- Comprehending the technical capabilities and benefits of cloud computing for a business;
- Developing an understanding of various service deliverable models, enabling technologies and mechanisms, cloud architectures, privacy issues, quality and metrics;
- Applying current technologies for working with clouds;
- Assessing the challenges faced by cloud deployments, and how they can be addressed; and
- Analysing and evaluating cloud solutions.

Table 2 outlines the lecture and computer lab topics aligned with achieving the above learning outcomes. Weekly lectures of two-hour duration are conducted each week during the semester except for Week 8, which is the teaching break.

Students’ learning is influenced by the recommended academic textbooks. Hence, the unit convenor covered the theoretical concepts in the unit and used the content developed by industry as a complement to it during the lecture. The convenor ensured through careful deliberations that the industry-relevant and practical content is aligned with the theory being taught to the students in the IT degree. Hence, the students can appreciate and build connection between the learnt theory and its practical application for IT industry.

Table 2: Syllabi of the Enterprise and Cloud Computing unit under intervention 2 integrating industry-developed content.
### Industry provided access to our students to labs hosted in AWS Cloud platform

Computer labs or tutorials are the primary means to supplement skills development through application of theoretical concepts (Van der Meij and van der Meij 2013). The labs are also important to gauge the knowledge and understanding of students about the concepts covered during the weekly lectures in the unit. Various IT units in the school utilize the computer lab environment in the university for the lab sessions for demonstration and application of understanding of the concepts by the students. However, these labs may not be suitable for specific contexts such as hosting of applications on Cloud or demonstrating demand-based scaling-up/down. Hence, the unit convenor had limitations regarding demonstration of practical application of Cloud Computing to enhance student-learning. Access to the labs hosted on the AWS Cloud platform helped overcome the limitation, and provided students an ability to experience the practical application of cloud-computing concepts.

As the largest Cloud service provider, AWS considers it as a priority to empower the next generation of cloud computing professionals. AWS provided student-centered and self-directed learning spaces (Wright 2011), computer labs, hosted on AWS with detailed guidelines for every task required by the applied Cloud Computing unit. The labs were

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Content</th>
</tr>
</thead>
</table>
| 1 | Cloud concepts overview  
Cloud economics  
AWS infrastructure overview | Registration to the AWS training portal  
Accessing VitalSource Bookshelf |
| 2 | Enabling technologies of Cloud Computing | Introduction to AWS Identity and Access Management (IAM) |
| 3 | Cloud Computing Models  
AWS Global infrastructure | Working with Elastic Beanstalk |
| 4 | Cloud-ready design principles  
AWS Compute services | Creating an EC2 instance |
| 5 | Networking and content delivery | Build your Virtual Private Cloud(VPC) and launch a Web Server |
| 6 | Cloud security  
Cloud security mechanisms  
Service level agreements | AWS Lambda |
| 7 | Cloud Storage services | Cloud-based security groups |
| 8 | Cloud Databases | Build a database(DB) server and interact with your DB using an app |
| 9 | Cloud architecting  
Well-architected framework | Scale and load balance your architecture |
| 10 | Cloud computing case study 1 | Deploy a Web Application on AWS |
| 11 | Cloud computing case study 2 | Making Your Environment Highly Available |
designed to engage students and facilitate active learning so that student participation and learning is increased. These labs provided students flexibility and opportunity to apply their learning in an environment simulating a real-world experience. The educator is available to guide the students, address their concerns in a timely manner, and support their learning as they progress through the lab activities. Such a learning experience increased students’ motivation to complete their weekly lab tasks in a consistent manner by the task deadline and enhanced their learning as evident in their performance in the activities.

In addition to access to the labs on AWS, students gained access to VitalSource Bookshelf that hosts course materials. It provides offline access via mobile applications with synchronized browsing and allows students to take notes directly in the course materials. Such self-directed learning space on VitalSource motivated students to advance their learning.

Our continued engagement with AWS opened a path for Intervention 3, intensive collaboration in the form of Bootcamp, detailed further.

Assessment Method

The academic developed assessment methods to help students monitor their performance and succeed. Assessment items were modified to align with the lectures and computer lab content and activities. The assessment included grading of the weekly labs so that students could be motivated to complete their tasks in a consistent and timely manner leading to achieving the learning objectives. In addition, a weekly quiz was designed for knowledge check associated with the weekly lecture and gaining automatic feedback for responses after quiz completion date.

INTERVENTION 3: EXTENSION TO INTENSIVE INTERVENTION - GOING BEYOND THE UNIT DELIVERY

Industry certifications offer a way for academic programs to remain up-to-date with industry demands (Shim, Gottipati et al. 2021). Certifications are becoming an important aspect of creating industry-ready graduates as integration of IT certifications into curriculum can improve graduate skills, and competency (White 2007). Certifications have a potential to enhance the employability of graduates as they reflect the technical skills and competency. Certification is also an indication to employers that a graduate is committed to continued professional development to remain abreast with advancements in a particular technology. In addition, certifications can raise the institution’s profile as an industry-collaborator for graduate skills. Hence, an intensive collaboration intervention was designed in the form of one-week Bootcamp free of cost for students in collaboration with the industry partner AWS. The purpose of the Bootcamp was to motivate and prepare students for industry certification.

The Bootcamp was organized at the university in collaboration with the industry partner AWS for providing an intensive Cloud Computing sessions to our students. The bootcamp was a mix of online and face-to-face components. Online session on the day one was attended by more than 50 students, where students learnt the foundations of cloud computing. Day two of the event was focused on Artificial Intelligence (AI) and Machine Learning (ML), where two face-to-face hands-on workshops were delivered by AWS experts. Students enjoyed working with generative AI and ML. Day three was an opportunity for our students to apply the skills learnt so far in the AWS Jam session facilitated by the AWS facilitator who delivered the hand-on experience. Students had to solve various AWS challenges in the Jam. Many students won AWS merchandise in prizes for solving the challenges.

The bootcamp provided our students an opportunity to upskill, gain advantage for AWS Cloud Practitioner Certification, and network with external stakeholders.

IV BENEFITS OF THE PEDAGOGICAL APPROACH

The pedagogical approach offered several benefits for students, educators, university and industry partners. The benefits include improved student engagement and learning,
industry-relevant education, preparation for industry certification, access to job opportunities, careers panels, and interview at Amazon, and educator upskilling.

Students completed the Cloud Computing modules for each week to learn how to apply the principles in the self-directed labs. They approached the applications of theoretical concepts in a way that they could visualize the feature they were implementing by seeing the outcome of their efforts in real time in the AWS Cloud labs, which will be typically missing in a traditional lab. They were able to identify if things went wrong, made changes and tried it again. Such practical and active learning space increased student engagement considerably. The learning improved success prospects of the students in the AWS certification exam.

Continuous feedback and evaluation kept students motivated. The lab content was developed and provided by AWS. Hence, the educator could focus their time and energy on ensuring students were supported and evaluated effectively. The faculty could regularly gauge student progress throughout the unit and help identify areas for support and improvement for students in the diverse cohort.

The industry-developed content helped in making the curriculum more industry-relevant and up-to-date with industry practices. The lecture and lab content was designed with a broad set of problems for students to tackle in order to simulate real-world challenges and experiences that graduates may face at the workplace. Such learning space has potential to increase industry-readiness of graduates.

The AWS Cloud Practitioner Certification is a globally recognized certificate. Attending the Bootcamp provided our students basic understanding of IT services and their uses on AWS Cloud, knowledge of core AWS services and use cases, billing and pricing models, security concepts, and how cloud impacts businesses. Such knowledge and learning helped students in preparation for the certification exam.

Eligible students received certification vouchers during the Bootcamp. As noted by the AWS consultant, “Congratulations to the first 18 students who have completed (all knowledge checks and labs) the AWS Academy Cloud Foundations class who received a 100% exam voucher worth about AUD$130.” For all the other students who attended the Bootcamp and planned to sit the exam, AWS provided a 50% exam voucher through the educator, demonstrating their commitment to empowering the next generation of cloud computing professionals.

Participants of the Bootcamp gained exclusive access to job openings at AWS. AWS Bootcamp students were invited to attend a virtual Careers Panel, including senior managers and solution architects from AWS. The panel discussed the open roles for interns and graduates in their departments along with giving an overview of their own roles and experiences at AWS. The event also provided details for applying for these roles so that the students could be identified as the Bootcamp program student through the process. Students who attended the Bootcamp and passed the AWS Certified Cloud Practitioners exam qualified for an interview with Amazon.

The approach provided a mechanism to the educator to invest their time creatively, experiment with flipped-classroom, and implement self-directed learning. The educator upskilled and became AWS-accredited educator in one of the most sought-after technology - Cloud Computing. As an AWS-accredited educator, the educator’s professional credibility is increased. The experience with the approach can be extended to various other advanced technologies.

V PRELIMINARY EVALUATION

In order to demonstrate the effectiveness of the pedagogical approach, we present the results and observations from the preliminary evaluation of the approach.

FEEDBACK FROM STUDENTS REGARDING THE GUEST LECTURES

Students were informally surveyed to investigate their perceptions for the benefits of guest lectures and to assess the impact on their learning. It was observed that students
recognise the importance of industry experts as guest lecturers. The students responded constructively regarding the guest lecture and suggestions for improvement. For example: “Lectures equip students with both useful theoretical and practical information by academics and guest speakers” “Include more sessions by guest speakers”

It became evident that students are gaining value out of the guest lectures by industry experts, and welcome closer collaboration with industry for practical application of the skills they learnt during the lectures. The closer collaboration was achieved through application of the continuous intervention integrating industry-developed content in the curriculum.

**FEEDBACK FROM STUDENTS REGARDING THE CONTINUOUS INTERVENTION**

Overall, the students expressed satisfaction regarding benefits from the structure of a curriculum that came from an industry expert, AWS, and focused on a leading technology, Cloud Computing. The labs available in the Cloud environment increased student engagement due to access and availability from off-campus locations.

**FEEDBACK FROM STUDENTS REGARDING THE INTENSIVE INTERVENTION - THE BOOTCAMP**

A survey titled ‘ACT Education AI/ML Bootcamp’ was conducted by AWS at the end of the event where average satisfaction score for the event in 2023 was 91.8%. A sample comment in the feedback is:

“Great experience. The organisers were amazing and were really accommodating. The content was also really engaging and informative, with some interesting and engaging practical activities.”

Our inference, from the formal and informal feedback, is that integration of industry collaboration interventions outlined in the approach in a university course will provide significant value to our graduates, university, and employers.

**VI DISCUSSION**

It is imperative for higher education institutions to ensure that education meets industry expectations. The presented approach is an innovative collaboration at the University of Canberra with a global industry partner, AWS, in a leading technology - Cloud Computing. It presents UC as a university collaborating with industry partners to increase the relevance and strength of their curricula. Hence, it contributes to enhancing the university’s reputation as a sought-after place for graduate skills.

The pedagogical approach presented makes contribution to enhancing teaching by providing a mechanism to keep university course updated with advancement in technology and industry requirement. Integrating industry perspective and industry-developed content enhances the industry-relevance of the course. In addition, the educators have access to resources to upskill themselves and deliver a course in a more practical and student-centric manner. The approach implemented the high-impact and effective teaching practices such as concern for student learning, clear goals and intellectually-stimulating content, appropriate assessment items, timely and constructive feedback, and student-centric learning (Smith and Baik 2021).

Industry collaboration interventions are pedagogically critical in IT education as a means of enhancing students’ learning experiences (Valentine, Marinelli et al. 2022). The approach has helped expose students to multiple interventions and perspectives that can help bridge the gap between theory and practice in IT industry. It provided students with opportunities to engage with latest technology and industry practices, improve understanding about their future profession, and develop skills and competencies to be
more effective in the classroom and future workplace. Such experience enhanced student learning and has implications on the graduate skills and employability for future workplace.

The knowledge and skills gained during the Bootcamp are valuable for students in achieving AWS Cloud Practitioner certification. The perks received during the Bootcamp are a motivation for students to complete the course and write the certification exam. The certificate is globally recognized and valued by industry. It is a great addition for students’ resume increasing their employability as many employers prefer their employees to have a relevant professional certification (Wang and D'Cruze 2019, Shim, Gottipati et al. 2021). In addition, the certified participants of the Bootcamp gained exclusive access to interview at Amazon accelerating their career prospects.

The approach provided students an opportunity to network with industry experts and AWS careers panel, who provided valuable career guidance as potential future employers. The guest lectures helped in building connections beyond the sporadic intervention. The experts showed interest in our other collaborative units. One of the experts participated in the panel of judges in the Capstone Expo (Karkhanis 2023) to engage with the students’ work more closely.

The presented approach has practical and policy implications for designing programs to create graduates that are ready for future. It has implications for any unit that involves engagement with industry, where the interventions in the approach can be utilised as a more effective way to enhance student learning outcomes in the specific area. The approach showcases a model to be adopted for other IT courses and disciplines. The interventions within the approach are independent. Hence, they can be applied in different units and adapted to the specific unit requirements. Application of those components of the approach is already evident as being implemented in other units with relevant industry partners such as Microsoft and Cisco. This indicates the relevance and value of the approach beyond the Enterprise and Cloud Computing unit. The complete approach application is being explored for another unit – Software Systems Architecture. Future work will extend the application of the approach in other disciplines and geography.

Few challenges and improvements have been identified for the approach. The industry-relevant content is for preparing students for certification and future jobs. However, not all the students in the unit attended the certification exam. This lack of participation could be due to students not having enough confidence with the exam preparation. To better prepare the students for certification exam, intensive Bootcamp was organised. However, low participation during the Bootcamp compared to the actual unit is a concern. This can be attributed to the time of organisation of the Bootcamp, which was during the semester break. During that time, students might have travelled to their homeplaces. Hence, we are planning to organise the Bootcamp early on after the semester ends. In addition, we are discussing to add an assessment component associated with the Bootcamp participation and certification exam.

The formal evaluation of the approach is to be conducted in accordance with a pending ethics clearance. The quantitative and qualitative analyses of data to be gathered in 2023-2024 will provide rigor to the evaluation. The extensibility of the approach to other geographies will be assessed in future work. The effectiveness of this innovative pedagogical approach with industry collaboration can be further validated in future as our graduates enter the workforce.

VII CONCLUSION

The pedagogical approach presented in this paper is an example of innovative university-industry collaboration programs that make an outstanding contribution to enhancing the student learning experience at University of Canberra. It is a three-pronged approach embedding education, industry-relevant active learning, and certification for preparing industry-ready graduates. The presented example of collaborative UC-AWS partnership in Cloud-computing education is transferable for designing programs for other popular IT specialisations such as AI and Data Science. The work demonstrates that effective university-industry collaboration at various stages of a unit can help to improve the skills and industry-readiness of our graduates. The overall positive and encouraging feedback
from the students regarding the approach motivates the academic to continue exploring ways to enrich students’ learning experience.

ACKNOWLEDGEMENT

We acknowledge the support of Amazon Web Services via the AWS Academy education program. This program aims to bridge the gap between industry and academia by providing higher education institutions with a free, ready-to-teach cloud computing curriculum that prepares students to pursue industry-recognized certifications and in-demand cloud jobs.

LIST OF REFERENCES


INDUSTRY-BASED IT CERTIFICATIONS IN HIGHER EDUCATION INSTITUTIONS: A STAKEHOLDER PERSPECTIVE

Jayan Chirayath Kurian  
School of Computer Science  
University of Technology Sydney, Australia  
JayanChirayathKurian@uts.edu.au

Zeena Alsamarrai’l  
Information Technology and Systems, Faculty of Science and Technology  
University of Canberra, Australia  
Zeena.Alsamarrai@canberra.edu.au

Simon Thompson  
Research School of Management, College of Business and Economics  
Australian National University, Australia  
Simon.Thompson@anu.edu.au

Luke Nguyen-Hoan  
Information Technology and Systems, Faculty of Science and Technology  
University of Canberra, Australia  
luke.nguyen-hoan@canberra.edu.au

Rosetta Romano  
Information Technology and Systems, Faculty of Science and Technology  
University of Canberra, Australia  
Rosetta.Romano@canberra.edu.au

Abstract:  
Industry-based certifications (IBC) are one way to provide credentials to learners in Higher Education Institutions (HEI) with product-specific skills (e.g., Low-Code development) that can complement academic degrees (e.g., Business Informatics). To understand the ecosystem of industry-based certifications in the context of HEI, we first visualize stakeholders using the influence and affected features of a rainbow diagram. In this opinion paper, we draw on our personal experiences to understand the opportunities and challenges stakeholders face through the lens of Curriculum Theory to determine that IBC is a recognized way of learning IT skills in a Higher Education Institution. By applying a case study in an Australian university, we explore the challenges and potential of IBC to create value (social, functional, and emotional) to stakeholders in the ecosystem. We will discuss how we integrated the Low-Code development content in an undergraduate and postgraduate course at a mid-sized university. We make several recommendations that could be adopted by stakeholders to drive strategic decision-making.

Keywords: Industry-based Certifications, Higher Education, Stakeholders, Low-code Development, Value creation.

I. INTRODUCTION

In the twenty-first century, micro-credentials are major disruptors of higher education [Varadarajan et al., 2023]. Academics have debated the benefits and challenges of embedding alternative credentials into the traditional higher education degrees [Ahsan et al., 2023, Thi Ngoc Ha et al., 2023, Bull, 2015]. Introducing competency assessments into the curriculum has addressed this concern to a certain extent [Dragoo and Barrows, 2016]. But, for rapid upskilling and gaining employment opportunities quickly, micro-credentials is one of the promising pathways [Varadarajan et al., 2023]. Industry-based certifications (IBC) are a type of micro-credential that could be embedded into the Information Technology curriculum in higher education [Hitchcock, 2007]. The certifications are generally administered by external organizations (e.g., Pearson VUE) and validated by industry partners (e.g., Microsoft). The IBCs are designed to meet the standards of the Information Technology industry and hence the requirements of recruiters and potential employers [Goldring, 2017]. In the next section, we describe the major industry partners in the ecosystem of IBCs.
Google, Microsoft, Nutanix, Project Management Institute, Amazon, and International Information System Security Certification Consortium are some of the well-known industry partners providing certifications in Information Technology [PCMag, 2023]. Other popular ones are CompTIA, Oracle, IBM, and Cisco. In Australia, some commercial and government organizations using Low-Code development platforms are the Commonwealth Bank, Services Australia, and the Department of Home Affairs. The Commonwealth Bank is the second leading company listed on the Australian Securities Exchange by market capitalization [Statista.com, 2023]. Services Australia is an executive agency of the Australian Government that offers a range of services and makes the government services simple to operate for customers [Services Australia, 2023]. Some industries where Low-Code development platforms have been implemented are Financial Services, Insurance, Healthcare & Life Sciences, Communications Service Providers, Government, and Manufacturing & High-Tech organizations. Thus, based on the above discussion, Low-Code development (e.g., Business Architect Certification) is one way to provide credentials to learners in higher education institutions with product-specific skills that can complement academic degrees. In the next section, we will identify the stakeholders in the IBC ecosystem.

II. STAKEHOLDERS

The stakeholders in the IBC ecosystem are discussed based on the influence and affected factors of a rainbow diagram [Chevalier and Buckles, 2008]. In the rainbow diagram, we represent two aspects (i) how stakeholders are affected by IBCs and (ii) the extent to which stakeholders influence IBCs. To represent the degree of impact and influence, we use the least, moderate and most scale. The stakeholder rainbow diagram is illustrated in Figure 1.

Figure 1: Stakeholder Rainbow Diagram

**Learners:** Learners are the students undertaking an information technology-based bachelor’s or master’s degree (course) at a tertiary institute (e.g., university) that incorporates an IBC component in one or more of the units in the course. This is an opportunity to develop knowledge and skills relevant to both their degree and future workplace. Learners are highly affected by IBCs, as these certifications affect not only their learning experience but also their future employment opportunities. Although they can provide feedback on IBCs through their experiences, overall, they have minimal influence.

**Educators:** Educators are the tertiary institute's academic staff who deliver the unit in which the IBC is embedded. This includes the unit convenor, lecturers, and sessional staff who facilitate the implementation and lab component of the certification. Educators are highly affected by IBCs as these staff will need to be trained and certified to deliver these certifications, and then provide training and guidance to students when teaching the certification material. Educators can provide feedback on IBCs, and although may have slightly more influence than...
students, will still have minimal overall influence as these staff are not the primary consumers of IBCs.

**Higher Education Institutions:** This includes universities and colleges that provide the IBC as part of their course units but do not have the authority to award the certification upon completion of the unit. Certification is awarded by the industry partner offering the certification. These institutions are moderately affected by IBCs, with the demand for IBCs having some effect on student demand and whether an institution’s course and unit offerings address industry and professional expectations. Like educators, at an institutional level, feedback can also be provided, particularly through partnership arrangements, but otherwise these institutions have minimal influence over the IBC.

**Employers:** Employers include commercial organizations, government agencies, and departments that require IT and ICT professionals with real-world skills and knowledge facilitated by the certification. As noted above, this includes (and not limited to) Financial Services, Insurance, Healthcare & Life Sciences, Communications Service Providers, Government, Manufacturing, High-Tech organizations, and others. Employers are moderately affected by IBCs, with these certifications providing a mechanism to verify employee knowledge and skills. The availability of associated training courses and educational offerings in this area provide opportunities for employers to upskill their employees or to obtain new employees with the necessary skills. Employer demand for industry-certified professionals drives uptake of IBCs, thereby providing employers with a moderate degree of influence.

**Certification Provider:** This is the organization that provides the materials and the credentials required by the certification. This generally includes theory-based content to support the IBC, training materials including practical labs and the technical platform to run practical labs, and certification exam material. The organization is also responsible for managing and authenticating the credentials awarded, either through their own platform or through a third-party credential service such as Credly. The certification provider naturally is highly affected by changes to the IBC as these will necessitate corresponding changes to the materials, platforms, and certification exams. Similarly, the certification provider has high influence on the IBC as this organization is the source of those materials and the credential itself.

**Exam Facilitator:** This includes the organization(s) that provide the invigilated exam environments for conducting the exams outside of the Higher Education institution, for example Pearson VUE. These organizations are less affected by the IBC than others, as the exam facilitators are only involved at the certification exam stage to provide the appropriate environment, whether online or in-person, for the exam to be undertaken. They also have a low level of influence, being able to influence the style and nature of the certification exam through provision of platforms or environments, but otherwise not having influence into the overall content of the IBC.

The industry-based certification ecosystem is illustrated in Figure 2. The benefits and challenges are discussed in the next section.
III. BENEFITS AND CHALLENGES

In this section, we will discuss the general benefits and challenges of IBC for stakeholders.

**Learners:** For learners, there is no additional or reduced costs for the certification. The certification cost is waived for learners once they complete the unit that is embedded with the certification content. It’s an opportunity for learners to gain a certification that is industry-recognized and complements university education. They are more marketable to future employers and have an increased chance of employability. Learners can acquire transferable skills and knowledge, across other organizations, and possibly countries where such skills are in demand. Learners are provided with an authentic learning experience using development tools and platforms that are used by industry which will jump-start their career. The challenges faced by learners are the prerequisite knowledge of modelling notations used in vendor-specific certifications. The relevance of a certification on a vendor-specific tool may vary subject to vendor change in learners’ current/future employer organization. The knowledge and skills developed using a specific certification may not be transferable to other competing toolsets within the same domain. The certification content may not be placed in an ideal place within the structure of their academic program, e.g., they may not realize the benefit of doing the additional work relating to the certification at the time, and when they do want to sit the certification (in the future) their knowledge may no longer be current due to certification upgrades.

**Educators:** For educators, IBC provides an opportunity for professional development and certification in the flow of work and within their workload. The employer covers the cost of the training and certification, and educators get an opportunity to upgrade skills. By embedding the certification content in the unit, educators can ascribe quality to the teaching resources and continuance of the demanding program. The challenges faced by the educators are a lack of experience with the vendor-specific tool, additional workload including material training, training for managing and running the lab environment, managing issues with students’ access, troubleshooting issues with little or no on-site technical support. Other challenges include retraining and upskilling required on a regular basis to remain current with the IBC and platform updates, additional teaching requirements based on the lack of standard terms used within a particular certification and across the domain and non-alignment of the certification content with the theoretical underpinnings of the course and the unit learning objectives.

**Employers:** For employers, they can source graduates who are trained to work with systems implemented in their IT environment. This reduces the costs of employee training and seamless
integration into the workforce with less lead time. Thus, employers can build an agile workforce that can integrate well into digital workplaces. The challenge for employers is the need to ‘untrain’ certain language concepts from students if the organization is using a different toolset other than what the learners have mastered in their academic program.

**Higher Education Institutions**: For institutions, IBC provides a better reputation as they support more employment-ready graduates, offer units that are aligned with industry requirements and standards and show better responsiveness to industry demands, particularly government organizations. The certifications also provide an avenue to establish academia-industry collaboration, that may provide opportunities for Work-Integrated Learning (WIL) for students, for example, internships with employers using the IBC. The challenges faced by higher education institutions are promoting the uptake of the certification exam as often students lack incentive to pursue the certification after the completion of unit in which the IBC is embedded, additional costs in paying for the training/certification of lecturers/tutors and risk of staff with IBC using these certifications to find other employment opportunities.

**Certification Providers**: With more individuals trained in the toolset, they are more likely to have that toolset recommended for deployment in industry by those individuals. The increase in the number of trained individuals in their toolset improves the availability of trained consultants, who could be provided to potential clients. The challenges faced by certification providers are the need to balance ‘fully paid’ certification students with university-based certifications and the need to work with the universities to ensure that the ‘correct’ version of the certification is being taught. This is because, certification learnings tend to evolve fast in-line with toolsets, while university courses can stay relatively static for several years.

**Exam facilitators**: IBC generates additional revenue by students completing certifications. On the other hand, exam facilitators may not be set up to support large numbers of students in their test centres for large units.

**IV. CASE STUDY**

Curriculum is a learning program within a formal setting [Scott, 2001]. Curriculum theory has four dimensions, Objective, Content, Method, and Evaluation. Objective is about the selection of content. The certification content was selected since the unit in which the content was taught included workflow modelling, and automation of business processes. Content is the subject matter to be taught. The subject matter included the tools to design, and develop processes management systems, and reengineer and automate processes. Method is the how, the pedagogy, the mode of delivery of the content. The content delivery was scheduled in two stages: first by introducing theory on business process management and second through self-paced learning followed by a practical implementation of theoretical concepts taught in lectures. Evaluation is the act of judging the individuals’ learning. This was done by implementing an already documented business process, which helped to test students’ knowledge. The students were able to develop communication, analysis, inquiry, and problem-solving skills while working independently and in a team with professionalism and social responsibility.

To understand the implications (benefits and challenges) of IBCs, we follow the taxonomy of values where the concept of value has been defined into three types: social, functional, and emotional [Sweeney and Soutar, 2001]. Social value refers to the influence generated by others at the workplace. For example, learners who completed the industry-based certification were given an opportunity by the certification provider to publish their credentials on a profile page. This professional acknowledgement by the certification provider will motivate learners to participate and contribute in Low-Code development forums. Contributing to the Low-Code development forums could generate social value (e.g., building professional networks and relationships) for learners. On the other hand, participation and contribution to the Low-Code development forums could lead to professional acknowledgment from other members in the community. This could generate emotional value (i.e., feelings experienced by learners) for learners. The functional value refers to the utility experienced by stakeholders because of completing a task. For example, educators can use the Low-Code development tools that they have taught in the unit for their research. Thus, completing a task efficiently and accurately at the workplace results in functional value for the stakeholders. Thus, based on the above discussion, we adopt the dimensions of Curriculum Theory and Value framework in this study.
To further investigate the benefits and challenges of IBC, we present a case study at a mid-sized university in Australia, where students from the School of Information Technology and Systems had the opportunity to engage in IBC. Particularly, this was for a Business Architect (BA) certification administered by one of the global software development companies to implement a tool that automates the implementation of code through the modelling of business processes. Over 200 plus roles are available on the LinkedIn job market on a single search day in July 2023 for the BA role so it is high in demand.

The Global software company has offices in Australia, Singapore, Thailand, Hong Kong, India, Japan, New Zealand, South America, Europe, and North America. It is used and trusted as everyday technology by some of the world’s leading companies such as HP, ING, PayPal, FedEx, Cisco, NAB, Optus, HSBC, Vodafone, and in federal government departments such as Services Australia, Department of Defense, Department of Home Affairs, and some Queensland Government departments. The technology used by the company delivers workflow automation and AI powered decisions making using a ‘Low-Code’ platform. The company has a university program which works with tertiary institutions to offer their curriculum at a university level. They supply the materials, the exercise system and provide training.

The certification training was incorporated into the requirements of one of the school’s units, offered both to undergraduate as well as postgraduate students. This unit is required in the Bachelor of Business Informatics, Master of Business Informatics in Project Management, and Master of Information Technology and Systems in Project Management. The unit is also available as an elective unit for other courses and specializations, such as the Bachelor of Information Technology and Bachelor of Software Engineering. The certification material was embedded with the unit and was delivered as part of the content and requirements of completing the unit. Academic staff involved in the unit had to undergo 1 week Business Architect training prior to the commencement of the unit. There was no requirement for the students to undertake the certification exam. Students were required to cover the topics of the certification in the form of self-study and had to cover the theoretical component in their own time as the 2-hours lecture was dedicated to covering the material from the University required unit in parallel with their self-paced learning. The unit convenor and lecturer created short videos to assist students with the allocated readings for Low-Code development. The practical labs commenced in the second half of the semester, with the assumption that all students had completed the required reading in the first half of the semester, again, in the form of self-paced learning. The labs were 1-hour in duration and were administered by trained and/or certified tutors. An assessment item was designed to test the students’ knowledge of the implementation environment, based on an already documented business process. This was an individual assessment and had a 30% weighting, to be submitted in the final teaching week of the semester. In the next section, we present the following reflections on the benefits and challenges of Business Architect Certification experience in Semester 1 (Feb-May), 2023.

Stakeholder benefits within the case study: The university and the learners are based within a region where there is a significant presence of Government agencies. The global software company is actively marketing their products into the Government agencies, creating opportunities for learners to use the certification as a recognized skillset that is actively being used and sought after within the Government agencies. As the certification is delivered as part of a required unit, and the university and the global software company are supporting the process, no additional costs are imposed upon the learner for an industry certification that is in demand.

In 2020, one of the Workplace Learning Trends placed the taught certification and tools within the top 10 for their skills of the future [Udemy Business, 2020]. In 2021, the Business Architect certification provided by this case study was ranked 30th in relation to salaries provided by industry for this skillset [Certification Magazine, 2021]. In 2022, Gartner [2022] predicted Low-Code application platforms would grow 25% within the Low-Code development market, growing the need for learners with these skillsets. The global software company provides a website that allows learners to share their learnings and certification status via career portals, allowing for them to be recognized and seek out work for the skillsets they have developed.

Stakeholders gained social and functional value through the network that was established during the unit organization and delivery, the certification provider, HEI and educators, were able to build relationships that allowed the improvement of each of their programs, and learners benefited through the additional curriculum, and availability of the certification and introduction
to employers through the HEI and industry events. Emotional value was realized through the successful delivery of the unit for educators, and for those learners that were able to complete the certification and successfully gain employment in their chosen industry.

**Stakeholder challenges within the case study:** The addition of certification requirements on top of the requirements for a university unit is an overhead that many students find challenging to complete, leading to negative sentiment towards the certification, or disconnecting from the certification component of the unit entirely. Much of the certification requirements for the unit structure were provided as additional self-paced learning for the tool, that had been aligned to the theoretical components of the unit, e.g., Topic A is taught in class, self-paced tool learning is provided by the certification unit material, and then tutorial exercises that apply the topic within the tool are conducted. This additional self-paced material was often seen as overwhelming by the students due to the amount required to be completed in each topic, the difference in language between the certification material and the theory, and the difference in modelling practice compared to the standard taught within the unit.

The placement of the unit within the program, during the case study, the unit with the implementation of the certification, was delivered as a 2nd year unit within a 3-year degree. Anecdotally, many learners questioned the certifications value to them, as they did not have a sense of what their career intentions were, and just wanted to complete their university program. However, when offered in 3rd year/final year, then many students have already made decisions about what sorts of jobs they want to do and will already have applied for jobs, so the exposure to and completion of the certification may be ‘too late’ to influence their decision.

Educators received up-to-date training in the new Low-Code application development platform and was able to work with other educators to find best-practice methods to facilitate the learning of these topics and toolsets, improving their professional and education skills and received the certification at no personal cost. Educators delivered the unit in one semester each year, while the Low-Code development platform and certification process continually evolved, requiring the educators to refresh and relearn content each time the unit was to be run. Educators were expected to learn and support administration tools to support the certification education environment run externally by the company. This overhead was challenging as the support for these tools was offered in different time zones used by Australian universities.

The Higher Education Institution (HEI) and the training/certification record systems had no integration, this has meant that the HEI cannot determine how many students actively pursued and completed the certification. This has made it difficult to determine the value of the certification to the learners from a HEI perspective, and if the investment and engagement with the Company is valuable to the program. Industry and Industry Employers that are engaged with HEIs, actively working with them to influence the type of outcomes expected from specific higher education programs for their current and future staff, can ask for programs to deliver specific knowledge, skills, and tools. For a HEI to be able to provide specific in-demand certification programs that support industry requirements, can strengthen industry/university ties leading to benefits for both groups. This can lead to employers seeking out graduates from specific HEIs and to support their current staff to attend the HEI to receive those skills on top of higher education degrees.

Educator emotional and functional value was impacted by the complexity of integrating some of the materials into the unit. Learners emotional value was impacted by the volume of additional work that was required to complete the certification over and above what was required for the unit. Social value of the certification provider was impacted by some of the learners being discouraged by the unit implementation and complaining that it was the certification providers fault that their degree program was complex beyond their expectations for a unit.

**V. RECOMMENDATIONS**

Based on the case study discussed in the previous section, we make the following recommendations that could be adopted by stakeholders to drive strategic decision-making. First, The Industry-based certification discussed in the case study can address the human resource challenges faced especially in the Government to Citizens (G2C) services. Second, it can address the needs of future workplaces, especially in Low-Code development platforms which is a disruptive technology in the design and development of systems. Third, higher
education institutions will benefit in terms of graduate employability by providing industry-based capstone projects in Low-Code development to final year students in the graduate and undergraduate programs. Four, educators researching in digital transformation can use the Low-Code development tools that they teach in their research, industry-based consultancy projects or collaboration across universities. Five, educators must work closely with certification providers to constructively align tutorials with the theory taught in lectures by inviting industry speakers who have successfully implemented Low-Code applications. Six, educators must design curriculum by considering the objective, content, method, and evaluation dimensions of the Curriculum Theory to address the unit learning objectives. Seven, the unit objective must be application-agnostic to meet the current and future needs of Low-Code development. Eight, the implementation of an analytics program in the unit will provide insights on the skills developed by students in problem solving, critical thinking, and teamwork that plays a critical role in graduate employability. Nine, the language used within the theory aspects of the unit, and the language used by the certification providers need to be aligned within the unit, to allow understanding of the theory within the practical.

VI. CONCLUSION

The objective of this opinion paper was to understand the opportunities and challenges stakeholders face through the lens of Curriculum Theory to determine that Industry-based certification is a recognized way of learning IT skills in a Higher Education institution. For this, stakeholders were analyzed using a rainbow diagram and the implications to all stakeholders were analyzed using the Value Framework. From a theoretical perspective, this study contributes by examining the dimensions of Curriculum Theory and Value Framework in the Industry-based certification ecosystem. The case study discussed in this opinion paper provides practitioners with nine recommendations to improve the adoption of Low-Code development in Business Informatics curriculum.

VII. REFERENCES


Computer personnel research: The global information technology workforce, pp. 95-100.


Abstract:
The adoption of blended learning in educational institutions has been driven by the growth of educational technology applications and evolving student learning preferences. While prior research highlights the positive impact of blended learning on student outcomes, its effects on student experience and the effectiveness of specific components (student-teacher, student-student, and student-material interactions) remain unclear. In two conjoint experiments, we assessed student and teacher preferences for diverse course configurations with blended learning elements. We show that the introduction of blended learning has a positive effect on the educational experience of students and teachers, yet the effect is non-linear. We test the heterogeneity of these effects across different course, student, and teacher characteristics. Finally, we provide qualitative insights on student and teacher evaluations of blended learning. Based on our findings, we offer recommendations for implementing blended learning, taking into account student learning preferences and teacher workload.

Keywords: blended learning, education, digitization, conjoint study.

I. INTRODUCTION

The rapid advancement of digital technologies has led educational institutions to undergo a digital transformation, integrating digital elements into their curricula [Leidner and Jarvenpaa, 1995; Nguyen et al., 2021]. Such a digital transformation has been reinforced by a new student generation of digital natives who have grown up immersed in digital technologies [Dondi et al., 2022; Henderson et al., 2015]. The digital transformation in education has led to the emergence and increasing adoption of technology-mediated learning, an environment where students interact with their peers, their teachers, and the learning materials through the use of information technologies [Alavi and Leidner, 2001; Vlachopoulos et al., 2023]. Technology-mediated learning has led to significant changes to (a) the way educational institutions operate, (b) the teaching methods employed by educators, and (c) the ways in which students access and interact with learning materials and instructors [Alavi and Leidner, 2001; Pinho et al., 2020]. Current research has contributed to the understanding of how technology can facilitate and transform the teaching and learning process, with a focus on technological and pedagogical aspects that can improve student experience and performance [Ng'ambi, 2013].

Despite the proliferation of digital technologies in education, the adoption of technology by educational institutions has historically been met with hesitance due to the complexity of the transformation process [Aditya et al., 2021; Fraillon et al., 2014]. Recognizing this need, the European Digital Education Action Plan 2021-2027 was developed to promote the establishment of a digital education ecosystem across the European Union [European Union, 2021]. COVID-19 further accelerated the integration of technology into education [Schleicher, 2020], with recent figures highlighting a broad adoption of digital learning tools [Bryant et al., 2020; Nguyen et al., 2021]. A wide variety of digital learning technologies are introduced, such as virtual learning environments, digital teaching tools, student response systems, and digital assessment tools [Lacka et al., 2021].
Technology plays a crucial role in supporting and transforming education, blending traditional and IT-based learning activities for an enhanced experience [Pucciarelli and Kaplan, 2016; Leidner and Jarvenpaa, 1995; Söllner et al., 2018]. The digital transformation in education has paved the way for the implementation of blended learning approaches, which combine traditional face-to-face instruction with technology-mediated learning to enhance the educational experience [Garrison and Kanuka, 2004; Graham, 2006]. Blended learning methods, such as flipping the classroom or use of digital learning tools in physical teaching, were suggested as the next educational innovation frontier since the early 2000s [Driscoll, 2002]. Previous evidence suggests that the adoption of blended learning in education shifts the focus from a teacher-centered to a learner-centered approach, enhancing students' learning experiences and increasing interactions [Bouilhères et al., 2020; Lacka et al., 2021]. As a result, studies showed an increase in student performance and in student engagement with learning materials, peers, and teachers [Albert and Beatty, 2014; Bouilhères et al., 2020].

Previous research has mainly focused on the effects of incorporating blended learning on student learning and engagement [Bulman and Fairlie, 2016], yet there is limited understanding of what is the impact of specific blended learning components on the overall experience and preferences of students. If blended learning increases learning but students do not adopt it, its potential value cannot be realized. At the same time, there is limited focus on how teachers assess this educational perspective. Some studies suggested that teachers would prefer blended learning due to its potential for increasing student autonomy and enhancing interaction [Bouilhères et al., 2020; Staker and Horn, 2012]. Yet, blended learning may be treated with skepticism due to the increased workload, technical issues, and challenges in maintaining student engagement [Garrison and Vaughan, 2008].

This paper aims at bridging this gap and examine the impact of specific blended learning elements on the overall experience of students and teachers. In collaboration with a major European business school, we conducted two conjoint experiments, where we asked students and teachers to evaluate various configurations of a course (varying in the extent of blended learning integration) in terms of preference, learning motivation, concentration, enjoyment, and expected workload. The research design allowed us to measure the utility derived from different levels of blended learning for students and teachers, to identify an optimal way to integrate blended learning. We show that blended learning has a positive impact on student and teacher outcomes, yet the introduction of multiple elements in tandem may backfire. We leverage qualitative insights on the advantages and disadvantages of using technology in education, to better understand the reasons for the non-linear effects.

This study contributes to education and information systems research in several ways. First, this is the first study studying the introduction of specific blended learning elements in education and compares their relative effectiveness. Second, it complements student experience with insights from teachers, a stakeholder often neglected from most studies in education and technology adoption research (Garone et al., 2022). Finally, it expands the understanding of the blended learning experience of both students and teachers by combining a conjoint experiment with qualitative insights on the value of technology in education. The practical relevance of this paper benefits stakeholders in management education (a) by providing insights into students’ and teachers’ blended learning preferences and (b) by presenting valuable results for teachers who aim to optimize students’ learning experience by restructuring their courses.

II. LITERATURE REVIEW

Technology-mediated and blended learning

Due to the rapid technological advances, educational institutions are going through a process of continuous digital transformation by implementing digital tools [Leidner and Jarvenpaa, 1995; Nguyen et al., 2021]. This trend is facilitated by the increasing internet adoption and proliferation of mobile devices in schools [Belo et al., 2016; Ciriolo et al., 2021]. Educational institutions have adopted technology-mediated learning (TML), an environment where students interact with their peers, their teachers, and the learning materials by blending traditional face-to-face education with the support of online information technologies and digital tools [Alavi and Leidner, 2001; Bower, 2019]. TML on education has the potential to support the flexibility and accessibility of students, and the personalization of their learning experiences [Henrie et al.,
2015; Piccoli et al., 2001] and improve learning outcomes, student engagement, and satisfaction [Sharma et al., 2022; Wu et al., 2010].

Blended learning constitutes a significant subset within the realm of TML. Blended learning methods combine educational activities taking place face-to-face or online, and synchronous or asynchronous [Garrison and Kanuka, 2004; Graham 2006]. Blended learning methods aim at improving students' learning experience by increasing their course interactions [Bouilheres et al., 2020]. Research on integrating technology into education and applying blended learning methods emphasizes the importance of educators' knowledge of technology, pedagogy, and course content [Bizami et al., 2023]. Accordingly, the Technology, Pedagogy, and Content Knowledge (TPACK) framework highlights the interactions between these knowledge domains, arguing that blended learning can be optimized at their intersection, where educators can effectively utilize appropriate technologies and pedagogical techniques to enhance students' learning experiences [Koehler and Mishra, 2006].

From a pedagogical perspective, blended learning is an approach that combines various educational activities, such as face-to-face and online interactions, with the aim of improving students' learning experiences and outcomes [Staker and Horn, 2012]. The face-to-face activities take place at a physical location and are supervised by an educational professional. They consist mainly of traditional instruction methods (e.g., lecture) but can also be enriched using various technologies (e.g., digital whiteboard). Online activities in blended learning can be accessed through electronic devices [Staker and Horn, 2012], are typically integrated with the offered face-to-face activities and are predominantly asynchronous. From a technological perspective, blended learning is facilitated by the introduction of various technological tools into educational programs. Laurillard [2013] presents a framework that shows different types of learning methods which can be supported using technology. The learning methods framework can be categorized into three main types of interaction: teacher-student, student-student, and student-content [Laurillard, 2013; Thurmond and Wambach, 2004]. Teacher-student interaction involves acquisition (transfer of content via offline or online lectures) and practice (course activities involving students, e.g., student response systems like Mentimeter). Student-student interaction is facilitated through discussion (discussion forums and peer feedback) and collaboration (creation of shared product using, e.g., Miro). Student-content interaction consists of investigation (students researching topics using various sources) and production of a product (e.g., exam, presentation). By incorporating these learning methods, blended learning can create interactive and engaging educational experiences.

**Student learning experience**

To properly assess the effectiveness of educational interventions, we should consider the learning outcome and the learning experience of students. Learning outcome is the extent to which the student has acquired the intended learning goal; how much the student absorbs the contents of a course [Alavi and Leidner, 2001]. Previous research showed that blended learning can contribute to enhanced academic performance as students participating in blended learning activities achieved higher grades compared to their peers in traditional classroom settings [Garrison and Kanuka, 2004]. Learning experience refers to the perceptions of students regarding the overall learning process, as well as their assessment of the different components of a course. Understand how students assess their learning experience is essential, as neglecting it may lead to higher dropout rates and reduced engagement of students. As the current generation of students grew surrounded by digital technologies such as mobile phones and social media platforms [Prensky, 2001], they are comfortable using technology to access large amounts of information quickly and efficiently. Their familiarity with rapid information streams has shaped their preferences for interactivity [McGuinness & Vlachopoulos, 2019]. Blended learning allows teachers to increase the interaction between students, teachers, and content [Boelens et al., 2018], catering to these student preferences. Overall, introducing blended learning elements into a course positively impacts the learning motivation, concentration, and enjoyment of students [Ndibalema, 2021; Thurmond and Wambach, 2004], leading to better perceived learning outcomes [Gomez et al., 2010]. Consequently, the attractiveness of the learning experience from a student perspective is enhanced. Moreover, incorporating technology in course programs better prepares students for the 21st-century job market [Dondi et al., 2022].
Yet, it is essential to consider potential limitations of blended learning. Previous evidence suggested issues of technological problems, lack of technical support, and poor infrastructure that can impede student learning in blended environments [Tarafdar et al., 2015]. Further, the excessive use of technology in blended learning can lead to technostress, negatively affecting students’ mental well-being and learning performance [Al-Fraihat et al., 2020]. Finally, the individual pace and remote nature of some of the blended learning activities may lead to reduced self-discipline and course engagement [Shivetts, 2011] as well as feelings of social isolation [Thurmond and Wambach, 2004].

Therefore, the integration of blended learning is not a one-size-fits-all endeavour. In line with the array of blended learning elements available, it is important to understand which and how many of these elements to integrate to ensure a positive overall experience of students. Accordingly, a limitation of the existing literature is the narrow focus on the presence or absence of a single blended learning element, rather than a configuration of various blended learning elements [Garrison and Kanuka, 2004]. This may not fully capture the complexity of blended learning environments or provide a comprehensive understanding of which specific elements are most effective.

Teacher experience

To appropriately evaluate the value of any educational intervention, it is essential to understand how all involved stakeholders evaluate and approach it. Therefore, understanding teacher preferences in blended learning is equally important since teachers play a crucial role in designing, implementing, and facilitating effective learning experiences. Considering a teacher perspective allows educational institutions to provide appropriate training, resources, and support to help blended learning integration in courses. Finally, it is essential to get teachers engaged and comfortable with blended learning, as that could lead to the development of engaging and personalized learning experiences for the students, which in turn may lead to better learning outcomes.

Blended learning has received mixed reactions from educators in higher education. Proponents of blended learning emphasize its potential for increasing student autonomy, offering diverse learning opportunities, and enhancing interaction between students and instructors [Staker and Horn, 2012]. However, some teachers express their concerns about increased workload, technical issues, and challenges in maintaining student engagement [Garrison and Vaughan, 2008]. Teacher workload emerges as a critical issue in the context of blended learning. The incorporation of digital resources, monitoring of online discussions, and providing timely feedback in virtual spaces can significantly increase the demands on instructors’ time and energy. Yet, research suggests that, over time, blended learning can contribute to a more efficient use of teachers’ time and a reduction in their workload (Le & Pham, 2021; Picciano, 2009). This efficiency is achieved through the reusability and adaptability of digital resources, streamlined communication channels, and the potential for asynchronous interactions that allow both students and teachers to engage at their own pace (Staker & Horn, 2012). Furthermore, blended learning models can foster increased collaboration and resource sharing among instructors, further reducing individual workload [Graham, 2006]. For blended learning to be implemented successfully, it is crucial to understand what may be bottlenecks in the adoption of blended learning and which elements may contribute largely to the teacher preferences and their overall experience. Such a perspective has been largely neglected in previous studies.

III. STUDY 1: INVESTIGATING STUDENT PREFERENCES

We conducted a rating-based conjoint experiment with students in a major European business school. Conjoint analysis provides valuable insights into user preferences and has a large history in marketing research [Green and Srinivasan, 1990], yet has been recently adopted by educational studies (Sinha et al. 2021). This method involves presenting respondents with various hypothetical scenarios or products, each characterized by a unique combination of attributes [Louviere et al., 2000]. Conjoint analysis is particularly relevant for education as it can determine the relative importance students attach to particular course (or university program) attributes and the utilities they attach to certain levels of these attributes. Respondents rate each product on a predetermined scale, and the resulting data is used to estimate partworth utilities, which represent the contribution of each attribute level to overall preference. By
analyzing partworth utilities, researchers determine the relative importance of attributes and understand trade-offs individuals make between them.

In the context of blended learning, the primary focus of this study was on courses. Therefore, we asked students to evaluate multiple configurations of an elective course offered in terms of intention to choose, learning motivation, concentration, and enjoyment. A course can be characterized by the various activities that are offered to the students. We described the courses based on three actionable attributes; activities that involve a teacher (teacher-student interaction), the guided interaction between students (student-student interaction), and the form of assessment (student-content interaction) [Laurillard, 2013]. For each attribute, three levels were introduced. The low level displayed the most traditional form of the attributes and functions as a benchmark (no blended learning). The medium level added one blended learning element, and the high level added two blended learning elements. The chosen attributes and their corresponding levels are presented in Appendix 1.

We used an orthogonal design to reduce the full factorial design of $3^*3^*3$ (27 conditions) to 9 conditions. Orthogonal designs allowed us to select a subset of conditions that ensures each attribute is statistically independent of the others, reducing multicollinearity and allowing for an efficient estimation of part-worth utilities, and at the same time reducing respondent fatigue and maintaining data quality without compromising the study’s ability to uncover meaningful insights into preference structures [Louviere et al., 2000].

The study procedure was as follows (Figure 1). First, students were randomly allocated to either a hard skill course on data analytics, or a soft skill course on digital strategy [Laker and Powell 2011]. In a hypothetical scenario, participants were choosing an elective course for their studies during the following semester. They were shown 9 alternative courses, each on a separate page (teaching staff, time schedules, reading material were similar). Every participant saw the same 9 courses (chosen based on the orthogonal design) in a random order. Participants evaluated each course in terms of their learning motivation, concentration, enjoyment, perceived learning outcome, and the likelihood that they would choose that course for the next semester (in 7-point Likert scale). Next, participants were asked to answer two open text questions regarding the advantages and the disadvantages of the use of technology in education.

242 students participated for a chance of winning a gift card. The demographic information of student participants was in line with the student population of the business school. An overview of the descriptive statistics can be found in Table 1.

![Figure 1: Study Procedure](image)

We first conducted a conjoint analysis to calculate the partworth utilities for each level of each attribute and the attributes’ relative importance. Partworths are measuring the utility a level of each respective attribute provides to an individual’s overall evaluation of utility (overall value). The utility estimates are interpreted within each attribute: the level with the highest utility estimate yields the highest value for the participants included in the sample, all other things being equal. The relative importance measures how important each attribute is when assessing a course and allows for the identification of the weight of each attribute. We first focus on the likelihood of students to choose the course. We find that the medium levels have been awarded the highest relative utility estimates within each attribute (student-teacher, student-student, and student-content interactions). Interestingly, the introduction of multiple elements of blended learning reduces the value the course offers to students. Such a non-linear effect of blended learning suggests that too many components have the potential to backfire, and students may defer from such courses. Further we find that the choice of a course with blended learning elements is largely driven by the student assessment (42.1%). Similarly, blended learning...
increases the expected motivation, concentration, enjoyment and expected learning of students, yet the high levels of all course attributes (where multiple blended learning elements are introduced) result in suboptimal evaluations. Student assessment drives the assessment of course motivation, enjoyment, and expected learning, whereas student teacher interactions drive the course concentration. The overview of partworth utilities and relative importance weights can be found in Figure 2.

Table 1: Descriptive Statistics Study 1 and Study 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Study 1: Students</th>
<th>Study 2: Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Student Level (N=242)</td>
<td>Teacher Level (N=29)</td>
</tr>
<tr>
<td>Age</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td></td>
<td>21.79</td>
<td>2.11</td>
</tr>
<tr>
<td>Female</td>
<td>0.49</td>
<td>0.50</td>
</tr>
<tr>
<td>Education level (MSc)</td>
<td>0.53</td>
<td>0.50</td>
</tr>
<tr>
<td>Soft Course Preference</td>
<td>4.76</td>
<td>1.68</td>
</tr>
<tr>
<td>Hard Course Preference</td>
<td>4.86</td>
<td>1.53</td>
</tr>
<tr>
<td>Course motivation</td>
<td>4.51</td>
<td>1.63</td>
</tr>
<tr>
<td>Course concentration</td>
<td>4.61</td>
<td>1.61</td>
</tr>
<tr>
<td>Course workload</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Course enjoyment</td>
<td>4.43</td>
<td>1.62</td>
</tr>
<tr>
<td>Course learning</td>
<td>5.06</td>
<td>1.38</td>
</tr>
<tr>
<td>Course choice</td>
<td>4.26</td>
<td>1.76</td>
</tr>
</tbody>
</table>

We further employed a panel data analysis at a course level allowing us to account for any unobserved individual-specific effects that may vary across participants and offering increased modelling flexibility. The results of both random effects and fixed effects models qualitatively...
resemble the insights from the conjoint analysis, where the integration of blended learning element is beneficial for all educational outcomes, yet a high number of elements is not necessarily appreciated by students (Table 2). The results are robust when we control for the order in which each course appeared for each participant. Further, we found no interaction effects between the attributes of the courses, suggesting the independence of the different attributes. We found no difference across the course types, or demographic characteristics of students. Finally, to efficiently account for the error correlation across the multiple models of the different educational outcomes and get more accurate and efficient parameter estimates, we employed a seemingly unrelated regressions (SUR) model. The results are robust.

<table>
<thead>
<tr>
<th>A. Partworth Utilities</th>
<th>Intention to Choose</th>
<th>Course Motivation</th>
<th>Course Concentration</th>
<th>Course Enjoyment</th>
<th>Expected Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0.01</td>
<td>0.05</td>
<td>0.03</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Med</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>High</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Relative Importance Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>MED</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>HIGH</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>MED</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

NOTES: Teacher: teacher-student interaction / Student: student-student interaction / Assessment: student-content interaction / Utilities are scaled to sum to 0 within each attribute. Hence, we do not test whether the mean utilities are significantly different from 0.

Figure 2: Conjoint Analysis Study 1

Table 2: Panel Data Analysis (Study 1)

<table>
<thead>
<tr>
<th>DV:</th>
<th>Intention to Choose</th>
<th>Concentration</th>
<th>Enjoyment</th>
<th>Expected Learning</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher MED</td>
<td>0.190** (0.078)</td>
<td>0.234*** (0.070)</td>
<td>0.233*** (0.071)</td>
<td>0.136** (0.058)</td>
<td>0.241*** (0.069)</td>
</tr>
<tr>
<td>Teacher HIGH</td>
<td>-0.052 (0.078)</td>
<td>-0.208*** (0.070)</td>
<td>-0.114 (0.071)</td>
<td>-0.063 (0.058)</td>
<td>-0.196*** (0.069)</td>
</tr>
<tr>
<td>Student MED</td>
<td>0.321*** (0.078)</td>
<td>0.278*** (0.070)</td>
<td>0.376*** (0.071)</td>
<td>0.229*** (0.058)</td>
<td>0.355*** (0.069)</td>
</tr>
</tbody>
</table>

1 Results are not reported due to length restrictions. They can become available upon request.
Finally, we analyzed the student responses regarding the advantages and disadvantages of blended learning using Latent Dirichlet Allocation (LDA), a natural language processing technique for probabilistic topic modelling [Blei et al., 2003]. Regarding the advantages, topic modelling identified two topics: (a) flexibility and independence of learning, and (b) efficient and fast paced learning. These topics reflect the fact that the use of technology in education allows students to study in their own pace and more efficiently. Regarding the disadvantages, the identified topics revolved around: (a) lack of motivation and attention, and (b) increased effort and distraction. Both topics reflect the potential decrease of the human contact element in blended learning. We present the methodology and some illustrative quotes from the received answers for each identified topic in Appendix 2.

IV. STUDY 2: INVESTIGATING TEACHER PREFERENCES

We replicated the research design of Study 1, adapting the instructions to a teacher perspective. Teachers were assigned a course, based on the type of courses that they teach. In a hypothetical scenario, they were currently designing a new course for the next academic year. The teachers were asked to assess the same nine courses as in Study 1, based on their teaching motivation, teaching enjoyment, perceived workload, perceived learning outcomes of students, and the likelihood that they would choose the course structure for their new course. 29 teachers from the same major European business school as in Study 1 participated. An overview of the descriptive statistics can be found in Table 2. We followed the same analysis strategy as in Study 1.

<table>
<thead>
<tr>
<th>A. Partworth Utilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention to Choose</td>
</tr>
</tbody>
</table>

NOTE: Teacher: teacher-student interaction / Student: student-student interaction / Assessment: student-content interaction; Standard errors in parentheses ** p < 0.05, *** p < 0.01 / Random Effects models are presented as recommended by Hausman test / Nobs=2178 / Ngroup = 242
First, we conducted a conjoint analysis on the likelihood of teachers to choose a specific course configuration for their next course. We found that the medium levels received the highest relative utility estimates for student-teacher and student-student interactions, whereas the inclusion of multiple blended learning elements was preferred by teachers. All attributes had a comparable weight in the choice of teachers. The results for teaching enjoyment, motivation and expected student learning were robust. Whereas for teacher-student interactions, teachers were less motivated and eager to integrate multiple blended learning elements, for the remaining attributes the inclusion of blended learning elements had a positive effect on a course assessment. Interestingly, the relative importance weights varied across the outputs. For teaching enjoyment, teacher responses were strongly driven by student-teacher interactions, whereas for the expected learning of students, the form of assessment had a substantially larger weight. The results regarding the teacher workload provided some very interesting insights. Teachers expected no difference in workload regarding the student-teacher interactions, whereas for the interaction between students and the assessment, teachers expected an increasing workload with each increase in the implementation of blended learning elements in a course.

We enriched the analyses leveraging the panel data structure of the teacher responses. The results of both random effects and fixed effects models were qualitatively in line with the insights from the conjoint analysis (Table 3). For activities involving teacher to student interaction, the inclusion of multiple blended learning elements had a negative effect and was less preferred. Regarding the student-student interaction, adding multiple blended learning elements had an inferior positive effect compared to no interaction at all. Finally, the inclusion of multiple elements in the assessment increased the utility of a course, signalling the preference of teachers to spread the assessment components to capture different levels of learning. The results for the teaching enjoyment and motivation, as well as the expected student learning indicated comparable effects. For teacher-student interactions, whereas introducing one blended learning element marginally improved the course assessment, introducing multiple blended learning elements had a detrimental effect on how teachers assess the course. However, for student-student interactions and assessment form, the inclusion of more blended learning elements increased the teachers’ assessments. Finally, we found that the inclusion of blended learning elements increased the expected workload of teachers for student-student interaction and the assessment. This was in line with the normative expectation regarding the effort needed to set up such processes within a course as these require an effort investment in advance. The results were robust when we controlled for the course order. Further, we found no interaction effects between the attributes of the courses, across the course types, or across demographic characteristics of teachers. Finally, to efficiently account for the error correlation across the multiple models of the different educational outcomes and get more accurate and
efficient parameter estimates, we employed a seemingly unrelated regressions (SUR) model. The results were robust.\(^2\)

Table 3: Panel Data Analysis (Study 2)

<table>
<thead>
<tr>
<th>DV:</th>
<th>Intention to Choose</th>
<th>Expected Workload</th>
<th>Teaching Enjoyment</th>
<th>Expected (student) Learning</th>
<th>Teaching Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher MED</td>
<td>0.046 (0.211)</td>
<td>0.011 (0.178)</td>
<td>-0.011 (0.164)</td>
<td>0.069 (0.159)</td>
<td>0.046 (0.165)</td>
</tr>
<tr>
<td>Teacher HIGH</td>
<td>-0.471** (0.211)</td>
<td>0.023 (0.178)</td>
<td>-0.782*** (0.164)</td>
<td>-0.322** (0.159)</td>
<td>-0.506*** (0.165)</td>
</tr>
<tr>
<td>Student MED</td>
<td>0.736*** (0.211)</td>
<td>0.356** (0.178)</td>
<td>0.517*** (0.164)</td>
<td>0.874*** (0.159)</td>
<td>0.437*** (0.165)</td>
</tr>
<tr>
<td>Student HIGH</td>
<td>0.494** (0.211)</td>
<td>0.713*** (0.178)</td>
<td>0.414** (0.164)</td>
<td>0.805*** (0.159)</td>
<td>0.207 (0.165)</td>
</tr>
<tr>
<td>Assessment MED</td>
<td>0.494** (0.211)</td>
<td>0.701*** (0.178)</td>
<td>0.253 (0.164)</td>
<td>0.678*** (0.159)</td>
<td>0.310* (0.165)</td>
</tr>
<tr>
<td>Assessment HIGH</td>
<td>0.770*** (0.211)</td>
<td>1.057*** (0.178)</td>
<td>0.540*** (0.164)</td>
<td>1.034*** (0.159)</td>
<td>0.437*** (0.165)</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.824*** (0.306)</td>
<td>3.805*** (0.254)</td>
<td>4.230*** (0.237)</td>
<td>3.536*** (0.235)</td>
<td>4.295*** (0.252)</td>
</tr>
<tr>
<td>R(^2)</td>
<td>0.08</td>
<td>0.12</td>
<td>0.11</td>
<td>0.17</td>
<td>0.06</td>
</tr>
</tbody>
</table>

NOTE: Teacher: teacher-student interaction / Student: student-student interaction / Assessment: student-content interaction; Standard errors in parentheses ** p < 0.05, *** p < 0.01 / Random Effects models are presented as recommended by Hausman test / N\(_{dc}\) = 261 / N\(_{group}\) = 29

Next, we analyzed the teacher responses regarding the advantages and disadvantages of blended learning using LDA [Blei et al., 2003]. Regarding the advantages, topic modelling

\(^2\) Results are not reported due to length restrictions. They can become available upon request.
identified two topics for teachers: (a) teaching support and (b) efficiency. These topics reflect how the use of technology may facilitate teachers through increased interactions and efficient usage of digital resources. Regarding the disadvantages, the identified topics revolved around: (a) lack of human interaction, and (b) increased workload. Both topics reflect concerns over the increased workload of blended learning and the lack of student engagement the remote nature of blended learning brings. We present the analysis in Appendix 2.

V. DISCUSSION

The digital transformation in education has facilitated the adoption of blended learning, an educational practice which combines traditional face-to-face instruction with technology-mediated learning [Graham 2006]. Previous research showcased the potential of blended learning in improving students' engagement and learning outcomes [Garrison and Kanuka, 2004], yet it lacked focus on specific elements of blended learning and how these impact the overall student experience. Yet, teachers have been largely neglected from blended learning studies. This paper bridges the existing gap by exploring the influence of specific blended learning components on the comprehensive experiences of both students and teachers. In two experiments with students and teachers from a major European school, we analyzed preferences for various levels of blended learning across three attributes: teacher-student interaction, student-student interaction, and student-content interaction.

In study 1, we found that students positively value the inclusion of blended learning elements in a course. In that respect, they expect to be more concentrated, and motivated to follow such a course, and they report a high expected enjoyment. Further we find that the expected value of a course is largely driven by the way students are assessed rather than the expected interactions with teaching stuff or peers. Remarkably, we show that the effect of the introduction of blended learning components in a course on different measures of students' learning experience is not linear. We suggest that there is an optimal level beyond which the benefits of blended learning may diminish or even become detrimental to the overall learning experience. The study highlights the importance of examining the overall student experience, rather than focusing solely on academic outcomes (e.g., grades) when considering the integration of blended learning. By assessing aspects such as learning motivation, concentration, enjoyment, and perceived learning, we provide a comprehensive overview of the impact of blended learning on students [Ndibalema, 2021]. Such an approach enables educators and institutions to make more informed decisions when implementing blended learning, ensuring that the approach not only supports academic achievement but also fosters a positive and engaging learning environment for students.

In study 2, we conducted a follow up experiment with teachers at the same business school. We found that that while implementing blended learning elements increases their workload, teachers generally prefer blended learning to traditional education, demonstrating a willingness to experiment with blended learning elements. Teacher preferences for blended learning elements offer interesting insights in terms of workload, teaching motivation, and enjoyment. Teachers tend to prefer traditional methods due to the potential time and effort required to integrate technology into their educational programs [Prensky, 2001; Chulkov, 2017; Gupta et al., 2020]. In conclusion, teachers are open to adopting blended learning methods, recognizing their potential benefits for student outcomes. However, concerns about workload and the challenges of implementing new technologies remain. Addressing these concerns and providing support for teachers can help facilitate the successful integration of blended learning elements into educational programs.

From an educational institution perspective, it is important to consider both students and teachers, as the main actors in the educational experience. To optimize higher education from a student perspective, educational institutions should focus on striking a balance, using technology to support the frequency and personalization of face-to-face interactions without replacing them entirely. This finding suggests that an optimal balance between traditional and technology-enhanced learning methods can lead to a more effective and engaging educational experience for students. In that respect, it is essential to approach blended learning as a complex system with multiple elements instead of a one size fits all endeavour. Similarly, educational institutions should consider teacher preferences as well as the expected workload from the implementation of blended learning. The insights from the two studies allow us to match the preferences of both groups to provide recommendations for an optimal configuration.
of blended learning implementation. We plotted the student and teacher preferences for all combinations of attribute levels in a course. We find that the course configuration that maximize the utility of both groups is a course which combines face-to-face lectures with student response system (e.g., Mentimeter), supported Q&A sessions, online discussion forum for voluntary interaction between students, and spreads the assessment form across traditional exam, weekly quizzes, and student presentation (Figure 4a). A comparable recommendation can be given when looking at student utility in contrast to the expected teacher workload (Figure 4b).

This research has several implications for the existing IS and educational literature on blended learning. First, this is the first study which examines the introduction of specific blended learning elements in higher education and compares their relative effectiveness. Previous studies focused on the introduction of blended learning in a uniform way, without focusing on the type of elements to be implemented. Moreover, whereas most studies focus on the impact of blended learning on academic performance, we analyze its impact on a multitude of outcomes which all shape different perspective of the overall learning experience from a course. Second, we incorporate insights from teachers, frequently overlooked in education and technology adoption research. Finally, we enrich our comprehension of the blended learning experience with the use of qualitative insights from participants. The managerial relevance of the study is twofold. First, it provides value for educational institutions by offering insights into students’ and teachers’ blended learning preferences and suggestions for enhancing knowledge exchange. Second, it presents valuable findings for instructors seeking to optimize the learning experience by reorganizing curricula or specific courses. We stress out the need to provide teachers with comprehensive training, resources, and ongoing support.

The study has some limitations which offer great potential for further research. First, the findings could be generalized by drawing from a long list of blended learning elements available for teachers. Moreover, we operationalized the levels of blended learning in an additive way, so that a high level of e.g., student-teacher interaction is including one extra component of blended learning in top of the medium level. Future research could explore the trade-off between quantity (how many) and quality (which ones) of blended learning elements to identify an optimal way of integrating it in a course. Second, the conjoint analyses rely on self-reported data from students and teachers, which may not accurately reflect actual behavior or rational decision-making. Future research could examine changes in behavior and learning through field experiments. Third, future research can replicate these studies across different faculties (e.g., technical universities) or different countries (study culture may vary across countries). Exploring these research directions will contribute to a more comprehensive understanding of the optimal implementation of blended learning in various educational settings. In conclusion, the study demonstrates that blended learning can effectively enhance various aspects of the learning experience when implemented in a balanced manner, considering the type of interaction and the specific needs and preferences of students and teaching faculty. As in most cases of technology adoption, there should be careful steps in integrating it to balance the advantages with the potential negative implication for the users.
VI. REFERENCES


APPENDIX I. ATTRIBUTES AND LEVELS OF BLENDED LEARNING

For teacher-student interaction, a low level consists of a traditional (non-blended) form of interaction (face-to-face lectures and Q&A sessions). A medium level introduces the use of a student response system (SRS; e.g., Mentimeter) [Majuri et al., 2018]. A high level adds a flipped classroom approach, by enabling students to watch pre-recorded video lectures and discuss the materials in detail during Q&A sessions with the use of an SRS. Student-student interaction can still occur in the classroom, but not explicitly structured via course activities. Yet, digital tools provide teachers with opportunities for a structured student – student interaction, e.g., via a discussion board [Balaji and Chakrabarti, 2010]. The low level entails no teacher guidance. The medium level includes an online discussion board with voluntary participation. The high level contains an online discussion board with a mandatory participation. Regarding the assessment, the low level consists of an offline exam, accounting for 100% of the final grade. The medium level introduces weekly online quizzes [Gholami and Moghaddam, 2013] and the high level a video presentation.

Table A1. Attributes and levels of blended learning

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Level of blended learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Activities involving teachers</td>
<td>1. Low: Face-to-face lectures and Q&amp;A sessions</td>
</tr>
<tr>
<td></td>
<td>2. Medium: Face-to-face lectures and Q&amp;A sessions with a student response system (e.g., Mentimeter)</td>
</tr>
<tr>
<td></td>
<td>3. High: Pre-recorded video lectures and face-to-face Q&amp;A sessions with a student response system (e.g., Mentimeter)</td>
</tr>
<tr>
<td>2. Guided interaction between students</td>
<td>1. Low: No structured interaction between students</td>
</tr>
<tr>
<td></td>
<td>2. Medium: Online discussion forum for voluntary interaction between students</td>
</tr>
<tr>
<td></td>
<td>3. High: Online discussion forum for mandatory, supervised interaction between students</td>
</tr>
<tr>
<td>3. Form of assessment</td>
<td>1. Low: Traditional exam (100%)</td>
</tr>
<tr>
<td></td>
<td>2. Medium: Traditional exam (60%) and weekly quizzes (40%)</td>
</tr>
<tr>
<td></td>
<td>3. High: Traditional exam (40%), weekly quizzes (30%), and video presentation (30%)</td>
</tr>
</tbody>
</table>

APPENDIX 2. ADVANTAGES & DISADVANTAGES OF BLENDED LEARNING

Participants were asked two open text questions regarding their opinion on the advantages and the disadvantages of the use of technology in education. To compute and categorize the topics raised by participants, we use Latent Dirichlet Allocation (LDA), a natural language processing technique for probabilistic topic modelling [Blei et al., 2003]. LDA assumes that each document is a mixture of topics generated from a Dirichlet distribution. In our context, a document is a participant answer to the open text questions. We preprocessed the text of each answer by tokenization and removing the stop words (e.g., “a”, “the”, “of”, “and”) as they provide limited semantic value. Next, to determine the optimal number of topics, we calculated the coherence and perplexity scores of the LDA model for a range of 2 to 15 topics. Based on the trade-off between coherence and perplexity scores, we selected the model with 2 topics for analysis. To confirm the meaningfulness of each topic and assign a topic label, we examined the top words of each topic.

First, we conducted the analysis using student responses (Study 1). Regarding the advantages, the two identified topics concentrate around: (a) flexibility and independence of learning, and (b) efficient and fast paced learning. These two topics reflect the fact that the use of technology in education allows students to study in their own pace and more efficiently. We followed the same procedure to identify the disadvantages of blended learning. The respective identified topics revolve around: (a) lack of motivation and attention, and (b) increased effort and
distraction. Both topics reflect the potential decrease of the human contact element in blended learning. Table A2 presents illustrative quotes from the received answers for each identified topic.

Second, we conducted the analysis using teacher responses (Study 2). Regarding the advantages, topic modelling identified two topics for teachers: (a) teaching support and (b) teaching efficiency. The topics reflect how the use of technology in education facilitates teachers, specially through the streamlined communication, asynchronous interactions, and the reuse and adaptation of digital resources [Picciano, 2009]. Regarding the disadvantages, the identified topics are: (a) lack of human interaction, and (b) increased workload. Both topics mirror concerns expressed by teaching faculty over workload, technical issues, and challenges in maintaining student engagement [Garrison and Vaughan, 2008]. Table A3 presents illustrative quotes for each identified topic.

Table A2. Advantages and disadvantages of blended learning (quotes from students)

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topic #1: Learning flexibility / independence</strong></td>
<td><strong>Topic #1: lack of motivation and attention</strong></td>
</tr>
</tbody>
</table>
| ● "Flexibility in terms of student participation and time management, combined with additional possibilities for course material demonstration and learning." | ● "The attention span is decreased, as you have no control of keeping people’s attention if they are seated behind a screen."
| ● “…freedom and independence for students, possibilities to combine studies with other activities more easily” | ● “Less interaction is not motivating students to keep up with their work.”
| ● "Creates a distance between students and teachers. Less able to ask specific questions during lectures.” | ● “Creates a distance between students and teachers. Less able to ask specific questions during lectures.”

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topic #2: efficient and fast paced learning</strong></td>
<td><strong>Topic #2: increased effort and distraction</strong></td>
</tr>
</tbody>
</table>
| ● "It is a faster way to communicate with other students. For me technology makes it easier to study also." | ● "Sometimes technology can be hard to grasp, and while a student may understand the subject matter, he or she may not be able to convey that understanding because of a lack of technological skills.”
| ● “…connect with the younger generation. The lack of technology in a degree would seem "old fashioned" and less appealing.” | ● “Sometimes it might be distracting in the form of getting taught via a laptop and on that laptop there are different things to do rather than studying.”

Table A3. Advantages and disadvantages of blended learning (quotes from teachers)

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topic #1: Teaching support</strong></td>
<td><strong>Topic #1: Lack of human interaction</strong></td>
</tr>
</tbody>
</table>
| ● "reduces workload, or gives opportunities for interaction that would have not been present otherwise, facilitates assessment” | ● “Lack of direct human communication”
| | ● “Anonymity and absenting.”
| | ● “Hard to make it professional, no interaction.”
<table>
<thead>
<tr>
<th>Topic #2: Teaching efficiency</th>
<th>Topic #2: Increased workload</th>
</tr>
</thead>
</table>
| "support teaching; stimulate and activate students…it makes grading super simple" | "Often additional work to set things up, students might have trouble using the technology."
| "Repeated access to the study materials, flexibility of time and location" | "It takes more planning and setup time than traditional methods. There are so many tools available, I often feel that I am not always using the right tool for the job I need to be done."
| "Enable self-learning, make it fun, complement face-to-face sessions" | |
| "…allows for interesting explanatory media to be used, allows for the delivery of a well structured content" | |


METAVERSE IN EDUCATION: A DYNAMIC CAPABILITY THEORY APPROACH

Juan Diego Roman Arbelaez
School of Computer Science
University of Technology Sydney, Australia
JuanDiego.RomanArbelaez-1@student.uts.edu.au

Jayan Chirayath Kurian
School of Computer Science
University of Technology Sydney, Australia
JayanChirayathKurian@uts.edu.au

Ghassan Beydoun
School of Computer Science
University of Technology Sydney, Australia
Ghassan.Beydoun@uts.edu.au

ABSTRACT:
The rapid evolution of technology has marked a new era of possibilities including the emergence of the Metaverse, which represents a technological disruption. This research in progress study delves into the Metaverse implementation within the educational sector through a thematic analysis of existing literature in Information Systems to identify key themes related to benefits, challenges, and values that the Metaverse can offer. In this study, the Dynamic Capability Theory serves as a theoretical framework, emphasizing the importance of adapting to a changing environment. Results reveal that the main theme, Metaverse in education, is supported by the subthemes Metaverse for educators, Metaverse for learners and Metaverse for regulators. In addition, social, functional, and emotional values of the Metaverse are discussed. As the Metaverse continues to evolve, a collaborative effort among educators, learners, and regulators is clearly needed to ensure its inclusive and enriching integration into the education sector, preparing the new generations for the future.

Keywords: Metaverse, Benefits, Challenges, Value creation, Educators, Learners, Regulators.

I. INTRODUCTION
The technology industry is rapidly advancing, offering remarkable solutions that greatly benefit our daily lives [Lacity et al., 2023]. It is estimated that by 2027, over 40% of large organizations will have a presence in Metaverse-based projects that will have a significant impact on their revenues [Resnick et al., 2022]. JP Morgan in the financial industry and OneRare in the global food industry notably have also established a presence in Metaverse for their business. Adapting to new related technologies and introducing them can be challenging [Lacity et al., 2023]. In particular, the Metaverse is considered a combinatorial innovation since it is not a single technology [Resnick et al., 2022]. It has been considered to offer very high interpretative flexibility [Dolata and Schwabe, 2023]. Hence various contradictions or incompatible visions are proposed by different researchers and actors [Dolata and Schwabe, 2023]. It is likely that an adaptive process will be necessary to examine its benefits and address concomitant challenges. This only will ensure that the Metaverse is developed in a way that benefits society at large.

According to Lacity et al. [2023], the evolution of the Metaverse is not easy to define since there is not a universally accepted definition of the term. Some define the minimal requirement of a Metaverse as a virtual world that a user can visit with an avatar. Others define it as a futuristic three-dimensional and immersive digital universe that seamlessly connects users to any virtual world. The launch of Second Life and World of Warcraft in the early 2000s popularized the idea of virtual worlds, and since then, the technology has continued to evolve [Lacity et al., 2023]. The Metaverse is seen as the next step in this evolution, bringing together different virtual worlds and creating a more seamless and immersive experience. The concept of the Metaverse has also evolved to include augmented reality (AR) as a key feature, which was not part of the
original definition of virtual worlds. The concept of the Metaverse has evolved over time as technology has advanced and new features have been added making its presence in customer service, brand influence, training, games, events, meetings, sales, retail, and trading [Resnick et al., 2022].

Nah et al. [2022] highlight that the possibilities are endless once we have sufficient resources to implement the metaverse on a large scale. This includes the use of virtual agents to automate the delivery of teaching content and facilitate students’ access to information in an educational context. Mixed Reality, a technology theme in metaverse was used by John et al. [2022] to understand its benefits and challenges to students’ learning experience. It was found that interactivity, immersion, and presence are the benefits, whereas difficulty using the device, accessibility issues, and the lack of flexibility are the challenges. There are multiple perspectives through which we can examine the metaverse. We will focus on the implementation of the metaverse in the educational sector. Given its distinct nature, adapting to this technology can be challenging for many individuals. However, our analysis will delve into the benefits and difficulties that stakeholders must address to maximize the advantages that come from this technology. Hence, the aim of this study is to examine the metaverse implementation within the education sector through a thematic analysis of existing literature in Information Systems to identify the key themes related to benefits, challenges, and value the Metaverse offers to its stakeholders. But first, we discuss related work on the Metaverse in the next section.

II. RELATED WORK

The Metaverse is a concept that started in fiction movies but that has now become a reality and a growing trend in the last few years. Despite the popularity of the term “Metaverse”, there is not a unified concept of what it means, resulting in various interpretations by internet giants [Wang and Medvegy, 2022]. Some of the big companies (e.g., Meta and Microsoft) are making changes to become the market leaders in this area [Peukert et al., 2022]. Meta has transformed its entire company image into a Metaverse oriented business, while Microsoft has acquired Activision to incorporate the latter’s interactive imaging technologies into its vision of the next generation internet. However, the term has come to be used as an encompassing term for all the various multi-user virtual environments that currently exist [Lu et al., 2022]. One of the ways to understand Metaverse is to examine its benefits, challenges, and value to its stakeholders.

The Metaverse has the potential to bring significant benefits to education, but at the same time there are numerous challenges for learners, educators, and regulators that need to be addressed during the transition to these platforms [Sultanow et al., 2022; Lu, 2022; Wang and Medvegy, 2022; Narin, 2021]. Through digital campuses, Metaverse can provide learners with a holistic campus experience in addition to virtual training and simulation [Sultanow et al., 2022]. According to Wang and Medvegy [2022], one of the key potential applications of the Metaverse is education and training. A content analysis of the articles published in Metaverse discusses how Metaverse can be used to design a learning process, and its application in engineering, mathematics, and sports [Narin, 2021]. Furthermore, the government can further support learning in remote areas through the virtual reality technology theme of the Metaverse [Lu et al., 2022].

Several researchers have identified the benefits that the government can gain from implementing the Metaverse. Some of these benefits include education and training by simulating different learning scenarios that can help prepare students or new employees [Lu et al., 2022]. Another benefit is healthcare accessibility by providing healthcare services remotely with Augmented Reality (AR) [Mystakidis, 2022]. Additionally, social connection by creating virtual scenarios where users can interact and form social bonds without leaving their homes [Sultanow et al., 2022]; and urban planning, which can benefit greatly from the Metaverse by creating simulated scenarios for smart constructions and city development [Wang and Medvegy, 2022].

Metaverse offers numerous benefits, but many challenges must first be overcome, especially if the government wants to get involved with these platforms. The most common challenges identified by researchers include privacy and security of the user, as there is a significant increase in the amount of data exposure when accessing these platforms [Lu et al., 2022]. Addiction is also a big concern, as many users may spend more time in the virtual world,
Diego Roman Arbelaez, Kurian & Beydoun

Metaverse in Education through Dynamic Capability Theory

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avoiding their responsibilities in the real world [Schobel and Tingelhoff, 2023]. Disinformation may also increase tremendously, as many individuals will generate content without having reliable sources, leading to false information for those immersed in the Metaverse [Peukert et al., 2022]. Furthermore, the digital divide may increase. Not all people will be able to afford the expected increase in the price of the technology. This can exclude people from low socio-economic background from new opportunities that the Metaverse can provide [Mystakidis, 2022].

We review some of the ideas to address those key challenges (addiction, privacy and security issues, digital divide, and disinformation) [Bao and Shou, 2022, Lu et al., 2022]. According to Better Health Channel (2023) [Digital Strategy and Services Unit in the Victorian Government’s Department of Health], one of the best treatments for addiction is based on cognitive behavioral therapy, which involves changing patterns of thinking and beliefs. Virtual reality-based applications have been found to be useful in cognitive behavioral therapy [Wu et al., 2021]. Furthermore, the virtual reality (VR) device that users use to enter the Metaverse can provide feedback on how much time they have been online and suggest taking breaks. This could help the users realize the amount of time they have spent in the virtual world. Moving on to the issue of disinformation, this is one of the most challenging problems to tackle as fake news are constantly being generated and influencing people [Bao, 2022]. However, if the government finds a way to regulate the information generated and distributed, the Metaverse can become a ubiquitous channel to inform users and keep them updated.

Digital divide in the Metaverse ecosystem can arise due to the high price of VR headsets, limited internet access, and other factors. As mentioned by Lu et al. [2022] governments in Australia have started working to ensure connectivity in all areas of the country. However, they will need to continue their efforts to make VR technology accessible to everyone, so that all users can enjoy the benefits that the Metaverse can offer and mitigate digital vision in communities. Lastly, privacy and security issues should be addressed to prevent users from overexposing their personal information. If the government handles this correctly by implementing Metaverse safeguards, then Metaverse can become a safe space for people of all ages and backgrounds. The opportunities and challenges of the Metaverse discussed in this section indicate that it is an emerging technology that has the potential to impact many areas of our society. The stakeholders will adopt new technologies based on the perception of value and hence in the next section we discuss value generated by the Metaverse.

The first step to create value with this technology is identifying all existing challenges that are obstructing the materialization of Metaverse opportunities [Schöbel and Tingelhoff, 2023]. Additionally, it helps individuals and organizations to make informed decisions on how to take advantage of its potential benefits and mitigate potential risks. According to Schöbel and Tingelhoff [2023], to bring the Metaverse to life and create value, users need to perceive them as useful. Value can be determined by individuals by their perception of how useful are, the inputs and outputs generated by the Metaverse ecosystem. Sweeney and Soutar [2001] classify value in three dimensions: emotional, functional, and social. Emotional value describes feelings and individual experiences (e.g., enjoyment), social value describes individuals’ self-concept (e.g., building relationships) and functional value describes performance and quality (e.g., completing a task) [Schöbel and Tingelhoff, 2023]. Once the benefits and challenges are identified, we will use the value framework to discuss emotional, functional, and social value to stakeholders in the Metaverse ecosystem.

In conclusion, there are many benefits and challenges for users of the Metaverse, but to have a smooth transition there are many challenges to overcome to make sure no one is left behind. Currently, many governments, including the New South Wales Government in Australia [Lu et al., 2022], are analyzing ways to bring the Metaverse to education, medicine, construction, economics, and many other fields. There have been numerous studies conducted on Metaverses; however, none of them comprehensively consolidate the value to stakeholders in an education context. There are many ways of evaluating value to stakeholders; however, based on the findings made by Lu et al. [2022] while studying different Metaverse applications and Schöbel and Tingelhoff [2023] by interviewing metaverse experts, using qualitative research is the best approach for answering the following research question. Hence the research question that this study aims to address is:
(1) What are the overarching themes of Metaverse in Education from an Information Systems perspective?

To address the above research question, we use a thematic analysis [Maguire and Delahunt, 2017] of existing literature in Information Systems to identify the key themes related to Metaverse in an education context. We adopt the Dynamic Capability Theory [Teece, 2018] as a theoretical framework for this study based on its capability to embrace internal and external competencies in response to a rapidly changing environment. The Dynamic Capability Theory and research method are discussed next.

III. DYNAMIC CAPABILITY THEORY

The dynamic capability theory is a theoretical perspective in the study of strategic management that has gained popularity in Information Technology due to its high relevance in contemporary business [Mikalef et al., 2021]. According to Teece [2018], the framework explains how firms can adapt to a changing environment and sustain competitive advantage over time. It suggests that a firm’s ability to build, integrate, and reconfigure internal and external resources is critical for its success. Dynamic capabilities of an organization include sensing (harnessing outside opportunities), seizing (generating value from those opportunities) and transforming (continuous improvement). The Metaverse will revolutionize many industries and companies including education that quickly adapt to the new business models it offers [Lacity et al., 2023; Teece, 2018]. Schools and universities need to learn how students can gain better experiences and acquire more knowledge through the opportunities that the Metaverse will present. Digital Capability Theory is suitable for this study since the benefits, challenges and values offered by Metaverse could indeed be examined in terms of harnessing, seizing, and continuous improvement. In the next section, we discuss the research method.

IV. RESEARCH METHOD

Qualitative research is a suitable approach to understand concepts and generate thorough insights about a phenomenon that is not fully understood [Neuman, 2014]. After careful consideration of the various types of analysis and methodologies, it was determined that a qualitative research approach would be the most suitable for this project since the aim of this study is to identify overarching themes in Metaverse found in an education context from an Information Systems perspective. Among the various methods available, thematic analysis was selected to collect and process the data, following the six-step process outlined by Maguire and Delahunt [2017]. The steps to collect, analyze and generate themes are discussed next.

Data collection: To gather relevant literature on the Metaverse, we conducted searches for the term 'Metaverse' in the Association for Information Systems (AIS) eLibrary and identified articles published within the last three years. We limited the search to three years since Metaverse is a relatively new technology and has gained significant attention from academics in recent years. Our primary data collection was from the AIS eLibrary (April-May 2023) followed by the Journal of MIS, Decision Support Systems, European Journal of Information Systems, Information and Management, Information Organization, Information Systems Journal, Information Systems Research, Journal of Information Technology, Journal of Strategic Information Systems, and MIS Quarterly (September-November 2023).

All the information for this study was gathered from secondary data and hence there was no direct interaction with individuals or institutions for data collection. We employed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method, which yielded 193 articles in our initial search for the term 'Metaverse.' After reviewing the titles, abstracts, and keywords, for the term “Metaverse”, we determined that only 37 of these articles were relevant to our research. However, when we narrowed our focus to the last 3 years, we found that only 33 articles were suitable for inclusion in this study. After a thorough examination of each article content with respect to the definition and discussion of the Metaverse, we identified 22 articles as relevant from an Information Systems perspective. In addition, relevant articles cited in these 22 articles were carefully examined which resulted in the adoption of the Value framework in this study. In addition, a recent industry-based publication from the NSW government [Lu et al., 2022] was also considered to assess the future impact of Metaverse.
The PRISMA method is illustrated below in Figure 1 and the data analysis steps are discussed next.

**Figure 1: Selection of articles using PRISMA**

**Data analysis**: We followed the six-steps process of Thematic Analysis outlined by Maguire and Delahun [2017], which consist of:

**Step 1**: Become familiar with the data – In this step researchers read and re-read the data to gain a general understanding of the data. Researchers took notes, highlighted important sections, and noted down initial thoughts. A shared google drive was used to store the selected articles mentioned in the previous section. Access was provided to both researchers and a summary of the relevant articles were prepared.

**Step 2**: Generate initial codes - In this step, researchers began examining the articles based on benefits and challenges of the Metaverse in education.

**Step 3**: Search for themes - Researchers searched for connections between codes to identify potential themes which are overarching ideas that emerge from the data. The main theme found was “Metaverse dimension in education”.
Step 4: Review themes - Researchers reviewed and refined the identified theme. This was substantiated by asking if the main theme was relevant to the research question and if enough evidence was found to support it.

Step 5: Define themes - Once researchers finalized the main theme, they discussed subthemes with respect to the dimension of Metaverse in education. This involved creating a clear and concise description of each subtheme. Thus, the main theme i.e., Metaverse dimension in education was supported by the sub themes i.e., Metaverse for educators, Metaverse for learners and Metaverse for regulators.

Step 6: Write-up - This involved writing up the analysis in a clear and concise manner. In the next section we discuss the results of thematic analysis.

V. RESULTS

Our examination of data revealed key insights into the potential advantages and hurdles associated with the Metaverse implementation in education. Main benefits in the education sector are its potential in simulating diverse learning scenarios. This can enhance education and training by providing immersive, experience-based learning opportunities for students and employees. The Metaverse can thus be used to prepare individuals for real-world situations in a safe and controlled environment, leading to effective learning. Thus, Metaverse plays a significant role for educators and learners. Due to significant large data collected, the main challenges the Metaverse has are the privacy and security concerns. Users are exposed to potential data breaches and privacy violations when accessing these platforms. Safeguarding user’s data and ensuring secure interactions within the Metaverse will be essential for its successful integration in education. Additionally, accessibility to the Metaverse remains a concern, as not everyone can afford the necessary technology. This can lead to inequalities. Governments and regulators in the education ecosystem must work together to close this gap, ensuring that all students have access to opportunities presented by the Metaverse. Educators and regulators play a huge role in mitigating the challenges ensuring students can have a safe and ideal environment to enhance their learning process. Thus, regulators play a significant role in the implementation of Metaverse. In conclusion, the main theme – Metaverse dimension in education is supported by three subthemes which are Metaverse for educators, Metaverse for learners and Metaverse for regulators. The Metaverse ecosystem in education is illustrated below in Figure 2 and discussed in the next section.
Metaverse for educators: Triantoro and Jackson [2022] state that educators will need to adapt to the new digital environment and develop new competences to provide adequate training for students. Strategies to upskill and reskill includes, branching scenario training, and role play serious games, which require educators to develop new skills and competencies to design and deliver effective training. Contreras et al. [2022] emphasizes that the Metaverse will allow for the personalization of content for each student, making it easier for teachers to monitor and evaluate their progress. It will also allow the integration of virtual environments in which students and teachers can interact as they would in a face-to-face classroom. The main concern is the loss of contact between the student and the teacher, as well as the potential negative effects on culture and relationships in the real world [Contreras et al., 2022]. Additionally, educators must find a way to regulate behaviors inside the Metaverse to prevent harassment and inappropriate attitudes between learners [Schöbel and Tingleshoff, 2023].

Rinn et al. [2023] emphasizes the importance of course design which must consider the unique features of the virtual world when courses are offered through this technology. Simultaneously, educators must facilitate learner interaction, as the absence of real-world interaction can be a potential drawback of implementing this technology in the education sector. Furthermore, Gleich et al. [2023] stress the need for technological literacy among stakeholders in the institutions using the Metaverse. Furthermore, understanding the best way to introduce students to this technology is crucial to prevent learner frustration and enhance content engagement which could lead to a significant improvement in the quality of education and better outcomes for learners.

Metaverse for learners: Rinn et al. [2023], discusses potential application areas of the Metaverse in education, including activities, events, and interaction which could enhance learners’ experiences. Additionally, the immersive and interactive nature of the Metaverse could provide the students with new opportunities to engage with the content and collaborate with their peers through a virtual environment. On the other hand, Triantoro and Jackson [2022] state that these virtual experiences provide learners with opportunities to learn through exploration and decision making in real-time on simulated environments that can enhance their learning experience. Furthermore, the Metaverse offers learners great control over their learning tasks by allowing them to access information from any location and personalize their learning experience. The Metaverse has the potential to transform the traditional learning experience and provide learners with opportunities to develop new competencies and skills (e.g., decision-making in an unfamiliar situation).

Stylianou and Savva [2022] highlight the potential consequences this transformation could have on younger generations, raising concerns about addiction and social isolation. School plays a vital role in creating friendships and developing social skills for children. However, a shift from face-to-face interactions to a virtual environment may prevent the development of these crucial social skills, leading to isolation and adverse outcomes, when these learners face real-world situations. Furthermore, Gumbo et al. [2023] emphasize that virtual worlds introduce the possibility of increased negative social experiences, including harassment. It is essential to educate and make learners aware of these potential experiences to prevent a significant rise in such incidents with the adoption of the Metaverse.

Metaverse for regulators: The use of the Metaverse in education presents several governance challenges. Contreras et al., [2022] states that the great technological advances required for the Metaverse may not be within everyone’s accessibility and not always available to all education institutions, leading to unequal access of educational opportunities to users from diverse background. Additionally, regulators need to ensure the safety and security of students in the Metaverse, as they may be exposed to cyberthreats such as cyberbullying and harassment. Furthermore, the use of these technologies in education may require the development of new policies and regulations to ensure its safety and ethical use, such as protecting learners’ data and privacy. To ensure the proper adoption of Metaverse, regulators must prepare educators with special training and resources that could mitigate the negative impact of this new technology [Contreras et al., 2022]. Additionally, Lin et al., [2022], mentioned that the governance challenges using the Metaverse include the need for community standards of conduct, which could prevent moral problems such as bullying, and insulting each other. Furthermore, due to the larger size of the Metaverse ecosystem, administration costs after adoption will significantly rise when compared to the traditional education system.

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Hunt and Angelopoulos [2023] have pointed out several challenges in the Metaverse, particularly in terms of interoperability, and scalability. Currently, the Metaverse is fragmented, with various platforms and technologies that are not compatible with each other. From a technical perspective, scalability poses a significant issue since the Metaverse is expected to experience rapid growth in the coming years. This growth could present challenges to the underlying infrastructure, including concerns related to bandwidth, storage, and processing power. Additionally, there are security, privacy, legal, and ethical concerns that regulators must address to ensure the safe use of this technology by users.

VI. DISCUSSION OF FINDINGS

The findings in the previous section suggest that the Metaverse has the potential to transform the traditional learning experience and to offer learners new opportunities to develop competencies and skills. The immersive nature of the Metaverse can enable students to engage with education content and collaborate with peers, providing social value through a virtual environment. Additionally, learners can gain greater control over the learning materials, which translates into functional value, and into experience innovative learning opportunities that translate to emotional value, allowing learners to personalize their information access. The Metaverse can thus be used by stakeholders in the education ecosystem to create value and improve the field of education.

It is evident that many challenges arise when using the Metaverse, and we cannot disregard the scope for unintended consequences, which may have serious implications to our society. Triantoro [2022] and Nickerson et al., [2022] have pointed out that the lack of accessibility due to high technology costs can significantly widen socio-economic disparities, resulting in unequal access to Metaverse-based education. These consequences are not limited to younger generations and can affect learners from diverse backgrounds. Additionally, Augenstein and Morschheuser [2022] have noted that while the Metaverse can enhance education in some cases, the level of immersion may vary depending on circumstances. In some context, it may not be as immersive as the real world, particularly during learning activities like driving or those involving physical safety as a concern. To enhance immersion, substantial investments in network infrastructures, software, and hardware are necessary to create the 3D environments required for an improved Metaverse experience in education [Marabelli and Newel, 2023].

From a theoretical standpoint, the Metaverse aligns with the sensing (harnessing opportunities) and seizing (generating value from those opportunities) dimensions of Dynamic Capability Theory. However, given the evolving nature of the technology, this study did not find evidence of its transforming dimension (i.e., continuous improvement). Nevertheless, from a value perspective, the Metaverse undeniably provides social, functional, and emotional value in education. The value dimensions are discussed below.

**Functional value:** The five functional values evident in the analysis are listed as follows:

1. **Personalization of learning:** Educators can create personalized learning experiences tailored to student needs. Learning materials and scenarios can be adapted to different learning styles, allowing students to learn at their own pace.

2. **Data driven insights:** Metaverse can provide educators with insights into student’s performance and behavior. By analyzing user interactions within the virtual environments, educators can identify the areas where the students struggle, allowing them to develop strategies to improve the learning process.

3. **Educators’ professional growth:** Educators can use the Metaverse to enhance their own development, collaborating with peers, attending virtual conferences, and experimenting with new teaching methods that will contribute to developing their teaching skills.

4. **Innovative assessments:** Traditional assessments can be replaced with innovative evaluation methods in the Metaverse. For example, performance assessment in diverse scenarios can offer a more accurate and authentic evaluation of students’ abilities.
5. Cost efficiency: The Metaverse reduces costs associated with physical infrastructure and materials. Instead, educational institutions can invest in virtual resources, which are more affordable for both, educators, and students.

**Social value:** The two social values evident in the analysis are as follows:

1. Immersive learning environments: The Metaverse provides a platform for the development of immersive learning environments. Through Virtual and Augmented reality technologies, students can “step” into virtual classrooms, historical events, or even scientific experiments. This enhances engagement and understanding, making complex topics more understandable.

2. Global collaboration: Classrooms can be borderless, enabling students from around the world to collaborate on different projects while sharing cultural insights, and gain global perspectives. This enhances cultural awareness and prepare students for the globalized workforce.

**Emotional Value:** Emotional value is a key aspect of Metaverse technology. As noted by Marx et al. [2022], one of the remarkable opportunities offered by the Metaverse is location independence. This means that the Metaverse enhances accessibility to education, especially for individuals with disabilities or geographical limitations.

1. Accessible to education: Students unable to attend traditional educational institutions due to health conditions or geographic isolation can access quality education, reducing inequalities in modern societies. They could participate online and share their experiences, gain emotional support from peers which could lead to a sense of accomplishment.

The three aspects of value creation are illustrated below in Figure 3.

![Figure 3: Value Creation](image)

In general, this study identifies the overarching themes of Metaverse found in education from an Information Systems perspective. We also found evidence of the sensing and seizing dimensions of the Dynamic Capability Theory and the social, functional, and emotional dimensions of the Value framework. The practical implications of this study are:

**First,** to harness the full potential of the Metaverse and to mitigate its challenges, it is important to invest in educators’ training to make a smooth transition and ensure a high-quality education.
Second, addressing governance and safety concerns, promoting digital inclusion, and developing regulations and policies are the fundamentals steps that government needs to take for a successful adoption of the Metaverse in education.

Third, improving teacher-student interaction, content personalization, and community engagement should be a priority in the Metaverse implementation strategy.

Fourth, continuous monitoring and evaluation will enable adjustments for optimal outcomes, ensuring that the Metaverse enriches the educational experience and prepares the workforce for the future.

VII. CONCLUSION

In conclusion, the main theme – Metaverse dimension in education is supported by three subthemes which are Metaverse for educators, Metaverse for learners and Metaverse for regulators. The Dynamic Capability Theory and Value framework were used to understand the theoretical aspects of this study. From a theoretical standpoint, the Metaverse aligns with the sensing and seizing dimensions of Dynamic Capability Theory. However, given the evolving nature of the technology, this study did not find evidence of its transforming dimension. From a value perspective, the Metaverse undeniably provides social, functional, and emotional value in education.

The exploration of the Metaverse implementation in the education field shows both, its big potential and the significant challenges ahead that must be addressed. This technological evolution offers immersive and personalized learning experiences, global collaboration, accessibility, data driven insights, innovative assessments, and cost efficiency. On the other hand, it also brings significant challenges to governance, privacy, addiction, disinformation, and accessibility. As the Metaverse continues to develop, its successful integration will require a collaborative effort of educators, learners, and regulators, ensuring that the benefits this brings are widely accessible for everyone. In the future, this study will be extended to gather insights from educators (e.g., academics in tertiary institutions), regulators (e.g., Tertiary Education Quality and Standards Agency) and learners (e.g., students in tertiary institutions) through a semi-structured qualitative interview to understand the value generated for stakeholders in tertiary institutions.

VIII. REFERENCES


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PROGRAMMATIC ASSESSMENT TO UNLOCKING
THE POWER OF SOFT SKILLS THROUGH A
MICROCREDENTIAL LENSE

Adriana Aletta Steyn
University of Pretoria
Riana.steyn@up.ac.za

Sunet Eybers
University of South Africa
Eeyberss@unisa.ac.za

ABSTRACT:
There has been a long-standing imperative to reevaluate conventional teaching approaches, particularly during the COVID-19 pandemic, which exposed the inadequacy of traditional teaching methods and revealed evolving student preferences. While past educational innovations like Massive Open Online Courses (MOOCs) have surfaced, they have yet to exhibit the capacity to facilitate industry-aligned skill development on a scale comparable to what Micro-Credentials (MC) seem to achieve. MCs are progressively gaining widespread recognition as a mechanism for learners to document and substantiate their learning and professional development, serving as tangible proof of their skills. As the demand for enhanced soft skills in the workplace continues to rise, Higher Education Institutions (HEIs) are intensifying their efforts to impart these skills. MCs are recognized as a vital tool for lifelong learning, aligning curricula with the ever-evolving industry requirements for fresh skills, competencies, and innovation in the rapidly adapting Fourth Industrial Revolution (4IR) landscape. Despite this, more research in higher education has been needed to explore the utilization of MCs for teaching and assessing soft skills. This study explores using a programmatic assessment approach incorporating MC into soft skills development. In this study, a cohort of final-year students engaged in various programmatic assessment activities throughout the semester, intending to earn a badge if they scored 70% or higher for the module. An online survey was distributed to gauge student perceptions and experiences of programmatic assessment and micro-credentials. The findings of this study underscore the positive impact on soft skills development within the higher education context through programmatic assessment activities.

Keywords: Badges, micro-credentials, Higher Education, Soft Skills, Teamwork

INTRODUCTION
There has been a longstanding belief that traditional teaching methods warrant re-evaluation (Steyn et al., 2017). Covid taught us that the old way of teaching is no longer how we should teach (Perla et al., 2023) or even what students want to see, and it has changed the government’s views of education (Wheelahan & Moodie, 2021). Employers wish to employ more work-integrated skilled workers (McGreal & Olcott, 2022; Msweli et al., 2022). One emerging avenue to explore that has created a growing interest amongst policymakers in higher education teaching is the phenomenon of Micro-credentials (MC) (Berry & Byrd, 2019; McGreal & Olcott, 2022; Varadarajan et al., 2023; Wheelahan & Moodie, 2021). Despite the value that Micro-credentials could hold for the higher education space, we still need to determine this value (Ashcroft et al., 2021; Ha et al., 2022). McGreal and Olcott (2022) acknowledged the need to rethink the broader credential continuum.

Even though previous education innovations have emerged, such as massive open online courses (MOOCs), MC needs more to ensure industry-aligned skills development on a similar scale as MC is doing (Wheelahan & Moodie, 2021). Thus, this topic must be broadly debated and explored, especially in the context of South African higher education.

The central question with implications examined in this study revolves around the conception of the individual as portrayed in the curriculum. The curriculum focus of this paper is soft skills development, in particular team skills. This paper forms part of a broader
exploratory study looking into adopting Micro-credentials to teach these skills to a group of final-year students at a higher education institute (HEI).

The remainder of the paper is structured as follows: the next section reviews the literature on the soft skills demanded by the industry, after which it will focus on micro-credentials and their application to HEI. The context of this specific study is introduced, followed by the methodology, analysis, and results sections. There is a discussion section, and the paper ends with conclusions and areas for further research.

**Literature review**

The literature review discussion starts with a short evaluation of soft skills in HEI, followed by current literature focusing on micro-credentials.

**Soft Skills**

For a long time, it has been the case that HEI trains more technical skills. However, the changing work environment, the technology revolution called 4IR, and Covid have changed the required skills demanded by the industry (da Silva et al., 2021; Sony & Mekoth, 2022). Soft skills highlighted by various authors are the ability to change and adapt rapidly (Kruger & Steyn, 2020), employee adaptability linked to interpersonal adaptability, problem-solving, and demonstrating cultural adaptability, to name but a few (Sony & Mekoth, 2022). Kovacs and Zaranande (2022) mentioned that COVID has led to a shift in the top in-demand skills and listed "collaboration, and teamwork, digital skills, empathy, autonomy, IT Skills, workload, and stress tolerance." da Silva et al. (2021) noted the required soft skills as "Communication, creativity, flexibility, leadership, motivation, and teamwork." Sony and Mekoth (2022) reported that although the industry requires various interpersonal skills, working in teams and with colleagues is the most substantial skill. This is confirmed by Msweli et al. (2022), stating the necessity of team-building skills as a part of soft skills.

HEI needs to start recognizing this need for soft skills and adapt accordingly. Over the past two decades, HEI has introduced these into its curriculum at various levels (Caeiro-Rodríguez et al., 2021).

As workplace management's demand for improved soft skills increases, HEI has increased the drive to transfer these soft skills. However, assessments of these soft skills are still under the microscope, predominantly character/competence assessments (Msweli et al., 2022). They continue to state that "Micro-credentials have not engaged with other assessment mechanisms for "soft skills" (Msweli et al., 2022). There is also no "common" understanding of how to assess these skills (Caeiro-Rodríguez et al., 2021) and that teaching and considering these skills differ country per country as well as per HEI, and this should be addressed. Caeiro-Rodríguez et al. (2021) investigated various European programs to see how they teach soft skills. What emerged is that most, if not all, of the programs incorporated a problem-based approach implemented through capstone projects. Some institutions also implemented Game-based learning techniques to facilitate these skills transfer (Caeiro-Rodríguez et al., 2021). There were two assessment examples; one focused on Peer evaluation, and the other analyzed the acquisition of these skills based on the Problem-solving model. However, none of these HEI considered exploring MC to increase soft skills. Msweli et al. (2022) noted using Micro-credentials (MC) for lifelong learning. They continued to say that one must adapt the current curriculum to the growing industry's needs for new skills, competencies, and innovation brought on in the rapidly adapting 4IR world. Msweli et al. (2022) continue to say that MC allows for competency-based professional learning pathways, thus ensuring students obtain the necessary skills employers require (Turhan & Akman, 2013). Soft skills can also not be taught passively (Caeiro-Rodríguez et al., 2021), another excellent reason for using MC in this module.
Micro-credentials

To understand MC as a recommended avenue for soft skills enhancements, one needs to gain a deeper understanding of MC. MC is gradually becoming a widely accepted mechanism with which learners (Varadarajan et al., 2023) — both in the professional world and higher education—can create and maintain evidence regarding one's learning and professional development and is shown as evidence (Kilsby & Fountain, 2019). Many observers recognize MC as a mechanism for identifying professional learning outcomes (Selvaratnam & Sankey, 2021; Varadarajan et al., 2023; Wheelahan & Moodie, 2021), thus acknowledging that they focus on the result of the learning process, not the time used for it. Some HEIs, specifically in New Zealand, have started recognizing MC as a credit-bearing qualification ranging from 5 – 40 credits (Varadarajan et al., 2023). But what is an MC), and why must we investigate this new phenomenon in higher education? MC is a well-designed and standardized framework integrated into a traditional application, assisting employees in hiring more easily (Hall-Ellis, 2016). It is also a space to build and create evidence of learning and professional development (Hall-Ellis, 2016). In short, Berry (2016) states that MC recognizes individual knowledge, placing a more significant emphasis on learning rather than "seat time," even talking about granular competencies that can be stacked (Berry, 2016; Pitt et al., 2019; Varadarajan et al., 2023). The best-focused definition clarifying micro-credentials could be that of Berry and Byrd (2019), saying MC is "content-focused and job-embedded, and they incorporate active learning."

MC is like the Continuing Professional Development (CPD) point structure used in many professional industries (Berry, 2016), although they refer to "continuing education units" in the teacher's environment. Micro-credentials are often used interchangeably with digital badges and Massive Online Open Courses (MOOCs) (Varadarajan et al., 2023). Various authors use these terms to understand MC and its impact on the industry (McGreal & Olcott, 2022) (Ashcroft et al., 2021; Borrás-Gené, 2018; Dyjur & Lindstrom, 2017; Ha et al., 2022; Kilsby & Fountain, 2019; Lim et al., 2018; Varadarajan et al., 2023). Some definitions of these interchangeable terms are: MC is a virtual, portable learning and skills acquired granularly (Rimland & Raish, 2019). Credentialing adopts competency-based professional education to recognize a learner's skills and accomplishments (Kilsby & Fountain, 2019). Mini certifications in specific studies or professional development areas will help identify students' skills (Lim et al., 2018). One key benefit of MC is the informal integration into learning (Dyjur & Lindstrom, 2017). Because MC provides valuable details on experience and expertise, MC is transparent (Pitt et al., 2019). It gives a more transparent view of the MC holder's skills and competencies (Berry, 2016). Due to the transparency and the potential to build your learning path, as well as the ability to skill oneself cross-discipline or increased range of skill set (Pitt et al., 2019), seeing it as a more detailed framework for assessing skills and knowledge (Dyjur & Lindstrom, 2017) and making it easier to verify skillset beyond only what one can learn from a higher education degree.

One of the most popular forms of MC is digital badges (Dyjur & Lindstrom, 2017). This clickable graphic contains an online record of achievement and information about the organization or entity that issued the badge (Borrás-Gené, 2018). Digital badges are defined as a representation of an accomplishment that is visual, available online, and contains metadata, including links that help explain the context and result of an activity (Gibson et al., 2013). A digital identity certificate is transferred electronically and verified with 100% accuracy by computers (Brands, 2002). Badges are a person's skills and accomplishments represented electronically via the web (Dyjur & Lindstrom, 2017; Pitt et al., 2019). Badges originate from game-based learning (Hurst, 2015), a tool assisting individuals in building their competencies and skills within and outside a traditional academic setting (Dyjur & Lindstrom, 2017; Hurst, 2015). As badges include certain elements and coding, badges, except for the fun part, also have an element of authority (Hurst, 2015) linked to them. Higher education should decide on Open Badge Interfaces to create and customize badges (Hurst, 2015). However, customization should be cautioned. Thus, one needs to determine how and who can do these customizations. Therefore, addressing the call to investigate the use of MC in Higher education, this study explores badges as part of programmatic assessment in a final year module called Project Management Behavioral Aspects, focusing more on soft than technical skills.

The question that arose, however, was how to assess these skills.
This study focuses on soft skills, designed to enhance students’ soft skills in teamwork, which may need to improve effectiveness when transitioning from the university environment to the professional world (Perla et al., 2023). Thus, this paper explores how programmatic assessment (van der Vleuten et al., 2012) was used, with an outcome of an MC in developing and teaching soft skills within a higher education institute.

Background on the module

This paper focuses on a class of approximately 250 final-year students in the soft skills module. Physical contact sessions were in the form of a two-hour class on a Friday afternoon, presented in a venue allowing only 30% capacity during the COVID period's partial return to campuses. Questions emerging were, "I've got this venue that can accommodate 60 students on a Friday afternoon. Who do I choose?" and then again, "It's soft skills. How do we examine soft skills?" Locating a larger venue meant accommodating more students, but only 150 students, according to the allowed capacity. Splitting the class into two meant that most students could attend one of the sessions, albeit only 50 minutes face-to-face. The challenge was to reduce the content to teach by half. A different approach was needed and management was willing to try alternatives. Following a continuous or programmatic assessment (van der Vleuten et al., 2012) was the obvious choice, with various learning activities introduced throughout the semester, 33 in total. According to the model for programmatic assessment presented by van der Vleuten et al. (2012), there are three activities for the ongoing evaluation: learning activities, assessment activities, and support activities.

Regarding the learning activities, students had to put in considerable effort in pre- and post-activities, staying up to date with the weekly material for the whole semester – failure to complete the pre-activity meant no access to the post-activity. It is important to note that not every activity counted marks but merely opened another activity or assessment. Regarding assessment activities, these activities ranged from quizzes, in-video assessments, wikis, and Flip grid videos to name but a few. In total, 33 activities throughout the semester counted for marks. Students had to complete reflective journals (reflecting on what they learned, so what, and now what) every 3 – 4 weeks, forming part of the support activities. Apart from this, weekly discussion classes took place, discussing the pre-activities and providing guidance on the week's topic. According to van der Vleuten & Schuwirth [29], it is important to scaffold learning for self-directed learning and divide the activities into mini-milestones, where students could obtain mini-badges. Ultimately, a student achieves a badge, a Micro-credential, if their final mark is 70% or higher. Activities for this module counted towards earning a badge, were retained on a Badgr platform, and were integrated through Learning Tools Interoperability (LTI) into the University's Learning Management System (LMS). According to the University of Alabama (2023), "Badgr is a digital badge issuing and tracking platform that awards badges based on achievements earned." Badgr is a cost-free solution that empowers individuals to effortlessly generate, distribute, oversee, and monitor badges for specific achievements accomplished by the recipients (Mallon, 2019). One of the many benefits of using Badgr was that students could link the badge to their LinkedIn profile (a social-media platform used for business and employment-focused focus specifically on professionals (van Dijck, 2013))

All badges were linked to module and program outcomes, allowing a badge to be accredited and used on professional networks as part of a student's CV. See Figure 1 to view the module's framework of how scaffolding took place and the overall structure of the course, indicating all the soft skills that formed part of this module.

Mini-BADGE 1: Understanding team theories and dynamics: 25% weighting.

Mini-BADGE 2: My role as individual in a team 25% weighting.
Mini-BADGE 3: My team in a project – 50% weighting

MAIN BADGE – Behavioural aspects of Project management (obtained after achieving a minimum of 70% for this module)

Figure

To better understand the project and show how the soft skills developed, this section will elaborate on the specific activities students had to complete (note that only some of the activities are discussed in this paper due to page limitation, but only a few highlighted).

The semester started with creating a team code of conduct and a flipgrid video where each student had to introduce themselves. The class could see all the videos but not share or download any. Students then had to create a team’s mission and vision statement and a checklist for how they will measure/track their team goals per team member. To understand leadership, students had to complete a leadership quiz. Some content was delivered as interactive video assessments, allowing for discussions, and not just lecturing during class. They also had to say what they were doing well, their KPIs, blockers, and what they could improve. Students had to do three reflective journals throughout the semester, answering similar types of questions as follows:

- What were you thinking/feeling throughout this module so far?
- What was good about this experience so far?
- What was bad about this experience so far?
- What does this tell me about myself and my team working dynamics?
- What is your new understanding of teams and working in a team?
- What could you have done more/better in your current team/situation?
- What do you need to do to improve your team and team dynamics?
- What broader issues do you/the team need to improve on in the future to make this team successful?
- What would you have done differently in this module?

Throughout the semester, students reviewed their role in the team, understanding teamwork skills by engaging in measurable activities and obtaining mini badges (micro-credentials). Towards the end of the semester, the groups also had to revisit their code of conduct and team dynamic checklists, which they had created at the start of the semester. All these activities allowed for programmatic assessment; if a student missed one activity, they could not complete the rest, forcing students to keep up to date.

Badgr was used to award the final badge. Figure 2 is an example of the badge in Badgr.
Figure 2. Overall view of Badge in Badgr

Note that 71% of all the students did manage to obtain the badge. Thus, 71% of the class averaged more than 70%.

To ensure that we follow a specific standard, Berry (2016) listed six components for MC for badge issuance. Thus, following set activities, research, methods, resources, submission, and scoring criteria were necessary. These requirements integrated into the badges, along with comprehensive details about the badge contents and the rationale behind the activities. All this detail is available on the badge and thus linked to their LinkedIn profile.

**Figure 3. Details description of the badge**

**DESCRIPTION**
This badge is awarded once a student successfully obtains a distinction after completing this module at the University of Pretoria that investigates the impact of individuals, groups, and structure on behaviour within organizations, for the purpose of applying such knowledge toward improving an organization’s effectiveness, with special emphasis on the IT work context. Knowledge of this module will enable you to appreciate the role of people skills, empowering people, stimulating innovation and change, coping with change, working in teams, and restructured organizations, helping IT employees balance work/life conflicts, and improving ethical behaviour. After the completion of this module, a student should be able to:

- Define, explain, describe and apply the soft skills of project management, as an individual (IBET accreditation, US MIB)
- Define, explain, describe and apply the soft skills of project management as part of a team (IBET accreditation, US MIB)

**EARNING CRITERIA**
To obtain this badge, students have to complete three mini-badges with various milestones linked to them and a final mark of 75% must be obtained to receive a badge. See detail below.

**Mini Badge 1: Understanding team theories and dynamics**

- Milestone 1 - Team Theory (50%)
  - Flipgrid video upload
  - After class individual quiz 1
  - Group Wiki - Code of conduct (Rubric)
- Milestone 2 - Roles (50%)
  - Lecture 2 online quiz - Marked
  - Wiki check for how you will measure/track your goals - Rubric
Tracking students’ progress was easy, and although the badge was awarded, the programmatic assessment approach ensured students worked through the content throughout the semester, keeping up with the work.

It is important to note that there were a few limitations of Badgr. Some limitations included being unable to create a pathway to track progress throughout the semester, while you set up the badge, you don’t have the option to post it on a specific date, the moment it creates the badge, it issues the badge, sending an email to the students notifying them it is issued, thus testing it was somewhat tricky. As this was the first use of Badgr, it was also unfamiliar, and there was minimal support from our internal LMS team or the Badgr team, creating frustration.

I. Methodology

This paper reports only on a few student activities completed during the semester, as part of a bigger exploratory study. Paper Interpretive in nature, a survey strategy was adopted, using a quantitative approach where students were asked to complete an online survey distributed through Qualtrics. The survey was distributed at the end of the semester with
the main objective of evaluating their experience of programmatic assessment as well as the micro-credentials. As the final year module had to be reviewed by an external examiner, the survey was distributed only after releasing the final marks and during the examination period, rewarding no marks for completing the survey. These all resulted in a lower-than-expected 14.4% response rate. However, the responses gave good insight into the student’s module experience. The data was analyzed using the basic Qualtrics analytics tool. The results allowed the course to be re-evaluated and adapted for the next group of students, as this was the first year we ran with this approach.

Data analysis

Most students were in BCom Informatics Information Systems final years (58%), followed by BIT - Information Technology (25%). The rest of the degrees were all degrees that formed part of the School of IT.

To better understand the student profile, the survey asked students how they prefer to learn by the statement, “I learn easier through:”

The following items were used extensively by most students:
- Collaborating with my fellow students and discussing the work.
- H5P Interactive video classes assessments.
- Completing activities online before class and then attending physical classes once a week.
- Finishing wikis as a team.
- Completing the reflective journals throughout the semester.

As this was the first pilot study with new activities for students and faculty, students had to indicate their most enjoyable activity.

Interestingly, the “own reflection journals and attending physical classes on campus” option were ranked the highest, 21%, and Wikis ranked third.

Asking students what their experience with the online activities was, the following actions were listed:
- Completing wikis.
- Completing the quizzes based on articles.
- Reading articles before a quiz and H5P Interactive video assessments.

There was a slight standard deviation, indicating little average variability. Therefore, most students selected the same option, showing all these activities were ‘easy to use.’

When asking the students how they felt about the new format of continuous assessment, most responses were overwhelmingly positive, as most students had a positive experience with continuous assessment. Surprisingly, students disagreed that the continuous assessments were overwhelming and frustrating Table 1.

<table>
<thead>
<tr>
<th>Option</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Made me understand the content and theory of team dynamics better</td>
<td>0.00%</td>
<td>0.00%</td>
<td>26.92%</td>
<td>73.08%</td>
</tr>
<tr>
<td>Was easy to use</td>
<td>0.00%</td>
<td>0.00%</td>
<td>26.92%</td>
<td>73.08%</td>
</tr>
<tr>
<td>Can be used to better understand our team’s structure</td>
<td>0.00%</td>
<td>0.00%</td>
<td>34.62%</td>
<td>65.38%</td>
</tr>
<tr>
<td>Provides me with more motivation to work harder in this module</td>
<td>0.00%</td>
<td>3.85%</td>
<td>23.08%</td>
<td>73.08%</td>
</tr>
<tr>
<td>Allows me to see if I am a good team player</td>
<td>0.00%</td>
<td>3.85%</td>
<td>30.77%</td>
<td>65.38%</td>
</tr>
</tbody>
</table>
When asking students about their overall experience of the module and the micro-credentials, 73.91% said that gaining a badge was a great motivator to complete certain activities, and 78.26% agreed that earning a badge motivated them to work harder in their team.

The question with new innovative teaching approaches is always, *but did they learn anything?* 73.91% said that the activities throughout this module contributed to a better understanding of the content and theory of teamwork.

An overwhelming number of students (82.61%) agreed with the value of attaining a badge that can link to a professional platform such as LinkedIn.

**Discussion**

Results indicated that a programmatic assessment approach, which incorporate badges, assisted students in gaining a better understanding of fellow team members' capabilities, leading to better utilization of individual team member capabilities and contributing to high-performance teams. Did the students learn anything? Students understood the effort it takes to become a highly effective team. The utilization of badges fostered individual motivation amongst most respondents, either during individual tasks or within a group. It further assisted students in grasping teamwork-related content more easily. This teaching approach enhanced the motivation to continue with lifelong learning, resulting in the need for more badges.

The perception was that badges improved students' employability and that skill levels increased through obtaining badges. The set requirement of 70% to receive a badge increased the credibility of the badge.

The current environment (LMS) contributed to the ability to complete activities for badges and played an essential part in the credibility of the badges. The technology catered for lifelong learning through the availability of mobile availability.

As a final point of discussion, asking students what they loved about the module generated the following word cloud using these settings: Not case sensitive, stop words ignored, and based on the number of work occurrences (Fig. 6).
Figure 6. Student feedback: what they loved about the module

It seems as if continuous assessment and activities were some of the topics the students loved.
Some specific quotes from the students:
“I loved that it focused more on the skills we should be able to use after the module rather than trying to make it just another thing that we would have to learn and try to remember.”
“The continuous assessment ensured I stayed up to date and I never fell behind. I’ve had two modules use continuous assessment and I find it really helps ensure you do not fall behind. Although I can see a flaw where if I did fall behind I would be incredibly disheartened to keep going.”
“The continuous assessments and reflections. It helped to actually think about what I learned and why.”

When asking students that they didn’t enjoy, i.e. “what was not fun”, students indicated:
“Reaching the conflict point of the module was not fun but it was necessary.”
“The problem of if you did not complete the pre-activity you were not able to do the other activity.”
“Sometimes found it a bit difficult to complete assessments when other modules had many assignments themselves.”

This approach might not work for everyone, but overall, the objective of this module, which was to teach students soft skills, specifically focusing on teamwork, was indeed met.

Conclusion

In conclusion, this study delved into applying a programmatic assessment approach using MC to unlock the power of soft skills, mainly focusing on teamwork in a higher education setting.

The study focused on the integration of MCs into a final-year module aimed at developing soft skills, with an emphasis on teamwork. The programmatic assessment approach incorporated various learning and assessment activities throughout the semester, culminating in a badge if students scored 70% or higher for the module.

The study’s findings underscored the positive impact of programmatic assessment activities and micro-credentials on soft skills development within the higher education context. Incorporating MCs gave students a tangible representation of their skills, fostering motivation and engagement.

The results indicated that students found the programmatic assessment approach beneficial in understanding team dynamics, realizing individual strengths and weaknesses, and improving teamwork-related skills.
While the study celebrated the success of the programmatic assessment approach using MCs, it also acknowledged certain limitations, such as the initial unfamiliarity with the Badgr platform and the need for better support. Additionally, some students found the assessments overwhelming, emphasizing the importance of balancing the assessment load.

This research integrates MC through a programmatic assessment approach for soft skills development in higher education. The positive outcomes observed in this study suggest the potential for broader adoption of such methodologies to address the dynamic demands of the Fourth Industrial Revolution and the evolving needs of the workforce. As education adapts to changing circumstances, exploring innovative approaches like programmatic assessment with micro credentials remains essential for shaping a future-ready workforce. Further research and refinement of these approaches will undoubtedly contribute to the continuous improvement of education in the context of rapidly evolving industry requirements and technological advancements.

References


RESHAPING HIGHER EDUCATION: PRODUCING T-SHAPED COMPUTING PROFESSIONALS

Margaret Hamilton  
School of Computing Technologies  
RMIT University  
Margaret.hamilton@rmit.edu.au

Ana Hol  
University of Western Sydney  
A.hol@westernsydney.edu.au

Joan Richardson  
University of Canberra  
richardsonjoanmarie@gmail.com

Jim McGovern  
RMIT University  
jimmcg3004@gmail.com

Blooma John  
University of Canberra  
blooma.john@canberra.edu.au

Abstract:

Input from employer groups consistently shows that people skills are often lacking in new computing graduates. Underdeveloped communication, negotiation and collaboration skills reduce an organization’s capacity to apply specialist skills and knowledge to solve problems and exploit opportunities creatively. Graduates must also be independent learners and be able to adapt as technologies and applications continually and quickly change. Underpinning job roles are an increasing number of computing specialties and understanding of how these apply in a range of application domains. Innovation stems from not only an understanding of computing specialties, but its integration with other specialties as Computing + X, or X + Computing. The challenge for higher education is to effectively include these people skills as well as to prepare graduates for expanding numbers of roles that each have their own requirements around breadth and depth of knowledge and skills. In this paper, we call for an approach to computing education which unifies all the computing disciplines.  We introduce our definition of a T-Shaped Computing Professional based on SFIA skills and Bloom’s taxonomy levels of difficulty and apply this to the ever-changing role of computing education particularly for accreditation and assessment of life-long learning and transferable skills.

Keywords: T-shaped graduates, computing professionals, computing programs, information systems program architectures

I. INTRODUCTION

Technology permeates everything that we do professionally and personally. Designing programs to deliver graduates across all business domains and specialist technology roles has become almost impossible. In Information Systems (IS) and higher education (HE) more generally, we need program architectures and courseware that keep pace with the emergence of new devices and applications of technology within organizations almost continuously.

During COVID-19 the rate of change in organizations and individuals use of technology especially for communications increased. Working from home became the norm across many industries. A general understanding and acceptance that workers require high level digital knowledge and skills has become the norm across the economy. Arguably, computational thinking and an ability to design and implement an algorithm using a programming language have become essential for new business graduates while successful workers across industry demonstrate digital competency to varying degrees of complexity. HE providers are being asked to design computing education to meet employer needs. Reshaping is required in...
Information and Communication Technologies (ICT) program architectures as it is no longer clear whether digital knowledge encased in essential functionality for other professions belongs in a new Micro-credential or a Graduate Certificate, or a totally new Program.

Based on the Skills for the Information Age (SFIA) Framework and associated description of 102 skills and competencies, recommendations for requisite knowledge and skills for Digital Professional roles have been described. Such foundational and specialist ICT knowledge can be combined with employability skills divided into business enabling and human capabilities. The description of ICT knowledge and skills leans on the SFIA levels and is organized in areas, such as, Information and Cyber Security as a family of Digital Professional skills aligned with more than 20 roles extending from the highly technical Computer Science (CS), Computing Engineering (CE) and Software Engineering (SE) to Information Systems (IS) and Risk Management (RM) type positions. The comprehensive description of ICT knowledge and skills is invaluable to the description of job roles and guides foundational and specialist knowledge and skills in programs of study. Measurement of the level of complexity of the application of professional knowledge and skills in work roles is more difficult within educational programs, other than in a capstone project course.

The Australian Government has generated a digital career pathway and an organizational SFIA 8-based digital license [1]. Both human and digital capabilities are included in the 150 digital job role descriptions both underpinned by SFIA. Government advice for positions includes details of relevant knowledge and skills, as well as competency SFIA levels aligned with appropriate pay scales. The system is comprehensive and has the capacity to guide curriculum development, especially in the digital professional knowledge and skills space.

The Australian Computer Society (ACS) underpins higher education accreditation requirements with SFIA [2]. The ACS accredits computing programs across Australian universities and requires program to align curriculum with SFIA 8 knowledge and skills associated with graduate roles. A typical program of study increases in levels of complexity as a student, progresses towards completion. The revised Bloom’s taxonomy is used to evidence increasing levels of complexity from the ‘Remember’ level, through ‘Understand’, ‘Apply’, ‘Analyze’, ‘Evaluate’ and ‘Create’ levels [3]. IS professionals apply technical knowledge and skills, in authentic domains to innovatively solve problems [4]. There are usually no entry requirements for work experience so the use the SFIA Levels to evidence depth and complexity of courses is fraught with difficulty in two dimensions. The first dimension is the measurement of complexity of application using SFIA Levels and the second is the sheer volume of job roles.

The IS2020 competency model for IS programs lists IT consultant, data analyst, computer systems analyst, IT auditor, software application developer, and cybersecurity analyst as the most common jobs for IS graduates but recognizes the breadth of impact of IS and overlap across specialist CS, SE, IT, cybersecurity (CyberSec), Data Science (DS) and Computer Engineering (CE) sub-disciplines of the ICT/Digital Professional [5]. The description of IS graduate roles is fluid at best but always difficult to translate into program architectures that are sustainable for universities.

The new IS2020 curriculum model includes competency areas and has shifted IS2010 elective courses to core and included new areas, such as Ethics. Specialist areas include Data, Technology, Development and Organizational Realm. The system recognizes the differing aspects of jobs across sub-disciplines. Descriptions of curriculum and choices allow for a focus on a myriad of job roles by recognizing the interplay between ICT sub-disciplinary knowledge through a need for core, specialist and Work Integrated Learning (WIL). Assurance of employability uses the revised Bloom’s taxonomy to describe complexity as well as establish foundational, core, depth in a specialist area of ICT, a capstone and human capabilities.

The research investigation in this paper examines the literature discussing the IS and ICT discipline in terms of graduate roles, University undergraduate program architecture and accreditation of quality assured curriculum. IS graduates obtain jobs in all industries and sometimes lose roles to non-Digital Professionals with another qualification as many particularly large organizations conduct specific functional on-the-job technical training. The critical program and course design challenge for academics and universities is to re-imagine the mix of knowledge and skills so that all possible industry contexts are included, and technology graduates are employable.
As a part of this research investigation a review of professional body and government accreditation requirements as they pertain to curriculum requirements and program architectures was undertaken. This was to enable an understanding of the current IS identity in terms of graduate roles, with a long-term view to simplifying accreditation and quality assurance.

The research questions are:

**RQ1**: What would an ICT Program Architecture that can support the great variety of roles look like?

**RQ2**: How could a process be developed to build communication/trust between government, professional accreditation bodies and universities, so that program change processes can be expedited?

## II. METHODOLOGY

The review of accreditation requirements undertaken as the basis for this research was managed as a case study that enabled a description of the synergies between industry expert comments, ACS ICT job profiles, the Australian Quality Framework (AQF) Level 7, IS 2020 and SFIA8 undergraduate IS program curriculum requirements for Information and Cyber Security Specialists. A Design Science research approach was used to assure the inclusion of data drawn from stakeholders’ external and internal university data [6].

The research focusses on creating business processes that streamline collection and consolidation of data to align industry graduate needs and program architectures, at the design point, to ease implementation and upgrade processes. It is anticipated that the merging of conversations between professional bodies, governments and University quality systems would build stronger relationships. Trust would enable simplification of business processes as reliance on compliance checks would be reduced. In the post COVID dynamic digitalized work environments, extension of the SFIA 8 T-shaped model built on agreement across professional and government accreditation bodies and Universities is necessary to speed up program change.

The study commenced with focus groups including Business and IS management industry representatives asked what they required of an IS graduate to be successful in the workplace (see Table 1 for the composition of the focus groups). Participants were asked to comment on current and future business processes that they feel are essential to support students and graduates entering the workplace.

Use of a qualitative case study approach to the research was critical as boundaries between phenomena and contexts are blurred and an in-depth understanding of IS graduate roles and program architectures was needed. IS graduates work across all domains in industry and therefore shaping of professional identities across IS are dynamic. A range of data sources were triangulated to evidence the description of an IS professional identity and alignment of the Information and Cyber Security Specialist and Business Analyst graduate roles across industry contexts.

The use of Design Science Research as a method enabled the creation of an artefact or Utility theory to improve the practice of program design so that external environmental industry needs and technology changes are incrementally and quickly reflected in programs [21]. Four components of the Design Science Research Framework were used to underpin the conceptual model for our work: a) Problem Diagnosis – descriptive and interpretive analysis to identify and explain the problem, as detailed in [7] based on the data from the industry focus groups presented in Table 1; b) Review of the SFIA 8 and SFIA T-shaped models, curricula from the Association for Computing Machinery (ACM) and the Association for Information Systems (AIS), [8]; c) Technology Evaluation – a case study in the Higher Education context from the ACS accreditations of AQF Level 7 undergraduate Information and Cyber Security Specialist and Business Analyst graduate roles; and d) Technology Invention or Design – to derive the system solution and perform normative analysis of the contribution to the SFIA 8 T-shaped model for graduate role descriptions. Following this methodology, recommendations for work...
to augment accreditation-university-government conversations to align industry roles and specialist IS undergraduate curriculum were devised and are presented in the conclusion to this paper.

**Data Collection**

Stakeholder analysis theory from [9] and Constructive Alignment from [10] underpin the research design, data collection and analysis. The instrumentalist use of stakeholder theory takes information drawn from processes that connect external program accreditation and internal university quality systems to foster continuous improvement. Quality of curriculum is assured through the use of constructional alignment. A functional outcome derived from the collection of information of all stakeholders will facilitate a functional outcome [11]. The aim is to deliver a simplified cyclical University quality assurance process that feeds and draws information from both accreditations and University quality systems to support program change. This approach assures that the opinions of all stakeholders are collected, which in turn will assure alignment of industry and government driven descriptions of IS graduate role requirements and specialist ICT programs at a meta level. Constructional alignment drives the quality of delivered courses/subjects within universities.

**Participants**

An instrumentalist stakeholder analysis was undertaken to assure perspectives on industry requirements for IS graduates and the how the information was translated into programs and courses was well understood [22]. In this project both general business and IS industry representatives, with experience recruiting graduates, were gathered in focus groups and asked what they considered necessary to be a successful IS employee today. A summary of the commentary served as a reminder of the importance of technical foundations and specialist knowledge combined with the human capabilities needed to understand problems and create innovative implementable solutions. The distribution of industry representatives participating is described in Table 1 below.

<table>
<thead>
<tr>
<th>Focus Groups</th>
<th>Business</th>
<th>Information Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 4 September 2020</td>
<td>1 x Business Recruiter</td>
<td>1 x Information Systems</td>
</tr>
<tr>
<td>2 – 4 September 2020</td>
<td>1 x Business Management</td>
<td>2 x Information Systems</td>
</tr>
<tr>
<td></td>
<td>1 x Supply Chain</td>
<td></td>
</tr>
<tr>
<td>3 – 30 October 2020</td>
<td>2 x Business Recruiters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 x Supply Chain</td>
<td></td>
</tr>
</tbody>
</table>

*Table 1: Industry Focus Groups 2020*

The place of IS graduates in industry is the first subject addressed in the literature review. Synergy across the descriptions of IS roles, predictions for important future change to graduate roles and common methods for designing and evaluating program/course architectures are discussed. An imperative to create appropriate program architecture quality and change processes is assumed.

During the technology evaluation and problem diagnosis phases of the research an inductive approach was used to seek a better understanding of mechanisms to align industry descriptions of IS graduate roles and university program architectures. This report first outlines findings from a review of descriptions of undergraduate curriculum requirements to deliver Information and Cyber Security Specialist graduates. The SFIA 8 T shaped graduate role sits at the heart of our investigation of program architectures.
In the focus groups questions asked of the participants centred around the following two:

1. What does industry regard as the most important characteristics of a successful IS graduate?

2. How can industry and universities collaboratively define an appropriate graduate IS skill set?

In Australia, ACS accredited IS undergraduate programs contain a five-course core, which is common irrespective of desired specialist graduate roles. Typically, the IT core includes:

- Applications Development – programming
- Infrastructure
- Systems Analysis and Design
- Database Management; and
- Project Management (Horizontal Bar of the T)

The core courses are followed by a long tail of options. In the Australian study of IS ACS accredited programs IT Project Management, capstones and WIL to develop professional skills were core [7]. A point of difference for Australian ACS accredited degrees compared to [4] has been the importance of Professional Practice Project Management, a mandatory part of IS programs alongside Interpersonal Communication and Ethics/Social Implications since 2001.

As the ACS places importance on capstones and WIL experiences, IT Project Management was included in the majority of programs as a core [7]. In older ACS accreditation guidelines both Ethics and IT Project Management were mandatory curriculum requirements. This was not deemed as requiring significant coverage in the IS guidelines of [4] but is now included in the IS 2020 curriculum [5]. The voices of industry representatives in the focus groups conducted affirmed that WIL was still important and is integrated in capstone and industry projects as indicated by the following comments from various participants:

- Real world experience via WIL, industry involvement, internships and capstone are critical. WIL more important than ACS accreditation of the program completed, as:
  - Real world problems help students fit in as grads when they finish
  - Industry gets a good conversion for students staying in the organization.
  - Hire an IS graduate but do not really care too much about accreditation as more concerned about capabilities in terms of application of IT skills to solve problems (Participant 1,3,4,5, 8, 9, 10).
  - Expect the graduates to work together in multidisciplinary teams – Learn and develop whilst in the diverse group which should help them gain the skills which they would need so they can meet the needs of a community. Soft skills are grown. Expand industry project opportunities and get graduates to mentor students (Participant 5, 10).

Here the similarities between the ACS [4] and SFIA 8 became apparent. It is a requirement of the AQF and ACS to evidence increasing depth through the combination of discipline knowledge and professional/generic skills, in authentic business domains. In SFIA 8 new added detail have been provided by an additional sub-categories and skills. Information and Cyber Security Specialist are described in detail for the first time (SFIA, 2021).
III. RESHAPING EDUCATION OF COMPUTING PROFESSIONALS

The development of people skills is an ongoing task and past work has been described as ‘Same Wine New Bottle’ by one of the participants. The T-shape [1] and its exploration in the context of SFIA job roles [2] offers the opportunity for a new approach, a lens through which knowledge and competencies can be viewed from a depth perspective as well as from the level of integration with other specialties, application domains and enabling people skills. A shift in emphasis enables the identification of higher education computing programs that are unique and/or successful in the modern world of work. The important question is: can the SFIA T-Shaped model be used to link industry and higher education by augmenting strategic conversations, describing emerging graduate families of roles and designing innovative programs suited to constant change?

SFIA has recognized the importance of skills other than technical skills needed by computing professionals through its exploration of the T-shape in job descriptions [1]. A T-shaped professional has depth (the vertical bar) of technical skills, as well as breadth (the horizontal bar) in the form of skills that enable creative cross-disciplinary working across application domains.

While T-shape professionals are continually developed in the workplace [3], higher education has an important role to play in laying the foundations and doing what they can to bridge the “real world” experience gap. Though some higher education providers [4] [5] and curriculum designers [6] [7] [8] [9] have embraced the concept of the T-shape graduate, it is not widely used as a tool to design programs and certificates that incorporate computing professional specialist and human capabilities required to apply learnt knowledge and skills to design solutions to real problems. Adoption of the T-shape in frameworks such as SFIA [2] and their use by national accreditation bodies will increase interest and motivation, but wider adoption faces challenges.

Firstly, further description of the combined computing specialist, human and business capabilities are typically included in a T-Shaped employee. Second academic program designers need practical tools to develop programs that align with T-shaped graduate roles as described by SFIA. The level of detail in which alignment is measured is worth investigation, as well as the character of programs and appropriate flexibility to address families of SFIA roles rather than a single graduate outcome. The vertical includes computing specialist knowledge and skills that make graduates able to apply learning to authentic problems. The application complexity can be measured using Bloom’s [3] as a third dimension. The notion of looking at specialist knowledge and skills in increasing depth and application in ever increasing complexity as a third dimension has the potential to reduce linear increasing levels of detail. The T-Shaped model can be the connection between industry descriptions of roles and flexible HE degrees. Finally, an understanding of the costs and benefits to Higher Education, Industry and Professional Associations is needed as validation of the need for change.

IV. DEFINING THE T-SHAPED GRADUATE

While the general ideas that underpin the T-shape are clear enough, definition of the T-shape vary greatly at a detailed level [1,8]. The model in Figure 1 provides a widely used model that captures the essential elements. A simple two-dimensional model cannot capture the complexity of academic programs but does lay the foundations for a way of thinking about curriculum.

Figure 1: The T-Shaped Graduate
Deep knowledge

The vertical bar ("|") represents the primary area of expertise of the graduate. It represents depth of knowledge and skills in a discipline, domain, or system, essentially the ability to analyse and solve problems from the perspective of an area of expertise, expertise not available from other professionals. This depth is not only in technical skills but a holistic combination of technical and non-technical skills (sometimes, perhaps erroneously referred to as “hard” and “soft” skills). For example, there should also be a deep understanding of written and oral communication, and ethical frameworks in programs for graduates who aspire to be business analysts who can effectively work with a range of business systems stakeholders to professionally elicit, document and communicate solution requirements and options.

From an educational perspective the vertical bar defines what graduates “can do” and can do well. Increasingly, professional education programs are expected to represent outcomes in terms of competencies [11] [12] [13]. Achieving this depth requires demonstration of higher levels of achievement in industry frameworks, such as level 3 in the European Software Skills for the Information Age (SFIA) [2], and level 4 or 5 in educational taxonomies such as Bloom’s [10]. Essentially, there is an expectation that professionals can apply analytical and synthetical skills to develop solutions or identify opportunities that requires deep knowledge of their discipline, domain, or system of expertise.

Disciplines are typically sub-fields of knowledge within broader knowledge areas [14]. The joint ACM/ IEEE-CS report [11] defines the computing disciplines as artificial intelligence, computer engineering, computer science, cyber security, data science, information systems, information technology, and software engineering. Discipline knowledge is the focus of higher education, and these are commonly presented as majors in computing degrees at both undergraduate [15] and graduate level [16].

More important for organisations is the application of disciplines in their domain and to their systems. Application domains or systems are areas with their own ways of working, regulatory frameworks and culture that deliver services and/or products, for example, specific areas in banking or financial services, health, transport, logistics and supply chain, and the justice system. Some disciplines are closely linked to a single area, but disciplines like computing can be termed domain-agnostic [17]. This domain-agnosticism should not preclude exposure to application domains and exploration of classes of systems such as distributed systems, real-time systems, web-based applications, e-commerce, scientific applications and so on.

Broad Knowledge

The horizontal bar (“---”) indicates some knowledge of other disciplines, or domains and systems. For graduates, this may be an exposure to different disciplines and ways of thinking obtained through program minors. The challenge is in deciding which other disciplines, how many and how much. In organisations, this is a more contained problem, achieved by rotation
across divisions [18]. This can be termed as “what we need to know” to look at solutions from a broader perspective. The outcomes for these need not be as high as for the deep knowledge, typically SFIA level 1 or 2, or Blooms level 2 only is required. From an educational perspective, this may be achieved more briefly and by lower levels of achievement, such as awareness, understanding of concepts and language of the discipline or domain.

The second part of the horizontal bar, located above all else, represents the people skills, the generic individual skills and competencies that support creativity and the free flow of ideas, discussion, and collaboration across disciplines and domains (see [19] for a good analysis of these skills under the banner of 21st-century skills). These are not only the focus of educators but are increasingly visible in job roles and advertisements [20] [21]. While there is broad agreement about the need for these skills and competencies, there is less agreement about which skills and how they are demonstrated.

V. PRODUCING T-SHAPED COMPUTING GRADUATES

The challenge for higher education professional education is to lay the foundations for personal career and life-long development within a constrained curriculum space in a relatively short period of time. The nub of the problem is that higher education has traditionally taken place separate from the workplace. The focus on employability has strengthened with the massification of higher education in the 60’s and 70’s and the emergence of the knowledge society. Difficulty in specifying and agreeing quickly changing requirements, long planning cycles in higher education, concerns that an employability focus detracts from the role of universities in developing graduates for life and a broad range of roles, and debates about balancing general and specific content are some of the perennial issues (see for example, p8 of [22]) in meeting the requirements of employers.

In this context the T-shape can provide a clarity around curriculum, an openness about what competencies are being addressed as part of the never ending task of improving graduate outcomes, and in the conversations with the world of work. Graduates are prepared for broad roles, often commencing in junior positions where learning and development in a particular domain or systems is the focus. The foundations are important, however, and good people skills will help the transition to senior roles and ultimately leadership roles where T-shaped behaviour is expected [23].

Many universities and their offerings can be outwardly supporting “new skills”, but internally failing to do enough to create more job-ready students and lay platforms for long careers including roles in management [24]. If the ‘Same Wine New Bottle’ observation is to be avoided with respect to the T-shape, then practical tools need to be developed. As the philosopher Edgar Morin said (quoted in [14] “It is not enough to value the links between experience, disciplines, creativity and ideas. One has to develop methods, strategies and practices that will transform these links into real connections.”)

Embedding the T-Shape in Higher Education

The T-shape does not, nor should it, prescribe “how” curriculum is implemented. The most significant guidance is that the horizontal and vertical components ought to be of equal size and importance. Different implementations will depend on different contexts and local needs.

There are however common questions that can be raised in the use of the T-Shape as a framework in the design of specific curriculum for computing programs.

- Program Level Considerations:
  - What are relevant disciplines, domain, systems, generic personal and technical skills in the context of computing professionals?
  - How should these be integrated into the program design?
  - What methods support learning within the curriculum?

- Institutional or Departmental Level Considerations
  - What are the implications for the scholarship of learning and teaching, particularly in the computing disciplines?
What are the implications for university organisational structures?

- National considerations
  - How can curriculum that better produces T-shaped graduates be encouraged and assessed on a national level?

Job readiness requires links between content and job requirements, but also appropriate levels of education [22]. Higher Education institutions, government and professional bodies assess the quality of academic programs and measure the complexity of the application of specialist skills and knowledge in authentic settings, often using Bloom's taxonomy [10]. A two-dimensional T-shape does not capture the complexity of the multiple learning outcomes (competencies), their interactions and their increasing sophistication. Some have addressed this through multi-dimensional T-shapes [25] [26]. Certainly, it seems that at least the addition of outcome levels, such as SFIA or Bloom's would be a constructive addition. There is a trade-off here between an accepted model that captures the T-shape at a lower level of abstraction, while remaining useful in communicating structure and outcomes. Also, useful maybe the development of curriculum mapping processes [27] that translate the detail at the learning unit level to the overall T-shape outcomes in a concise and informative way. Like constructive alignment it will provide a tool that has a clear and simple process, but with enough flexibility to fit a range wide range of needs.

Benefits of Producing T-Shaped Graduates

There is obvious complexity in deriving benefit from employees in any circumstance, and the same is true for T-shaped professionals. Current thinking is that a critical mass of T-shaped professionals is seen as a necessary condition for organizations to adapt and survive in the digital economy [25]. Productive innovation is an on-going pursuit for many organizations. Delivering innovation through improved products, services, or simply ways of doing things better require professionals with deep understanding of technical solutions and their domain of application as well as the ability to work across a range of areas of expertise. Real-world problems and opportunities are rarely siloed [3]. Successful change, innovation and an understanding of impact require collaboration. The notion that collaboration within an organisation facilitates creativity and innovation is not only commonly promoted in the popular industry press, but also supported by research [28]. Further, studies suggest in more dynamic environments generalist teams, or teams with breadth of knowledge, will produce better outcomes [3].

Most recent studies, suggest that innovation results from the interaction of individuals in the context of structural (or organisational) influences [29]. Organisational systems and practices provide motivation and support to exercise expertise and creativity in individuals and teams [30]. The combination of domain expertise and creativity skills is important for innovation [31]. Individual training and development programs are beneficial indicating that creativity can be developed [32].

Developing T-shaped graduates can come at a cost [3]. It would require a considerable retooling effort in curriculum development. Broader expertise needs to be available and learning resources and situations more complex and expensive. The debates about what is best for graduates will be eternal, but there needs to be a belief and understanding that designing curriculum for the T-shape has arguable benefit for both the individual and the community, if it is to be embraced by higher education.

VI. CONCLUSIONS AND FUTURE RESEARCH OPPORTUNITIES

University IS program architecture and course curriculum design procedures need to be reviewed alongside professional and government accreditation requirements to reflect the importance of the business and its contextual domain on the data drawn from applications and technologies. Programs require technical depth and contextual breadth in a specific industry domain. Business acumen underpinned by graduate personal attributes enables the T-shaped role required to perform in the workplace. T-shaped program architectures support working students in multidisciplinary teams to innovatively solve real world problems. To act effectively in the roles irrespective of industry, graduates need to:
1. Contextualize or apply specialist knowledge in a specific domain that requires some knowledge at a foundational level of the industry in question e.g. health – Breadth = top of the T;

2. Have acquired specialist technical skills and knowledge – Depth = vertical to the ascending into the horizontal T;

3. Assure students can apply the appropriate skills and knowledge - using Blooms and TEQSA requires a third dimension.

IS professionals in addition to Information Systems (IS)/Information Technology (IT) skills and knowledge require contextual understanding of the business domain. Graduates obtain jobs in all industries and compete with professionals in the contextual discipline with sometimes just on-the-job training to win roles despite completion of programs. The critical program and course design challenge for academics and universities is to re-imagine the mix of knowledge and skills to serve all industries. Answering questions around - what is the value added? If indeed the recognition of the importance of the mix of discipline and business contextual skills is critical, how does that play out in universities? What does the appropriate skill set look like within courses and programs? Can assuring quality and enabling incremental change contribute to moving forward whilst allowing choice and flexibility for students to aspire to a range of IS graduate roles?

The T-shaped computing professional enables a review IS/CS SFIA Version 8 T-Shaped model graduate role descriptions with a view to assuring alignment of the ACS, SFIA and AIS. It provides a tool to align SFIA graduate roles in the workplace and enable quality assurance of curriculum evidenced by the revised Bloom’s taxonomy. Simplification of compliance tools will enable a shift in focus towards upgrade in the digitally dynamic post-COVID world. The mapping against SFIA and Bloom’s during accreditation processes creates unnecessary work. Simplification of the tools to describe curriculum knowledge and skills at evidenced levels is critical to the building of trust between the parties.

The T-Shaped Model could be improved by the addition of a third dimensional to enable a simple evaluation of graduate role level of complexity. The third dimension would shift the levels of complexity in response to applications of IS/IT in a range of professional contexts. An extension that would also allow groups of specialist subjects/units on the vertical “need to know” would assist in rapid response to student needs. Building on the common core base across ICT would provide an opportunity to move to an incremental change situation rather than building expensive programs.

Reshaping the T-shaped professional computing graduate brings together community requirements and roles, the skills of professionals, and the target competencies of higher education graduates. It provides a means of clarity that can communicate links between professional skill such as those laid out by SFIA8 and what higher education programs can realistically provide.

Despite the volume of literature, the T-shape is an immature concept. Three areas have been outlined that would be useful in gaining greater acceptance and benefit. An agreed definition of T-shape will make it easier to communicate and implement for both academic managers and teaching staff. Guidance on how to develop and demonstrate T-shaped-ness would assist curriculum designers and developers and ease professional accreditation strategic conversations. Finally, greater understanding and acceptance of its benefits and awareness of its costs will encourage discussion and adoption as a program architecture design tool in universities and their schools and departments.

Better definition, clearer benefits and improved methods can lay the foundation for producing graduates who can better meet the needs of individuals, organizations and the community in the 21st century. These are not simple problems to resolve. Definitions need agreement, better methods require experimentation and active research from a committed critical mass of users, and considerably more research and analysis of cost and benefits. The rewards, however,
would seem to be considerable for both graduates and the community. Ultimately, it may be a way of clarifying realistic expectations about what employability and job readiness can be achieved by computing graduates.

VII. REFERENCES


About the Authors

Margaret Hamilton is Professor in the School of Computing Technologies, Discipline of Cloud, Systems and Security at RMIT University. Her research is about human computer interaction, user experience, mobility and computing education. Her teaching involves ethics, critical thinking and professionalism from “Professional Computing Practice”, “Advanced Professional Development” to “Innovation Ecosystems and the Future of Work”. She is the Co-Editor-In-Chief of the ACM Inroads magazine, and in 2022, she became an ACM Distinguished Member for Outstanding Educational Contributions to Computing.

Ana Hol is Associate Professor and Associate Dean, Learning and Teaching in the School of Computer, Data and Mathematical Sciences at Western Sydney University. Her research interests are in the areas of Information Systems, SMEs (Small and Medium Enterprises) Information Technology use, acceptance and adoption; eTransformation and eCollaboration of the businesses within developed and developing countries; Information Systems and applications for education; social networking technologies; process optimisation and knowledge management. Ana is a member of Enhanced Living with Information Systems Research Group and an associate member of Telehealth Research and Innovation Laboratory. Ana is a co-editor of the International Journal on Advances in ICT for Emerging Regions and a program committee member and the reviewer for 14 international conferences. Her teaching interests are in the areas of eTransformation, eBusiness, Enterprise Information Management and Information Systems Deployment and Management. Ana is a winner of the Australian Computer Society (ACS) Disruptor ICT Educator of the Year (2018) Award and the South East Asia Regional Computer Confederation Global ICT Educator of the Year 2018 Award.

Joan Richardson is an independent researcher and consultant. Joan has previously been Professor of Business Information Systems at RMIT University. She has worked with the Australian Computer Society (ACS) accrediting Information Systems (IS) programs on behalf of RMIT University and conducted research looking at Computing discipline program architecture and delivery innovation. She was the principal author of the first Information Systems (IS) Australian text and resource suite published by Pearson Education in Australia from 2001 to 2019. Her contributions to Higher Education were recognised by an Australian Learning and Teaching Council (ALTC) citation for the use of emerging technologies to meet the opportunities created by new generation learning spaces.
Jim McGovern. Independent consultant and researcher. Jim holds a PhD in business applications of AI from the University of Melbourne and has previously taught in computing disciplines at RMIT University and the Queensland University of Technology.

Blooma John is an Associate Professor of Information Systems at the Faculty of Science and Technology, University of Canberra. Her research interests include digital transformation, mixed reality, social informatics, and educational technologies. She received her Ph.D. in Information Systems from Nanyang Technological University, Singapore. She is a fellow of the Higher Education Academy and a member of the Association for Information Systems. She has published her research outcomes in various Journals, Conferences and Book Chapters. She won RMIT Excellence in Learning and Teaching Award 2015, University of Canberra Commendation for Outstanding Contribution to Student Learning 2021 and Teaching Award for Programs that Enhance Learning and Teaching in 2022.
DIGITAL MEASURES TO DECREASE THESIS PROCRASTINATION IN DISTANCE EDUCATION

Heidi Rinn  
heidi.rinn@akad.de  
AKAD University (IDEA – Institute for Digital Expertise and Assessment)

Mirjam Merkel-Kiss  
mirjam.merkel-kiss@akad.de  
AKAD University (IDEA – Institute for Digital Expertise and Assessment)

Susanne Robra-Bissantz  
s.robra-bissantz@tu-bs.de  
Technische Universität Braunschweig (Abteilung für Service-Informationssysteme)

Daniel Markgraf  
daniel.markgraf@akad.de  
AKAD University (IDEA – Institute for Digital Expertise and Assessment)

Abstract

Thesis procrastination arises besides other factors from task aversion, anxiety, and a lack of task structure. Social integration, including emotional support from peers and supervisors, is crucial for overcoming these challenges. Nevertheless, social integration is challenging in distance educational settings that have increased during and after the pandemic. This study investigates how to design digital support measures to address thesis procrastination in distance education at a fully digital University of Applied Sciences in Germany. The research follows a design science research approach, incorporating three design cycles and five evaluations. The results indicate that a fair-like measure in a virtual world, introducing a mentoring program and covering organizational topics and scientific writing, is effective. Design principles and design features are validated, so that implications for researchers, practitioners, and virtual world developers can be derived and discussed.

Keywords: Virtual World, Higher Education, Thesis Blocking, Procrastination, Social Integration.

Introduction

According to the latest educational report in Germany, the duration of study, i.e., the time needed to finish a study program, increases constantly for years (Autor:innengruppe Bildungsberichterstattung, 2022). Furthermore, drop-out rates stagnate at a high level (Heublein et al., 2022). Procrastination, the needless delay of a task, is one symptom that causes an increased duration of study or even drop-out (Engberding et al., 2017). Task aversion or even anxiety, and a lack of structure of the task promote procrastination. Therefore, bachelor and master thesis procrastination gains special attention in research, because the
task is at first unstructured, and unknown and can even cause writing anxiety (e.g., Pravita & Kuswandono, 2022; Sari & Kusumaningrum, 2022; Tuasikal & Patria, 2019). Social integration in the form of emotional support from peers and faculty members is a decisive success factor for overcoming these challenges (Rennie & Brewer, 1987; Tuasikal & Patria, 2019). Peers can positively influence each other’s motivation by simply being present (Kindermann, 2015). Nevertheless, social integration is a problem in distance education, which spread to all universities in the cause of the pandemic (Lörz et al., 2020). Since a complete shift back to the classroom is unlikely per a current study (Luebcke et al., 2022), distance learning alternatives have to be established to foster social integration targeted at completing the thesis. Virtual worlds are a promising approach to solving this problem because they encourage social presence, i.e., the feeling of being together (Edirisingha et al., 2009). Rinn et al. (2023) identified a research gap in prescriptive design knowledge for social interaction and social integration purposes in the context of higher and further education.

Against this background, we address the following research question (RQ) to be studied at a fully digital German distance education University of Applied Sciences where students may never meet in person:

**RQ: How to design a networking event in a virtual world to promote the social integration of students and thesis writing in distance education?**

To answer the research question, we describe the relevant theoretical background leading to the idea of applying a virtual world due to its social presence, detail the methodology based on the design science research paradigm, and present the results from three design cycles and five evaluations. We discuss the results and derive implications for researchers, practitioners, and virtual world developers, and conclude with a summary and limitations for this study.

**Theoretical Background**

Academic study programs require self-determination, self-control, and planning skills for gaining and applying knowledge (Engberding et al., 2017). These requirements are even increased for thesis writing (Pravita & Kuswandono, 2022). Social integration, e.g., through peer presence or emotional support can be supportive for finishing the thesis and can lower the risk of thesis procrastination (Kindermann, 2015; Rennie & Brewer, 1987; Tuasikal & Patria, 2019). Nevertheless, social integration is challenging in distance education, with the result of missing social control and support so the probability of thesis procrastination rises (Sari & Kusumaningrum, 2022). Procrastination in general refers to "the voluntary delay of an intended and necessary and/or [personally] important activity, despite expecting potential negative consequences that outweigh the positive consequences of the delay." (Klingsieck, 2013, p. 26)
In the Rubicon model of action phases, procrastination occurs at the "critical point [...] of action initiation" (Engberding et al., 2017, p. 419), i.e., the core of procrastination is an intention-action gap (Steel, 2007). The virtual event to be designed should address and bridge exactly this gap. The lack of social control due to insufficient social integration can be overcome by synchronous digital measures with social presence. Social presence is the extent to which digital communication is close to physical communication (Rice, 1992; Short et al., 1976). Originally a communication theory, social presence theory has entered educational research, especially in combination with virtual worlds (Edirisingha et al., 2009). Due to their high social presence, virtual worlds are widely spread in education covering different disciplines (Rinn, Khosrawi-Rad, et al., 2023). Social presence is influenced by the identification with the avatar representing oneself (Nadolny & Childs, 2014). Designing a course in a virtual world requires knowledge of technology, pedagogy, and content, and especially the intersections of those areas of knowledge in accordance with the Technology Pedagogy Content Knowledge (TPCK) framework (Mishra & Koehler, 2006) and should be made sure to be present when designing the measure collaboratively (Stahl, 2004).

Mentoring is a learning relationship between the mentor, an expert who can provide guidance and support, and the mentee, whose support areas are academic, professional, or personal (Etzkorn & Braddock, 2020). Mentoring can be formal, e.g., in so-called mentoring programs (Burlew, 1991) or informal (Etzkorn & Braddock, 2020). It was initially defined in an institutional context when an executive made a career happen. Later the mentee was made responsible for the outcome (Burlew, 1991). In the late 1990s mentoring reached higher education research (Alonso-Muñoz et al., 2023). Current research trends in higher education are on mentoring for minorities (Alonso-Muñoz et al., 2023). Furthermore, studies reveal that mentoring can positively influence academic performance (e.g., Fox et al., 2010) and students’ retention (e.g., Bettinger & Baker, 2011), but also decrease stress and enable self-efficiency (Alonso-Muñoz et al., 2023), problem areas of procrastinators.

**Methodology**

To answer the RQ we designed a measure following the Design Science Research (DSR) approach (Hevner, 2007). DSR ensures scientific rigor in designing artifacts and generates abstract design knowledge. The workflow and structure of the steps performed are based on Vaishnavi & Kuechler (2007). Within the five evaluations across three design cycles, we followed the Human Risk and Effectiveness strategy (Venable et al., 2016). In general, we planned to follow the rule to have 8 to 12 evaluation participants based on Hwang & Salvendy (2010). The following table reveals the course of action performed in May and June 2023.
Table 1: Steps performed within the design cycles

<table>
<thead>
<tr>
<th></th>
<th>Design Cycle 1</th>
<th>Design Cycle 2</th>
<th>Design Cycle 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Awareness of the problem</strong></td>
<td>Covered in introduction and theoretical background based on literature</td>
<td>Written interviews on students’ demands</td>
<td>Unchanged since prior cycles</td>
</tr>
<tr>
<td><strong>Suggestion</strong></td>
<td>Preliminary mapping diagram with design principles</td>
<td>Extended mapping diagram and design features</td>
<td>Confirmed design principles and design features</td>
</tr>
<tr>
<td><strong>Development</strong></td>
<td>Minimum Viable Product 1 (MVP1)</td>
<td>Minimum Viable Product 2 (MVP2)</td>
<td>Prototype roll-out to real students</td>
</tr>
<tr>
<td><strong>Evaluation</strong></td>
<td>Focused expert group interview with MVP1 as object</td>
<td>Focused expert group interview with MVP2 as object</td>
<td>Group interview &amp; quantitative evaluation with participants</td>
</tr>
<tr>
<td><strong>Conclusion</strong></td>
<td>Revision of mapping diagram and design features</td>
<td>Confirmation of design principles and design features</td>
<td>Confirmation of design principles &amp; design features</td>
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<td></td>
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<td></td>
<td>Effectiveness of measure</td>
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After we had narrowed down the problem space via literature research, we developed a first suggestion in the form of a mapping diagram as proposed by Möller et al. (2020). From a priorly conducted systematic literature review (Rinn, Khosrawi-Rad, et al., 2023) we identified relevant theoretical foundations and derived meta-requirements and from them elicited design principles (Gregor et al., 2020; Möller et al., 2020). The resulting preliminary design principles from our reflective development strategy were the basement for developing the design features (Möller et al., 2020). To evaluate these design features and principles we organized a focused interview with experts from the domain. A focused interview is targeted at gaining insights on an object (in our case the MVP) which is presented during the interview (Döring & Bortz, 2016; Ries, 2011). The selection of the virtual world for the MVP was based on the market experience duration and the availability of an in-world editor for easy adjustments and adaptations. Design Cycle 1 was finished with a revision of the mapping diagram and the corresponding design features. To gain further insights into our target group in Design Cycle 2, we asked students about their needs and expectations for the announced course in terms of the upcoming thesis in a written interview as proposed by Schiek (2014). This kind of interview was chosen because a synchronous interview with mainly students in a full-time occupation (Alonso et al., 2017) was judged to be unrealistic. Another focused expert group interview was conducted based on
the revised MVP. The focused interview as well as the students’ interview results led to a revised mapping diagram and design features for Design Cycle 3. Two group interviews were conducted synchronously at the end of the measure in accordance with Flick (2007). The interview guide reflected the design principles and their effectiveness. The interview recordings made with Microsoft XBOX Game Bar were automatically transcribed with Microsoft Word and coded with MAXQDA. The code system was deducted from the interview guide and subcategories were complemented exploratively. In addition to the qualitative evaluation, we conducted a quantitative survey hosted at umfrageonline.com. The validated constructs we included were facilitating conditions, social presence related to the virtual world, technology experience, and computer self-efficiency following Brown et al. (2010). Furthermore, we added social presence related to the course communication following Arbaugh et al. (2008) and avatar identification following Van Looy et al. (2012). Behavioral intention to use the mentoring program, start the thesis, contact a potential supervisor, and contact peers from the course were asked with two items each following Venkatesh et al. (2003) to capture intention and (planned) action. Therewith, we can identify potential gaps relevant to procrastination. To rate the different support measures, we invented our questions on the importance of a support contact, manual, offline tutorial, introductory video, and synchronous introduction. In addition, we asked for demographic information. So, the quantitative evaluation is complementary to the qualitative one which has a focus on gaining further insights into the target group and the overall effectiveness of the measure towards the goal of making students start their bachelor's thesis.

Results
To answer the RQ, we followed the pattern proposed by Vaishnavi & Kuechler (2007). In the following chapter, we describe the evolvement of the final design over three design cycles for suggestion, development, and evaluation.

Suggestion
We reanalyzed the MAXQDA file of a priorly conducted systematic literature review (Rinn, Khosrawi-Rad, et al., 2023) to identify common theoretical foundations for virtual world application in the educational domain. We systematically filtered them for relevant theories contributing to our research question. We identified the Constructivist Learning Theory (Jonassen, 1994), the Social Presence Theory going back to Short et al. (1976), and the Technology Acceptance Model (Davis, 1989), which we substituted with the newer and more detailed Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. (2003). Furthermore, we added Identity and Control, and Strong / Weak Ties as relevant for virtual worlds in distance educational settings with the aim of social networking (Rinn, Necker,
et al., 2023). In terms of bachelor thesis procrastination, we found the *Theory of Thesis Blocking* (Rennie & Brewer, 1987) and the so-called *Rubicon Model* (often referred to in the context of procrastination) that explains the human decision-making process (Heckhausen & Gollwitzer, 1987). From the theoretical foundation, we derived meta-requirements and in a later step design principles (DPs). In *Design Cycle 2* we added user stories (USs) from the students’ interviews on their expectations before the actual course. One US led to a new user requirement and an additional DP. After *Design Cycle 2*, no revision or addition to the DPs was made. The mapping diagram depicts the derivation process along the three design cycles.

**Figure 1: Mapping diagram (in accordance with Möller et al., 2020)**

**Development**

The development process brought up design features (DFs) that were iteratively revised and refined in the three design cycles. The following DFs described reveal the final version.

**DP1 (online learning setting)** was translated into three DFs. DF1.1 is to keep technical barriers low with the solution selected to not exclude potential participants from joining. The solution selected has low hardware and bandwidth requirements according to its manual and is available for Windows and MacOS. DF1.2 is closely related to DF1.1 and marks the selection
of the tool from a functional perspective. We chose a professional multi-user virtual world (TriCAT spaces) that supports spatial audio, a selection of avatars to choose from, lip sync, and automatic gestures. The avatars and the environment look realistic, and the navigation is optimized for mouse and keyboard. This is an advantage over e.g., Engage, another commercial and realistic solution optimized for head-mounted displays. TriCAT spaces come with a room scenario (called Coaching) with a large park area and a patio outside a small building with three rooms. This realistic and informal environment should create social presence and a videogame-like and fun learning setting for a positive attitude. The learning setting was presentations on one hand and a gallery with posters and referents next to them for a fair experience on the other hand. DF 1.3 represents the scenario editor included that enables non-technical staff like teachers to adapt the scenario by adding e.g., pillars with self-made content, virtual notebooks with screen-sharing functionalities, and other objects or furniture.

**DP2 (course design)** was set up by five DFs. We combined technical introduction and peer exchange (partner interview on a topic free to choose) to an informal warm-up when participants joined consecutively in the first 10 minutes (DF2.1). In the subsequent introductory presentation of 20 minutes, we explained the structure and the process of writing a thesis. Furthermore, the Rubicon model was introduced to make participants aware of human decision making and we advertised the mentoring program from DP5 (DF2.2). For students’ activation and for supporting the construction of knowledge we subsequently had students walk freely through the fair area in the virtual park for 45 minutes. We supported students’ orientation with numbers on the posters and arrows for a round course on the floor. Each booth contained a poster and was accompanied by a referent who explained the presented content but also answered additional or general questions. The topics covered were literature search, statistics search, workflow on filtering search results (tool-based), and citation. Due to the spatial audio avatars who stand further apart hear each other fainter or not at all. When too many participants were talking too close to each other an audio area could be added spontaneously as visible in Figure 3 on page . Students could also have bilateral chats on informal topics while walking through the park (DF2.3). For the consequent presentation, students were summoned with the *Open Voice Channel* function that transmits the voice independently from the distance to the other participants. The presentation aimed to help students find and formulate a topic and the corresponding potential supervisor by explaining methods and revealing where additional information can be found (DF2.4). At the other end of the park, a cinema area was set up with an automatically playing video on formulating a research question and the corresponding topic relevance (DF2.5).
DP3 (technical support) is represented in another four DFs. At the very beginning of the project, we provided technical instruction to all employees involved, namely professors, referents, and supporters to make sure the course design can be developed collaboratively along the TPCK framework. Employees only marginally involved in the project, namely class management and student support services, were informed in advance so they could react accordingly in case they got questions from students (DF3.1). We sent a pre-announcement of the course with a contact person named (equal to the sender) for any type of questions. The same contact was named in the registration e-mail two weeks in advance (DF3.2). In the registration e-mail, we included a small step-by-step instruction and a link to a Zoom session that started 30 minutes before the actual course, so that those who needed help could gain support for installation and login voluntarily (DF3.3). The technical introduction to the virtual world at the beginning of the course was performed by two referents taking the support role as an additional one. Having two supporters available makes sure participants with problems gain immediate help. In general, the introduction was informal and playful and combined with the partner interview from DF2.1 (DF3.4).

DP4 (curriculum integration) is found in two DFs. The course participation was voluntary (DF4.1). The students invited directly via e-mail were selected by the following criteria. All students were business bachelor students with 140 to 170 credits. This potential target group consisted of 102 students, 70 of whom had started their study program in 2017 or earlier and are likely to procrastinate (DF4.2).

DP5 (post-course mentoring) is revealed in two DFs. The mentoring program added in the Design Cycle 2 is offered by the referents participants get to know during the fair visit. This fact ensures a lower hurdle to contacting a mentor compared to naming persons on a list. Furthermore, students can choose a person who is sympathetic and trustworthy, especially students with a procrastination history, who might feel embarrassed (DF5.1). Contentwise the mentoring concentrates on task structuring, time management, and emotional support (DF5.2).

Evaluation
Evaluations were made along the complete design process and included the perspectives of professors, technical experts, and students. The following graph reveals the evaluation method, target group, sample size, and corresponding design cycle following the evaluation framework of Venable et al. (2016).
In the following section, the evaluation results are described chronologically as indicated in Figure 2.

The **focused interview with experts** was conducted within TriCAT spaces, with the adaptations that have been made with the included scene editor in advance in Design Cycles 1 & 2. The interviewees consisted of three professors, one of them vice-rector, and five experts on virtual worlds for educational purposes. The focused object, which is the central part of a focused interview, is the derived design features from DP1 to DP4. Therefore, the interview was taking place in the virtual world. The results of the interview as well as the actions taken for Design Cycle 2 can be summarized as follows: All design features of DP3 and DP4 were confirmed. DF1.3, the fair-like presentation, was generally accepted but detailed with the posters being put on a cuboid to be visible from four sides to extend the number of students to view the posters at the same time. Furthermore, the poster content was adapted to better fit the target group of bachelor students. DF2.2 and DF2.5 were added.

The **students’ interviews** were announced within the identified target group of 102 students. Only three students participated and added the user requirement for an accompanying mentoring program (named twice and backed by literature), plus a confirmation of two already existing meta-requirements. This addition in Design Cycle 2 is reflected in Figure 1, on page . The second **focused interview** with experts in Design Cycle 2 was held with a subset of interviewees of the first one (two professors, and two virtual world experts). All DFs and DPs
revised in Design Cycle 1 were confirmed, accepted, and approved to be rolled out with students shown in the following figure.

![Figure 3: Fair-like, informal design of the learning setting](image)

12 of the 16 registered students participated in the course in Design Cycle 3. 11 students were enrolled in business administration targeting a bachelor’s degree, and one student was still in a diploma program. The digital affinity is high for students at the distance learning university since it is completely remote and digital (Blumentritt et al., 2020). Four of the 12 students started their studies in 2017 or earlier, so one-third of the participants are potential procrastinators. Compared to the rate among those contacted initially (67% procrastinators), procrastinators are underrepresented in the course. Two of the participants made use of the voluntary virtual world installation and login support. Three participants extended the course duration of three hours voluntarily by another 30 minutes to watch the video and ask additional questions.

Toward the end of the course, we held two group interviews with 10 of the 12 participating students (three and seven). In terms of DP1 (online learning setting) and its corresponding design features, the advantages named by the students (12 nominations) outperform the disadvantages (4). Advantages named were e.g., the social interaction (3 persons), the format virtual world itself (3), and the option for bilateral conversations (2) as well as the game-like character (1). Disadvantages mainly targeted the technical hurdles: Installation (2), the additional time needed (1), and the headset that is a prerequisite for the spatial audio to not produce an echo (1). In terms of DP2 (course design) the main positive aspects (9) named
were e.g., learning about literature search options in the learning management system (2), meeting the own supervisor (1) or learning where to find topic areas for those who do not have an idea for a topic yet (1). The disadvantages were partly heterogeneous, e.g., in terms of the duration, while one regarded the three hours as too long, the other would have preferred to have slightly more time. The same for the fair setting: Two would have preferred a presentation over a fair, while three explicitly praised the fair-like setting. Two mentioned that they wished to have had such a session at the very beginning of their study program. While DP3 (support and training) was rated positive in general (5), the criticisms all point in the direction of the login process. Two students admitted that they had not read the invitation e-mail containing the installation link because they had expected a process comparable to teleconferencing tools. Another student thought the registration link was a login link and had obviously not read the invitation thoroughly as well. Only two students had an improvement idea addressing training: the instruction at the beginning should ideally be separated from the course and available asynchronously. DP4 (curriculum integration) was rated positive in terms of voluntariness (1), participant composition based on similarity concerning study subject and progression (1), and well-positioned before the thesis to decrease anxieties (1). One student described a procrastination situation of four years of postponing the thesis and felt bad in the company of students finishing within the standard period of study. Rating the achievement level of the goals set with the course, three students have noted down one or more names of potential mentors, one of them had the plan to contact a certain mentor. Four explicitly said they wanted to start the thesis soon. Four already had a supervisor before the course, one found the supervisor in one of the two presenting professors. Four students mentioned to have a more detailed view of their potential topic, one would have preferred to have concrete topic proposals presented in the course. The networking aspect was rated positive twice but with one remark, that social networks are especially important during the initial phase of the study program.

The day after the course in Design Cycle 3 the participating 12 students were provided with the documentation and the link to the survey for **quantitative evaluation**. Nine students participated in the survey. The age ranged from 25 to 56 with an average of 34 and a median of 27 years. All items are measured with a 7-point Likert (agreement) scale with no inversion (1=strongly disagree; 7=strongly agree). The following table reveals the summarized results.

**Table 2: Quantitative evaluation results**

<table>
<thead>
<tr>
<th>Construct name</th>
<th>Cronbach’s Alpha</th>
<th>No. of items</th>
<th>Mean</th>
<th>Standard Deviation (SD)</th>
</tr>
</thead>
</table>

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Facilitating conditions (resources, knowledge, support) are rated rather high (mean 5.82) with a moderate standard deviation (SD 1.57), comparable to the slightly and in general higher rated computer self-efficiency (mean 6.15, SD 1.08). Nevertheless, technology experience is technology-dependent and individually differing. While technology experience in videoconferencing is well established among participants (mean 6.00, SD 1.12), video-gaming is less distributed and individually different (mean 3.89, SD 2.57), and professional virtual world experience is little in general (mean 2.44, SD 1.81). Social presence related to the course communication is good in general (mean 5.18, SD 1.28). The social presence related to the virtual world on average is even higher (mean 5.59, SD 1.17), but there is one item value that is out of line (I was able to form distinct impressions of some course participants, mean 4.11; SD 1.62). Removing that item increases the average to 5.32. Since the avatar identification is generally very low (mean 2.22; SD 1.38), this might be the reason for the low impression of peers. We could neither confirm nor disprove the age-relatedness of this identification issue due to the small sample size. Another item below average (construct: social presence related to the course communication) is the virtual world is an excellent medium for social interaction with a mean 4.67 and an SD 1.23. The rating of the support measures is revealed in the following diagram. Besides the introductory video, all other measures were already in place for the course prototype, but in the case of the offline tutorial not explicitly communicated.

<table>
<thead>
<tr>
<th>Facilitating conditions</th>
<th>0.774</th>
<th>3</th>
<th>5.82</th>
<th>1.57</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support measures</td>
<td>0.723</td>
<td>6</td>
<td>5.22</td>
<td>1.49</td>
</tr>
<tr>
<td>Social presence related to the virtual world</td>
<td>0.745</td>
<td>3</td>
<td>5.59</td>
<td>1.17</td>
</tr>
<tr>
<td>Social presence related to the course communication</td>
<td>0.924</td>
<td>9</td>
<td>5.18</td>
<td>1.28</td>
</tr>
<tr>
<td>Technology Experience</td>
<td>0.704</td>
<td>3</td>
<td>4.11</td>
<td>1.83</td>
</tr>
<tr>
<td>Computer Self-efficiency</td>
<td>0.925</td>
<td>3</td>
<td>6.15</td>
<td>1.08</td>
</tr>
<tr>
<td>Avatar identification</td>
<td>0.922</td>
<td>4</td>
<td>2.22</td>
<td>1.38</td>
</tr>
<tr>
<td>Behavioral intention</td>
<td>0.813</td>
<td>8</td>
<td>4.45</td>
<td>1.77</td>
</tr>
</tbody>
</table>
Figure 4: Evaluation results for support measures

The behavioral intention can be seen as a general effectiveness evaluation of the measure and is depicted in the following figure.

Figure 5: Evaluation results of behavioral intention

In the 7-point Likert scale used, the value 4 would be neutral, higher would indicate a more probable action, and lower a less probable action. In the Rubicon model by Heckhausen & Gollwitzer (1987), the plan to act is closer to the real action than the intention. A high gap between an intention value and an action value indicates that people have not made up their minds yet to act. Comparing the action plan values (I plan to…), peer contact is the least probable action for participants (mean 3.67, SD 2.12), followed by officially starting the thesis (mean 4.00, SD 2.12). The high SD indicates high individual differences. Contacting the supervisor is slightly positive (mean 4.33, SD 1.94), and contacting a mentor is the most probable action to be taken by all participants (mean 5.22, SD 1.09). The gaps between intention and action are generally low (mentor 0.45, thesis 0.0, supervisor 0.45, peer 0.22). Two participants contacted a mentor within the four weeks (both procrastinators), the other actions are not transparent to us. The mean for all plan values is 4.31 and slightly higher than neutral. Due to the low duration of four weeks during the holiday season and the fact that one-third were most probably procrastinators (started in 2017 or earlier), the measure itself can still be interpreted as effective.
Discussion

Five evaluations were made during the three design cycles, three evaluations were rather formative, and two were summative. In this discussion, we concentrate on the summative feedback, i.e., the students’ group interview at the end of the course and the quantitative evaluation after the course. We argue that the summative evaluations already include the feedback from the previously made formative evaluations.

Although we have evaluated our prototype course with non-technical related students, quantitative results reveal a very high computer self-efficiency. We assume this is a consequence of the digital study model of the distance education institution, that these students have consciously selected. Nevertheless, students name technical hurdles like an installation as the main disadvantages of the online learning setting and criticize the additional time effort. We conclude that the technical hurdles are negative due to time efforts rather than the lack of technical knowledge or self-confidence. The online learning setting in the virtual world was praised for its social presence and the suitability for social interaction in the interviews but social interactions scored below the average with a low SD in the survey. Our interpretation is, that the low avatar identification could have caused that. Problems with avatar identifications, when the selection is very limited (around 20 per gender), have also been uncovered in a prior study (Rinn, Necker, et al., 2023), our quantitative survey results add insights into the extent of this deficit.

Qualitative results indicate that individual solutions or options are necessary to prevent resistance and meet individual demands, e.g., in terms of a more flexible course duration by offering asynchronous content like videos. This is due to individual differences in the perception of the course duration and design (presentation vs. fair). This result highlights the urge for autonomy as indicated in the technical foundation identity and control. Although two students had preferred asynchronous virtual world technical training, the need for an offline tutorial was rated rather low with a high variance. We conclude that one should address individual preferences again in terms of introduction and communicate the options explicitly. The statement that social networks to peers are especially important during the starting phase of the study program is in line with another study in the context (Rinn, Necker, et al., 2023). Before starting the thesis, contacting faculty members is more important to students in distance education than contacting peers.

Implications for research are on how to increase the participation rate of only 12 out of 102. Especially the rate of procrastinators should be increased with two-thirds being among the identified target group and only one-third being among the actual participants. Advertising via marketing, the publication of success stories, and direct contact via phone could be evaluated
for effectiveness and add additional design features for curriculum integration. Furthermore, a long-term study with a larger focus group for measuring actual success in terms of e.g., thesis grade compared to those not participating in the measure would gain additional insights into the effectiveness. Teaching method variances could refine or diversify design features and potentially design principles. Researchers should include further perspectives like marketing, class management, and student support services to inform practitioners on how to perpetuate the solution. Since mentoring was the lowest hurdle for participants to get started with the thesis, a standalone mentoring program could be developed in another design science project. For higher scalability, solutions with artificial intelligence-based conversational agents should be designed (Khosrawi-Rad et al., 2022).

Implications for practitioners are the fact that an introductory video would be of help for future courses as an additional option. This result aligns with qualitative results that e-mails are not read carefully and the login process is expected to be comparable to videoconferencing solutions. The synchronous session for login support that was voluntary in advance of the course was given a rather low priority and we conclude it should not be made mandatory. A direct contact person during and before the sessions is important. Although not read by everyone, a written manual is still seen as a helpful tool for the introduction. A procrastination hotline could help to increase the participation rate among procrastinators and de-taboo the problem. Separate courses for long-term and regular students should be offered to decrease embarrassment for procrastination and ideally increase their participation rate.

Implications for developers of virtual worlds either for research or commercial purposes are to adapt the login process to well-known videoconferencing solutions since this is the expectation of full-time working students for efficiency. The availability of a web application would make the installation optional. For better identification with the avatar, the choice and individualization options must be increased from today’s mostly preconfigured 20 avatars per gender. Also, diversity aspects must be considered to foster inclusion. Successful business models like the free-to-play FORTNITE have proven, that customers are willing to pay for avatars, which underlines the importance (Schöber & Stadtmann, 2020).

Conclusion

Following the design science research approach, this study contained three design cycles and five evaluations. While the first three evaluations were rather formative and exclusively qualitative, the evaluation of the last design cycle and the naturalistic prototype with real students was both qualitative and quantitative. The formative evaluation results went into the
naturalistic summative evaluations in design cycle three. Therefore, the results focused on the final two evaluations. These results reveal that a fair-like measure in a virtual world introducing a mentoring program and covering organizational topics as well as methods and tools fostering thesis writing is efficient. The validated and final design principles for the design of the intervention are the online learning setting in a virtual world, the course design to activate students, technical support before and during the course, curriculum integration for a homogenous target group, and post-course mentoring for continuation. These result in various implications for researchers, and the numerous design features developed reveal implications for practitioners and virtual world developers. The main contribution is a scientific rigorously developed blueprint including the perspective of multiple stakeholders that can be easily applied to other educational institutions. Due to the high digital affinity of the business-related target group, the blueprint is transferable to more technical students in information systems education.

In the study we assumed that the duration of being in the study program is the only predictor for procrastinators. This is a simplification in the absence of qualitative data. There might be other factors like financial burden or lack of time that caused the extension of the duration of study. Furthermore, we initially planned to follow the rule to have eight to 12 evaluation participants based on Hwang & Salvendy (2010) but failed in two cases. With the high number of evaluations (five) in three design cycles this limitation is negligible. Furthermore, the interview groups were unequal (seven and three) because we let them choose the group. An equal distribution would have been ideal. Since all evaluations took place in the same educational institution the results are context-bound to a certain degree.

For productive usage, scalability, and cost-effectiveness new technologies should be monitored for applicability and value-add. Promising technologies could be artificial intelligence for technical support or even post-course mentoring. Furthermore, head-mounted displays mirroring mimics to the virtual self or controllers transmitting gestures would increase the number of nonverbal cues and thus social presence. The options for methods to be transferred from face-to-face to online would increase as well. For a productive operation, the stakeholders identified in this study are students, professors or teachers, rector, IT support staff, class management, student care services, virtual world developers, mentors, and marketing staff.

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References


FROM STUDENT EDUCATION TO SOCIETAL IMPACT
ASSESSING UNIVERSITY VALUE

Bart van den Broek  
University of Amsterdam  
bart.vandenbroek@student.uva.nl

Emőke Takács  
ERI Hungary – European Research Institute  
t.emoke@eri.net.in

Toon Abcouwer  
ERI Hungary – European Research Institute  
toon@abcouwer.nl

Abstract:
The turbulent times that have marked the start of the 21st century have brought along new, seemingly impossible existential questions that reinforce the importance of a good relationship between the academic community and the world. This research looks at how university students and members of society perceive the value a university provides. This was done by conducting interviews with 5 students of the University of Amsterdam, 5 members of Dutch society who had no direct ties to any university organisation and finally a member of the Executive Board of the University of Amsterdam. The mismatch in understanding we found, highlights the need to find a way to bridge the gap between societal expectations and the examined university’s sense of value. For this, parties must prepare and solve complex challenges ahead of modern society. While stressing the importance of education, we also paid explicit attention to the role IS/IT plays in performing the task by a university. As the research was conducted as a thesis research project that had to be prepared in three months, as a research method, we used the approach of a single-case study within the University of Amsterdam.

Keywords: value, University mission and vision, Me-We-All approach

“If you think education is expensive, try ignorance”
-Derek Bok

I. INTRODUCTION

With modern developments such as the rise of artificial intelligence, increased scepticism towards governmental agencies and the scientific community, and rising prices of student housing and loans, the landscape of higher education is rapidly changing in the Netherlands. This makes it more critical than ever to understand a university’s value. Besides shaping students’ intellectual development, higher education organisations play a crucial role in contributing to societal progress. Thus, evaluating how students, the broader society, and the university itself perceive the value of a university is of great importance for ensuring its continued relevance and effectiveness. By identifying this gap, this research tries to make clear the importance of education in contemporary society as well as the role of IS/IT supporting the bridging of it.

II. CONCEPTS

II.1. Values
Defining values, the core principles that guide our lives can be surprisingly difficult despite their profound impact. Values shape us internally: our moral compass and concept of right and wrong, but also externally, our outlook on factors such as family, community, religion, and politics. People aren’t born with values like they are born with arms and legs; they are imparted to individuals through direct parental guidance, where parents teach their children about appropriate behaviour, as well as through indirect influences such as positive and negative responses received from the outside world (Schwartz, 2012). Values are continued throughout generations through culture and tradition, as adults who were brought up with specific values pass them to their children, who will, in turn, pass them to their children. Along the way, values change as society itself changes and evolves. This evolving nature of value and the complex interplay of personal
and societal values make it a challenging subject to grasp. We will look at values through three distinct perspectives: individual, organisational, and societal.

**Personal values**

Personal values are the central foundation of people's everyday decisions. Unfortunately, values are never stationary, rarely independent, frequently in conflict with other values, and always challenging to define accurately. Values themselves will change in time as well as in the environment. Besides that, values constantly clash with each other.

If values are so hard to grasp, how can we begin to define them, let alone consistently act accordingly? Argandoña (2003) proposes that *values are central desires or beliefs regarding final states or desirable conducts that transcend specific situations and guide the choice and evaluation of our decisions.*

**- Students’ values**

Focusing specifically on the values of higher education students, we see that they are shaped by their personal experiences, expectations, and goals, just like any other personal values. Besides individual differences between students, there are some common denominators of common values that students share, according to recent literature.

One of the most common values of students is high-quality teaching and learning. Students expect their teachers to be knowledgeable, engaging, and supportive, and they expect their assignments and literature to be adequately challenging, relevant and meaningful. Students who feel that their teachers and coursework meet their expectations are more likely to be motivated, engaged, and successful (Sander et al., 2000).

Students greatly value the availability of support and resources and access to educational resources such as academic advisors, tutors, libraries, and software that help them succeed academically. They value support for their mental and emotional well-being, counselling services, wellness programs, and peer support groups. When they feel that their education organisation provides adequate support and resources, they are more likely to feel empowered and confident in their ability to succeed. (Crisp et al., 2009)

The value of a sense of community and belonging is to feel connected to direct peers, teachers and the general academic community, ensured by social events, extracurricular activities, and opportunities for collaboration and teamwork. A study by O’Keeffe (2013) has shown that when students feel that they belong to a supportive and inclusive community, they are more likely to feel motivated and engaged in their education programs.

**Organisational values**

A common definition of an organisation An organisation consists of different individuals working together to reach a shared goal. All individuals naturally have personal values, and opinions, while an organisation sets values to implement and show to the outside world. Organisational values have some unique characteristics: some values serve to create an identity to the outside world (Ashforth & Mael, 1989), help establish a culture within the organisation (McKinnon et al., 2003) and are shared between organisational leadership and its employees to determine employee fit (Cable & Edwards, 2004).

**- Values in organisational identity**

These values are used for marketing strategies as potential customers want to purchase from companies they feel connected to, which means companies that represent the same set of values that they do (Karababa & Kjeldgaard, 2014). Most companies operating in Western markets will proudly showcase their values aligned with popular Western values to boost sales. Other values are issues proudly represented and actively stood by but not necessarily in line with the personal values of the organisation’s employees and management.

Understanding organisational values can be challenging. Identifying those truly carrying organisational values is difficult since the organisation is an artefact and technically cannot carry them. When examining organisational values, critical analyses check if they are genuinely integrated into the organisation’s existence rather than being utilised solely for marketing strategies.

**- Values in higher education organisations**

Higher education organisations develop, implement, and uphold a clear set of values that align with their services. The values a university represents shape the culture and ethos of the organisation and influence students’ learning outcomes. *These students will, at some point, take over control from the current generation. Therefore it is of the utmost importance to carefully think about what they are being taught and how and in what environment they are taught* (Cortese, 2003).

The mission statement of the organisation describes its purpose, its reason for existence and who or what it intends to serve. In contrast, the vision statement describes the future plans and aspirations of the organisation. The mission and vision provide a framework for the organisation to develop a final strategic
Values in society

Societal values are the foundation of how people interact with each other in their environment. They define what is considered acceptable or desirable and what is good or bad in a community. It can be influenced by many dynamic factors, including culture, religion, history, and politics, that change over time as society evolves (McClintock, 1978). Humans are social beings who rely on their community for personal well-being and survival. The foundation of this community is shaped by its values, which are, in turn, shaped by culture and tradition. People expect others within their community to uphold and represent the same values that they do, the idea being that if everyone works together in the same direction, everyone prof-its (Maryanski & Turner, 1992).

Societal values also play a crucial role in defining individual identity. People often develop their sense of self-based on the values of the society in which they live. These values can influence people’s beliefs, behaviours, and attitudes towards others. There is, therefore, an essential dynamic between the personal and societal scale: personal values influence society’s when shared by a group of people, and societal values influence individuals taught and considered right or wrong. Figure 1 provides a visualization of this interaction, in which individuals can be seen exerting influence on the society they operate in, while this same society simultaneously influences these individuals.

Determining the difference between personal and societal values is a complex and challenging task due to several factors. Most important is the subjective nature of value; every person and every society will inevitably have some differences in their values based on fundamental differences in history and experiences. The interconnectedness of personal and societal values further complicates the distinction, as societal norms and vice versa shape personal values. Additionally, personal and societal values are dynamic, evolving in response to individual growth and societal changes, making it hard to pinpoint what values are present accurately. Conflicting priorities can arise when personal interests clash with the greater good of society, making it difficult to prioritize one over the other.

Despite these challenges, recognizing the existence of both personal and societal values is crucial for comprehensive decision-making. In this research, we work with the idea that societal values are similar to personal values but shared by many people in which they are the benefactors.

Interaction between values

Organisational values are generally established by an organisation's leadership team and are meant to align with its mission, vision, and goals. They serve as guiding principles for all employees and are essential in creating a functional and healthy work environment. The organisation as an entity can also have its values, independently from the management. Societal values are shared and shaped by cultural norms, traditions, and history and are often reflected in laws and social policies. Sometimes, values are hard to separate. In general, careful analysis of who benefits from a final state is a way to determine whether a value is predominantly personal or societal.

II.2. The ‘Me, We, All’ Approach

While individual values can differ significantly from organisational and societal values, they are not necessarily in conflict. Organisations often seek to promote and support specific values that align with those held by individuals or society. The “Me, We, All Approach” by Abcouwer et al. (2022) discusses the relationships and the importance of balancing the different perspectives of individuals (Me), organisations (We) and society (All). ‘Me’ refers to the personal perspective of the individuals with their values, desires, strengths, likes, dislikes, etc., that commonly form the foundation of their doing. ‘We’ translates to the organisational or group perspective, which consists of many individuals who work together towards a shared goal and individual benefits. ‘All’ is the largest group of ‘We’ imaginable consisting of ‘Me’ individuals organised in society.

Usually, organisations focus on offering products or services for a group of individuals and make profits for the stakeholders, we consider this to be “traditional organisations”. More and more, there is a focus shift toward doing good for the nature and the society. Profit organisations are more ‘Me’-focused, while non-profit ones benefit society (All).
Figure 2: Organisations usually focus on Individual ('Me') or Societal ('All') needs

Figure 2 provides a visualization of the direction in which two organisation types, a traditional organisation and a non-profit organisation, focus their values. A traditional organisation, as mentioned before, is primarily focused on offering products and goods in exchange for money, providing value to the stakeholders, in this context the "Me’s. There is naturally always some second-hand effect on larger society as these products and goods generally provide value to the lives of their buyers, as visualized by the dotted line towards the 'All' direction. A non-profit organisation is quite opposite, in which the focus lies in providing value for society with a small second-hand effect on individual stakeholders.

The purpose of a university: Me, We or All?
Universities are public non-profit institutions aiming to deliver high-quality education to students and advance global knowledge through research (Boulton & Lucas, 2011). They focus on students in the 'Me' direction, offering high-quality education (which students expect) and research that organisations (We) and society (All) will benefit. Society expects a university to educate students and thus prepare them for taking jobs. A central task is also to conduct research answering questions important in society. This interplay of interests creates critical dynamics among Me-We-All, where a balance between individual and societal concerns and values is necessary.

As seen in the figure, universities are perfectly in the centre between the parties. This ties to corporate social responsibility: operating in a way that respects the environment used by ‘All’ and the people that make up the organisation (Lindgreen & Swaen, 2010).

Understanding the concepts of values, perspectives, and the purpose of a university made us research whether students’ and society’s expectations of a university’s value align with the value that a university aims to provide to these two parties. To find an answer, we conducted literature reviews and interviews at the University of Amsterdam, integrated the findings and compared them to the theory.

II.3 Education and the role of IS/IT
Based on the findings in the previous paragraphs, education plays a key factor in bridging the value gap as identified in par I.1 and focusing on developing a new balance within the me-we-all perspectives as introduced in par I.2.

As this research took place within the boundaries of the University of Amsterdam (UvA), we based our analysis mainly on the policy documents of the UvA. However, as UvA is a highly ranked university in the Netherlands, we consider the UvA to be representative for many other universities in the world.

In general, universities should be aware of their essential role in dynamic developments in contemporary society.

Within our case study at the UvA, the strategic plan is quite explicit in the role UvA wants to play. Taking from the Strategic plan ’Inspiring Generations’ (Universiteit van Amsterdam, 2021a), we’d like to quote the core value statement of the UvA:

“Our core values

The UvA conducts science that seeks to understand and serve the world, without being bound by political, religious or other constraints. We are an ambitious and creative public university in Amsterdam. We are both independent and engaged. We strive for a sustainable, prosperous future and champion justice and equal opportunities. We listen and give people the freedom to ask questions, to show curiosity and to debate. We do this with respect for the contribution, background and beliefs of each and every individual, and in an environment which is socially and intellectually safe. We will defend these values at all times."

The plan also identifies the importance of education in serving both society as well as the human dimension as is shown by the following quote:

“We will ensure that our best academics lecture on our programmes too, because, after all, our programmes have an academic, research-intensive focus. And, as far as the format of our degree programmes is concerned, we will strive for a ‘human dimension’; within the constraints of available resources of course.”

In the Digitalisation agenda (Universiteit van Amsterdam, 2022) the UvA developed in 2022 the following quote reflects the importance of IT/IS in a modern education setting.

“We see digitalisation as a key driver to realise the UvA’s ambitions. In addition, digitalisation also brings with it important responsibilities. That is why we pay close attention to our public values, such as independence, safety and sustainability, and work to remove obstacles that students and staff currently encounter.”

These references to the specific policies of the UvA clearly shows the importance of education and that IS/IT support is crucial in realising this ambition. Even though it was out of scope to compare these policy documents with those of other universities, we firmly believe that many (inter)national universities take a comparable stance.

But how does this work out in a practical situation within the daily practice of a university? In the next paragraph, we further explore the setting in our single-case study.

III. DATA GATHERING

III.1. The student perspective

First and foremost, it was very clear from the interviews with 5 students of UvA that students are almost entirely focused on their relationship with the university organisation. When asked what a “good university” was, the answer was always roughly the same: A good university provides outstanding education and is actively engaged with its students. Research or valorisation did not matter to them. From the student’s perspective, a university’s most important role is to provide good education and prepare students for their future careers.

Secondly, students’ values in higher education are frequently personal, such as honesty and kindness. They want a university where their teachers and peers treat them with kindness and respect and get constructive and fair feedback on their assignments. Closer to the organisational and societal level, diversity and inclusivity appear only after these. This strengthens the idea that from the student’s perspective, the university is there primarily to support them and them alone.

When asked what students believed the UvA’s primary goal should be, they consistently answered that they believed that the university’s responsibility is to educate students and indirectly help society by delivering highly educated people who will later take on important jobs and roles.
The arrows indicate how value should be provided according to students, who believe their university should focus primarily on students. The unfilled blue shadow resembles the expected “central position” from figure 3, from which the university spreads its focus equally between students and society. As seen, students perceive that a university should focus much more closely on its’ students than on society.

III.2. The university perspective

To understand the values of the University of Amsterdam, we first analysed its “Strategic Plan 2021 – 2026, Inspiring Generations” (Universiteit van Amsterdam, 2021a). As referenced in the previous chapter, its primary goal is to improve its internationally renowned position in education, research and valorisation via the following core points.

Inclusivity. As an open, independent, and accessible university, UvA does not bind itself to religious or political ideologies. It includes people from as many different viewpoints as possible and creates an open environment where everyone can safely, respectfully and professionally discuss anything academic.

Engagement. UvA develops more intense, small-scale classes and tailored curricula to improve student-teacher interaction, thus improving the quality of education and increasing the sense of belonging the student experiences in their study program. After the studies, UvA still provides resources to ensure lifelong learning.

Independence. UvA is aware of its evident position in the world, openly promoting and upholding values like independence, honesty and inclusion. To protect the integrity of science and scientists, the university wholeheartedly believes that they must stay independent and not rely on outside parties too much.

Sustainability. UvA, as a sustainable organisation, promotes the use of environmentally friendly materials and reduces general consumption, allows all students to follow any course related to sustainability, and implements the topic in the courses.

Health and Safety. UvA focuses on the mental and physical well-being of students and staff.

Next, we analysed the Mission and Vision of the university (Universiteit van Amsterdam, 2021b) with a clear and consistent message in various publications, as its website emphasises the importance of inclusiveness, diversity and equality or the quality of teaching and learning. It strives to provide an engaging, stimulating, and challenging learning environment and prepare students for a rapidly changing and complex world. They recognise that the world is constantly evolving and that it is essential for their students to be equipped with the necessary skills and knowledge to navigate the challenges of the future.

Finally, the UvA states that research is the heart of their work. Each of the UvA’s faculties conducts high-quality research in their field, which helps to increase knowledge and solve societal challenges. The UvA aims to support researchers by granting funding, storing data and helping publish findings. Ultimately, the UvA considers itself a “leading research university”.

Analysing the published values and arguing whether they are values related to the individuals that make up the organisation (‘Me’), the organisation itself (‘We’), and/or the environment in which the organisation operates (‘All’), we came to the following findings.
Inclusivity is primarily directed towards the individuals: students and staff that make up the organisation. Today it is essential to be inclusive; however, in the end, the students and employees benefit from these values. Therefore, we consider it primarily in the personal direction with a second-hand effect towards society.

Engagement is focused on students, making them feel connected to their program, peers, teachers and the university. They primarily benefit from this approach as they receive the education that helps them develop the skills that will help society. Therefore, we state that this value is focused on students, with another secondhand effect towards society.

Independence for a university is only possible if it relies on funding from external parties. UvA wants to be an independent organisation that is not excessively influenced by external parties such as political parties, wealthy or influential individuals, governmental agencies, digital platform providers or capitalistic organisations. This value is entirely directed towards society.

Sustainability and the environment-friendly initiatives of UvA target society in general.

Health and safety are clearly directed towards the individuals, the students and the staff, who are provided with a healthy and safe work environment.

To verify our findings, an interview was conducted with a member of the Executive Board of the University of Amsterdam, responsible for financial policy, innovation policy, central management of UvA services and the University Valorisation committee. A subset of the questions asked can be found in the annex. The general conclusion we draw from the interview is that the University of Amsterdam is very much aware that it has a responsibility towards both its students and society and that there is a difference in understanding of value between the three groups.

UvA considers itself a valuable university for students when it supports them in becoming critical thinkers who dare to ask questions and can find answers to them professionally and scientifically correctly. Another important goal is that students should enjoy the study experience and develop as human beings. Although UvA wants their students to get good jobs that earn them a sustainable income, this is not their central purpose.

UvA considers itself a valuable university for society when it delivers high-quality research projects that help society in various areas, such as answering societal, ethical, exact and fundamental questions and shape general thinking. The concept of valorisation ensures that research provides value. UvA, with its relatively recalcitrant nature, forms a climate in which everything can be openly questioned as long as it is done respectfully. In other aspects, such as academic performance or quality of research, UvA is similar to other Dutch universities.

When asked how the university aims to balance its responsibilities, the answer was that UvA does not want to be just “a school on a higher level”. UvA is aware that it needs to find a healthy balance between
educating students and conducting research and is currently focused slightly more on conducting excellent research. Educating students provides significant value to society as these students will have to take on many challenges in the future.

The results of the interview show a slight focus in the society direction. But how does this translate in the digitalisation agenda as it was developed based on the strategic plan of UvA?

**UvA’s digitalisation agenda**

In its strategic plan, the University of Amsterdam (Universiteit van Amsterdam, 2021a) clearly states the importance of digitalisation:

>“Since the previous Strategic Plan, the technical capabilities of computers and information technology have increased enormously. At the UvA we generate knowledge that is relevant to the digitalisation of many areas of society. [...] We also recognise the huge impact that digitalisation has on freedom and privacy, and how important it is to take care in this regard.

As far as the way in which we deliver our education is concerned, the effectiveness of learning is at the top of the digitalisation agenda.”

The University of Amsterdam has published a digitalisation agenda in which they describe their goals and aspirations for the future in a more technological context. This digitalisation agenda was published in May 25th, 2022 and is therefore considered up-to-date. The document is divided into multiple chapters, each focusing on a different context in which digitalisation opportunities and risks are assessed. Chapters focus specifically on education, research, management, and sustainability.

The digitalisation agenda (Universiteit van Amsterdam, 2022) describes what UvA plans to do in terms of digitalisation.

>“This translates first and foremost into activities to ensure that digital services are and remain in order, so that our students and staff can study and work easily and effectively. Examples include the digital workplace, student.uva.nl, the digital learning environment and digital testing, the research infrastructure and High Performance Computing.

In addition, the digitalisation agenda gives direction to renewal, so that we respond to new opportunities and risks in time, and digitalisation contributes optimally to the UvA’s ambitions. Within this ‘renewal agenda’, we have the following spearheads:

- Making collaboration easier, both within the UvA and with external parties. For example, with the Virtual Research Environment (VRE), a virtual collaboration environment for researchers;
- Easing the workload of employees. For example, using Robotic Process Automation (RPA) to relieve employees of repetitive tasks;
- Making it easier for staff and students to find what they need. For example, by creating one place for answers with ‘Ask a Question’;
- Provide insight into the opportunities and risks of applying AI (artificial intelligence) in education, research and operations at UvA.

In all initiatives, we put our public values into practice. For the digitalisation agenda, these are:

- Independence: we value our digital sovereignty and guard against over-dependence on commercial ICT providers;
- Sustainability: as a vanguard player, the UvA has an essential responsibility for the transition to a sustainable society. This is reflected in our research and teaching, and also in our efforts to reduce our own ecological footprint;
- Inclusiveness: we take care not to create a gap between those who can and those who cannot keep up with developments in digitalisation.”

As we are mainly interested in the role of education in the context of this research, we mainly focused on the chapter on education in the digitalisation plan.

The agenda states that:
“Digitalisation enables customised education: providing students with an optimal learning experience, at their own level, manner and pace. Digitalisation also supports hybrid education (partly on campus and partly online). There is also an increasing need for opportunities for informal online collaboration for students.

The campus and the campus experience are the foundation of UvA education. The COVID-19 crisis has provided a lot of experience on the impact and (im)possibilities of online education. These insights form the basis for deploying digitalisation for an enriched teaching and learning environment, where new technological possibilities are meaningfully deployed and the campus experience is central.”

It is this context in which we did our study for values, role of education and supporting IS/IT within a University environment.

III.3. Societal perspective

We interviewed Dutch residents who had no direct connection with any university and belonged to an active age group between 40 and 66 years old, born and raised in the Netherlands. The interviewees shared their opinions, knowing there were no right or wrong answers. A subset of the questions asked can be found in the annex.

The general conclusion that can be drawn from the interviews is that members of society have a similar view on the value of a university as students: a university is valuable if it does a good job serving its purpose as an educational organisation. Members of society don’t seem all too acquainted, let alone concerned with the existence of a university. To most, a university is “just a school for smart people”.

Society members are also unaware of any significant differences between universities in the Netherlands: they do not think one university is better or more valuable than another. The deciding factor used to identify differences in university is the city in which it is located, and any potential differences between universities are credited to the difference in geographic location. For example, people expected the University of Amsterdam to be more diverse because Amsterdam is a very international city. In contrast, Leiden University was expected to be more politically focused due to its location near The Hague, the political capital of the Netherlands.

Regarding the value of a university, members of society looked more toward what a university can do for its students in the context of education than toward what it can do for society in the context of research. Values within a university organisation should, according to society, focus on ensuring that students have a safe, enjoyable environment in which they can receive an excellent education. Members of society consider values such as inclusivity and sustainability important because they want universities to teach students to be inclusive and environmentally cautious.

Ultimately, members of society are not interested in the value that universities provide to society directly. To them, a university is just an organisation for professors with old briefcases and ambitious students who want to party above anything else. Although people reacted surprised when informed about the large amounts of tax money spent on universities for education and research, all interviewees strongly believed that the funding was fair. A university fulfils its purpose as long as students receive high-quality education in an enjoyable and safe environment.

![Figure 7: Value dynamic from society’s perspective](image)

During the interviews we recognized a very significant focus on the student direction.

IV. ANALYSIS

We have found a disparity in the perception of the value during this research. In the interview with the vice president of the UvA, it became clear that the university is aware of this disparity but does not necessarily feel the need to do anything about it.

From the viewpoint of students, the value of a university lies in its ability to offer high-quality education. According to students, this is achieved through employing knowledgeable and skilled professors,
providing excellent study facilities such as libraries and valuable software and, most importantly, personal engagement with faculty staff. We conclude that students believe that a university should be a school in the first place and that any other activities, such as research and valorisation, come second. The values students believe a university should incorporate in its strategic plan are relatively low-level and instrumental, such as kindness, engagement, and honesty. These values are also almost always directed toward the Me-domain.

By studying the strategic plan, we found that The University of Amsterdam, as a higher education organisation, divides its value into three domains: education, research, and valorisation. The domain of education is primarily directed towards students, as they are, per definition, the ones receiving education. Educated students in turn, contribute value to society, although this is seen as a second-hand effect. Research and valorisation are less focused on students and more on society as a whole. Rather than considering these two domains as separate, we consider them interconnected, believing that good research is inherently valuable. The University of Amsterdam is proud to conduct excellent research and believes that by doing so, it contributes value to society, as can be found in the results of the interview with the vice president. The UvA knows it has to find a healthy balance in its activities to satisfy all parties. Based on the analysis of the UvA’s strategic plan combined with the findings of the interview with the Executive Board, we believe that the UvA is slightly more focused on its research activities than on its educational role.

Society’s perspective on the value of a university is largely similar to the perspective of students, as shown by the interviews conducted with the members of society. This is demonstrated by the fact that members of society also believe that the primary value of a university lies in its capacity to provide high-quality education to students. Society members do not seem too concerned with a university’s research projects, let alone the value these projects may provide. Instead, it regards a university primarily as an educational institution, with research being perceived as a secondary activity.

Students and the University of Amsterdam are on the same page about what value a university should provide. Students have expectations that their university will provide them with exceptional education, and the university strives to fulfill this expectation. Students respect and support their university’s research activities, but only if this does not hinder their educational activities.

We also find an interesting discrepancy between how the University of Amsterdam aims to provide value to society and society’s expectations of a university. It seems that society primarily considers a university to be a “school for smart people”, where the value lies in educating students who will later occupy important and valuable jobs in society. Although a large part of a university’s value lies in its educational services, this is not the primary way the UvA’s organisation intends to provide value to society. To provide value to society, the University of Amsterdam spends significant amounts of time, money and energy in conducting valuable research, which seems to go unnoticed by members of said society. Even more interesting is that the UvA’s executive board is aware of this discrepancy but does not appear to make an effort to do something about it.

In conclusion, the three parties disagree when asked what values a university should provide. Students and their university are more in tune with each other than the university and society. Whereas the UvA wants to provide value to society by conducting valuable and trustworthy research, society only expects a university to educate its students to prepare them for their future careers. Whether or not this issue needs to be addressed, we will leave it for future research, but we believe that in any healthy relationship, clear communication is vital. Universities are magnificent organisations that traditionally stand at the forefront of scientific development. Still, in doing so, it has forgotten to look back once in a while to see if the rest of the world was following. In this rapidly changing world, we live in today, maybe it’s time to stand still for a moment to regroup so that we can all tackle the issues that lie ahead together.
Based on these insights, the University of Amsterdam worked on developing a specific view on the role of IS/IT and digitalisation within the university context. Figure 9 shows the focus areas that were defined.

**Figure 8:** Comparison of perceived value dynamic from all three parties

**Figure 9:** Focus areas defined by the University of Amsterdam
Given the limitations of this research, we didn’t analyse all these focus areas. To get an insight into the UvA analysis, in figure 10 we only show the central part of the detailed approach for education, as developed within the Digitalisation agenda.

As shown in figure 10, the focus within the digitalisation agenda tries to balance the individual and societal focus where the university should play a role in a lifelong learning context. In this sense, the UvA chooses a clear focus on a broader role than only being a ‘school for smart people’.

V. CONCLUSION

The results have shown that the University of Amsterdam and the society in which it operates have gotten estranged. Since Dutch universities are all considered relatively similar, we believe that the findings can be generalized to all Dutch universities. The world is at the dawn of unprecedented change due to the rapid development and deployment of for example, artificial intelligence, as well as a notable rise in anti-institutionalism and sceptical attitudes towards scientists and world leaders. Ironically, change is a constant phenomenon and although it can be intimidating, resisting it rarely leads to fruitful outcomes. It is not the change itself that is feared, it is the unknown that comes with change that is feared. This is exactly where university organisations can step in. As educational and research facilities, universities should place the utmost importance on conducting research and, educating registered students and, most importantly, making challenging subjects understandable to all, especially the “normal people”. There is no use in solving complex questions if one can’t clearly explain the answer and how it was formed.

The lack of understanding, ultimately caused by lack of communication between universities and society, is a significant problem that should be looked at. Universities are organisations that specialise in doing what they do, but this specialisation is only helpful if the rest of the population recognises it. The findings of this research paper have revealed that there is indeed a significant lack of understanding, and we hope that this will inspire future research projects to find ways to tackle this problem.

VI REFERENCES


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Annex

**Subset of questions for students attending the University of Amsterdam**

<table>
<thead>
<tr>
<th>Question m1</th>
<th>What did you consider when choosing a university to study at?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question m2</td>
<td>What values do you think the UvA might have, based on your personal experiences in your time as a student?</td>
</tr>
<tr>
<td>Question m3</td>
<td>If you were the head of a university organisation, what values would you want to implement into your strategic plan?</td>
</tr>
<tr>
<td>Question m4</td>
<td>Considering the fact that a university has a large responsibility towards both students specifically as well as society in general, how would you ideally like this balance to be?</td>
</tr>
</tbody>
</table>

**Subset of questions for University of Amsterdam**

<table>
<thead>
<tr>
<th>Question w1</th>
<th>How would you define what a “good” university is?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question w2</td>
<td>How does the University of Amsterdam want to be seen by both students as well as Dutch society?</td>
</tr>
<tr>
<td>Question w3</td>
<td>What are the core values of the University of Amsterdam?</td>
</tr>
<tr>
<td>Question w4</td>
<td>How does the UvA try to balance its responsibilities between its students and society?</td>
</tr>
</tbody>
</table>

**Subset of questions for members of society**

<table>
<thead>
<tr>
<th>Question a1</th>
<th>What universities within The Netherlands do you know and what do you think separates them?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question a2</td>
<td>How would you determine what university is a better university than another?</td>
</tr>
<tr>
<td>Question a3</td>
<td>If you were the head of your own university, what values would you implement into your strategic plan?</td>
</tr>
<tr>
<td>Question a4</td>
<td>What do you think makes a university valuable?</td>
</tr>
</tbody>
</table>
EMOTIONAL STRAIN AND EDUCATION IN THE SOCIAL FIELD

Marina Torgovnik
Institute for Applied Informatics (InfAI) at Leipzig University
torgovnik@infai.org

Amit Kirschenbaum
Institute for Applied Informatics (InfAI) at Leipzig University
kirschenbaum@infai.org

Abstract:
This paper addresses the challenge of conveying emotionally challenging topics in online adult education in the social field, and seeks to answer two key questions: 1) What are the main research themes concerning the relationship between adult education and emotions? 2) What implications for online interventions can be drawn from this research to help learners manage emotional strain arising from emotionally challenging topics? Systematic and non-systematic literature searches were conducted to identify the main themes concerning emotions and education. Based on these, the paper proposes data-based interventions for emotional distress in online courses, such as providing brief emotion regulation instructions, emotional training and communication opportunities while considering learner autonomy. The paper therefore extends the discussion on learning and emotions and may aid to further investigate the management of topic-induced negative emotions in online learning environments.

Keywords: further education, emotion, emotion regulation, intervention, social field

I. INTRODUCTION

In the age of communication technology, e-learning plays an important role from primary education onwards. It offers various learning settings: asynchronous or synchronous, individual or group. This is true also for social work qualifications, where e-learning is used as a learning tool both in higher education modules and in continuing vocational training [Madoc-Jones and Parrott.; 2005; Racovita-Szilagyi et al., 2018; Bressem et al., 2016]. Social work, and the social sector in general, is an emotionally demanding field. It involves continuous exposure to difficult life situations which challenge the clients, combined with the role expectations of this profession. These factors may lead to exhaustion, alienation, and may eventually result in burnout, if not regulated [Elsässer and Sauer, 2013; Nüsken, 2020]. On the other hand, functional emotion regulation strategies, awareness and a change of perspective to see positive effects of difficult situations, can help social workers to handle their emotions and prevent burnout [Collins, 2007; Wendt et al., 2011a; Wendt et al., 2011b; Bogo et al., 2017; Morrison, 2007]. Emotional stress can be triggered by the learning environment itself. This may be due to isolation resulting from the physical and temporal separation of the learner from the tutor [Crouch and Montecino; 1997], but also as a result of collaboration in an online environment [Allan and Lawless; 2003]. However, studies discussing e-learning in context of social work education investigate primarily the didactic and pedagogical aspects of these programs and the success of conveying knowledge. Recent studies discuss challenges of e-learning in this field, but they focus rather on the teaching aspects, such as ethical issues [Reamer, 2013] or the development of an effective teaching presence [Davis et al., 2019]. They do not address the emotional state of the learners which may be affected by the contents of the learning materials which can lead to a dysfunctional strain and thus to an impairment of the learning process. To avoid dysfunctional emotional strains, learners in an online setting should be helped to regulate their emotions, which can usually be done with the help of an instructor in face-to-face environments. According to Dinkelaker [2021], visual access to the faces of the other participants in online video conferences (if they activate their cameras) does not necessarily provide the same opportunities for non-verbal communication as in-person events. Even if all participants are visible on the screen and they, in turn, have their gazes fixed on the screen, the participants cannot have direct eye contact. We can tell whether attendees are looking at their screen or not, but we cannot discern what exactly they have their attention on. Consequently, it is not possible to comprehend the learners’ perception and learning process to the same extent [ibid.]. Furthermore, our ability to empathize is impeded by the absence of perception of participants’ facial expressions and gestures. Effective communication requires the reception of (facial) feedback from the other party. However, in the digital space, we are
unable to assess, for instance, whether a smile is directed toward a certain person or whether
the participants are still engaged [Susman, 2022, p. 8]. This lack of empathy poses a problem
as it may result in unobserved emotional distress. This issue exacerbates further when dealing
with asynchronous digital learning settings. Therefore, the goal of this paper is to serve as step
toward developing a framework which enables digital vocational education in the social sector
by proposing appropriate interventions, i.e., a bundle of recommendations and impulses for the
learners, to help them overcome or prevent dysfunctional emotional strain that otherwise would
negatively influence the learning process. The objective of this paper is to answer following
questions:

- What are the main themes in research concerned with the relationship of adult
  education and emotions?

- What implications for online-interventions can be drawn from the existing literature to
  help the learners to reduce emotional strain arising from sensitive topics and restore a
  functional learning-state?

To answer these questions, existing literature has been reviewed. The paper is structured as
follows: First, we present two major theories concerning emotions in relation to learning and
emotion regulation (II), then we describe the literature search, categorization and analysis
procedure (III). We then review the main themes of the literature found (IV), namely:
intervention studies aimed at reducing negative emotions in educational settings, particularly
those arising from stress and anxiety, the main components and effectiveness of stress
management and mindfulness programs, the importance of communication when confronted
with negative emotions, and research on the effectiveness of emotion regulation strategies
outside of educational settings. The findings are then discussed and implications for the design
of the future interventions are outlined The proposed interventions include data-based
recommendations, such as providing brief emotion regulation instructions, emotional training
and communication opportunities while considering learner autonomy (V). Finally, the results
are summarized and conclusions for further research are presented (VI).

II. THEORY

There are two main theories on which most studies of the relationship between emotions and
learning and emotion regulation are based on. These two theories – the Control-Value Theory
of Achievement Emotions and the Process Model of Emotion Regulation – are presented in this
section, to provide a better understanding of the relationship between learning and emotions
and of how and why emotions can arise as well as how they can be influenced.

The Control Value Theory of Achievement Emotions developed by Pekrun provides a
framework for the effects and causes of emotions in academic settings. It focuses on
achievement emotions, which are defined as “emotions tied directly to achievement activities
or achievement outcomes” [Pekrun, 2006, p. 317]. The theory includes emotions such as
enjoyment, anger, frustration and boredom that are directly related to learning activities as well
as “outcome emotions” such as joy, pride, anxiety, hopelessness, shame, and anger which are
related to (expected) success or failure [ibid, p. 320]. It provides implications for educational
interventions to influence learners’ emotions, in particular, to reduce negative emotions like
boredom, shame, anger and hopelessness and foster positive emotions like hope, pride and
enjoyment of learning [ibid: pp. 327-329, pp. 333-337]. For instance, the author describes
attributitional retraining as a way to change the students’ emotions. The idea is that achievement
emotions arise from judgements of learner’s competence or perceived control to master a
learning task or to be successful. It may also arise from the attributed relevance of the learning
activity, which can be intrinsic, like perceiving the learning content as valuable, or extrinsic,
such as getting a good grade [ibid, p. 336]. Therefore, getting learners to see the value of the
learning content can help them to regulate their emotions and improve their learning. However,
by focusing solely on achievement emotions, only a limited range of possible emotional
responses is taken into account. Pekrun [2018] also identifies other factors that trigger emotions
in the learning process. Emotions therefore may be not only achievement-related (e.g., fear of
failure) but also epistemic (e.g., confusion), social (e.g., sympathy for my fellow learner),
technology-related (e.g., frustration due to a poor internet connection), or topic-related (e.g.,
dealing with child poverty). These topic-related emotions can be especially relevant to courses in the social field, but they are not deemed significant beyond their mere mention.

To find a way to help learners cope with topic-related emotions, it is necessary to first consider the regulation of emotions. According to Gross’ Process Model of Emotion Regulation, emotions trigger a “coordinated set of behavioral, experiential, and physiological response tendencies that together influence how we respond to perceived challenges and opportunities” [Gross, 2002, p. 281]. How individuals attempt to influence their emotions per se as well as their responses to them, depends on the emotion regulation strategies they employ [Gross, 1998, pp. 281-282]. Gross distinguishes five strategies, which primarily differ in their effect on the emotion-generative process: situation-selection (e.g. decide to skip class), situation-modification (e.g. not talk about a certain topic), attentional deployment (e.g. focusing on something else), and cognitive change (e.g. seeing the benefits of a difficult situation) belong to the group of antecedent strategies – i.e., they operate before the emotional response is fully activated. Whereas response-modulation (e.g., suppressing of feelings) is considered as response-focused strategy, which is used when an emotion is already induced [Gross, 1998, pp. 281-285; Gross, 2002, p. 283]. In real-life situations, usually more than one strategy is applied simultaneously. Gross points out, that while there is increasing interest in researching the application of emotion regulation strategies to different situations, it is still unclear under what circumstances which strategies are effective [Gross, 2015, pp. 15-16].

III. METHOD

To answer the research questions, we first performed a non-systematic literature review primarily using educational and psychological databases. After that, we conducted a forward-search for empirically tested interventions, to find indications on how to help learners who experience emotional strain in a learning setting. As the ongoing search revealed a lack of research on this topic, a systematic literature search using Cooper’s taxonomy followed [Cooper, 1988]. To find relevant literature, we defined inclusion and exclusion criteria, based on the knowledge gained from the previous non-systematic search. The focus was on peer-reviewed publications in English and German language of the years 2003 - 2023. There were no restrictions concerning a specific research methodology, geographical region or set of journals. Due to the lack of literature on interventions for adults in learning settings who experience emotional distress induced by sensitive course-topics, the search concentrated on publications that examined the relationship between emotion and adult learning. The defined keywords addressed this relationship. They included: “learning”, ”online learning”, ”e-learning”, “adult”, ”emotion”, ”intervention” and ”emotion regulation”. We conducted the search on the “ERIC” - (Education Resources Information Center) database. It resulted in 1069 hits, which were sorted out in the first round based on their titles. Literature concerned with education often focuses on school education and therefore on children and adolescents as learners. We excluded this kind of literature as it does not address adults. The same goes for papers focusing on individuals with disabilities and behavioral problems. Although the research interest focuses on vocational training, we included publications with university students as participants in the analysis due to the limited literature on this topic. Information on how we conducted the search and the inclusion as well as exclusion criteria are presented in Figure 1.

Figure 1: Conducted Search and Selection Criteria

![Figure 1: Conducted Search and Selection Criteria](image-url)
In total, we screened the abstracts of 86 publications, together with 42 publications from the previous, non-systematic search. Next, we once more screened the whole content of the remaining 27 publications for their relevance to answer the research question. Finally, we analyzed and categorized the remaining 21 papers in order to examine the main themes concerning the relationship of adult education and emotions and draw implications for possible e-learning interventions. Following the approach suggested by Webster and Watson [2002], we developed a matrix to organize our readings. The matrix comprises information on the sample, the emotions under consideration classified as negative or positive, as well as achievement or non-achievement emotions [Pekrun 2006, 2018], the type and purpose of intervention as well as the research method used. We then synthesized and analyzed the key themes that were identified. The methodological procedure is depicted in Figure 2.

**Figure 2: Methodological approach**

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**IV. DATA ANALYSIS**

Despite an intensive search, we found no literature on (short-time) interventions in online learning settings for adults after exposure to sensitive topics that can trigger strong emotions. The relevance of designing such an intervention is particularly relevant for courses related to social issues. Studies confirmed that negative emotions can impact self-perceived competencies [Rodriguez et al., 2014] and performance [Jarrell et al., 2017], whereas positive emotions can enhance motivation and learning [Ramsay and Holyoke, 2013]. Of the 21 papers identified as relevant, six had adults as the target group, twelve papers were aimed at university students, and three publications did not specify a target group. Furthermore, most publications focused on achievement emotions (N = 9) rather than emotions arising from emotionally challenging topics. We also included literature that is not related to educational settings to provide reviews of interventions targeting emotional distress (N = 4). The other literature focuses on (non-academic) stress (N = 2) and other emotions (N = 6) like grief [Döveling and Wasgien, 2013], or does not specify which emotions it examines [e.g. Jiang and Koo, 2020].

After screening and categorizing the remaining literature, we found four main groups. These include (1) intervention studies in educational settings, (2) stress management and mindfulness programs, (3) the role of communication and (4) emotion regulation strategies.

**Emotion regulation and Education**

Studies in the first category examined different interventions to foster positive emotions for enhanced learning. None of the studies employed emotionally challenging topics to measure the learning outcome, but all of them targeted the relationship between emotions and education. For instance, Engelmann and Bannert [2019] used material on probability theory to measure the participants’ learning outcome with a subsequent knowledge test, while D’Mello et al.’s [2010] study involved computer literacy classes for the participants. Engelmann and Bannert [2019] and Quay and Quay [2018] examined the effects of brief trainings on emotion regulation. Even though, neither found significant improvements in learning outcomes, participants reported reductions in negative feelings like anxiety and stress. On the other hand, there are studies confirming the impact of attributional styles and attributional retraining as a means of regulating one’s emotions [D’Mello et al, 2010; Hall et al., 2007; Kumschick et al., 2021]. However, given the differences in methodology and intervention implementation, it cannot be stated with definite certainty that these results indicate the superiority of attributional retraining for emotional regulation in educational settings. Some of the studies utilized videos as an intervention [Engelmann and Bannert, 2019; Quay and Quay, 2018; Kumschick et al., 2021].
For example, in the study conducted by Kumschick et al. [2021], participants viewed a video depicting a classroom disruption. The experimental group additionally watched a video featuring the disruptive student’s reflection on his actions, while the control group did not watch this reflection [Kumschick et al., 2021]. Then again, D’Mello et al. [2010] examined the effect of a dialogue-based intelligent tutoring system (ITS) on the participants’ attributional styles and learning outcomes. The tutoring system responded to negative emotions such as boredom, confusion and frustration experienced by learners during the course. It then provided motivational responses, by attributing negative affects to the learning process itself or the learning material rather than to the learners.

Moreover, examinations of attributional styles also differ in their underlying assumptions, resulting in variations of their instructions and responses to the learners. Hall et al. [2007] instructed the learners to complete an affective writing task that entailed reflecting on an unsuccessful exam or assignment and its emotional impact on them. They posited that the effect of reattribution would emerge “by encouraging students to construct a coherent emotion-based narrative” [ibid., p. 281]. This would lead to an incorporation of negative experiences “into an organized linguistic structure, allowing the memory to be understood and forgotten more efficiently” [ibid.]. As a result, the authors expected that the negative experiences would be prevented from impeding learning processes. On the other hand, D’Mello et al.’s ITS aimed to “keep students engaged, boost self-confidence, heighten interest” [D’Mello et al., 2010, p. 246] to enhance learning outcomes. Furthermore, significant effects were observed in low-elaborating students, while high-elaborating students were not impacted by the affect-oriented interventions [D’Mello et al., 2010; Hall et al., 2007]. It also remains unclear whether this type of intervention would prove effective for emotionally challenging learning content since the studies are solely focusing on achievement emotions. Engelmann and Bannert [2019] as well as Quay and Quay [2018] suggest that the lack of impact of their interventions (cognitive reappraisal and mindfulness trainings) may be due to the short duration of the theoretical input and practice phase, which did not provide ample opportunity for students to learn how to appropriately apply the learned strategies. According to the authors, to effectively use emotion regulation strategies, more practicing time is needed. In summary, there are no answers yet, to the questions what emotion regulation strategies (i.e. cognitive reappraisal, reattribution, mindfulness trainings) are best suited and how they should be implemented (i.e. theoretical input and practice phase or continuing impulses throughout the course) for helping individuals to regulate their emotions in education.

Stress management programs

Another main topic of the identified papers involves training for managing stress and anxiety through mindfulness and/or emotion regulation. The literature shows how to design effective training programs for learners to functionally regulate their emotions and mitigate negative emotions [Fidler, 2004; Lehr et al., 2014]. It also outlines the main components and requirements necessary for successful stress management programs. These programs usually cover strategies such as cognitive reappraisal, reattributions, perspective changes, relaxation techniques or psycho hygiene and typically consist of theoretical inputs on stress emergence and its consequences, as well as self-evaluations of the stress level. Often, after the theoretical input, a practical part is also included [Fidler, 2004; Lehr et al., 2014, Engelmann and Bannert, 2019; Quay and Quay, 2018]. Regarding the requirements for the success of such programs, the literature highlights the importance of granting the learners autonomy in the learning process to avoid drop-outs. Furthermore, long-term objectives should be implemented, as the acquisition of emotion regulation skills and the alteration of attributional styles require long training-phases [Fidler, 2004; Lehr et al., 2014] as previous studies showed [Engelmann and Bannert 2019; Quay and Quay, 2018]. Group training sessions are recommended to ensure that various perspectives are considered in finding solutions for handling stressful situations. The included literature also emphasizes the importance of regular participation and that participants shall not be in any acute stress which requires therapeutic measures [Fidler, 2004; Lehr et al., 2014]. Lehr et al. [2014] analyzed the particular requirements and challenges of online stress management programs. According to the authors, these programs often consist of short videos or audio recordings conveying information about stress management. Additionally online journals are used to monitor one’s own health status and its’ progress. They summarize that studies indicate the effectiveness of online programs for decreasing negative emotions like anxiety and depression [Lehr et al. 2014]. Nevertheless, they also note that keeping track of one’s own emotions and document the progress in a journal may be labor-intensive and may require a substantial amount of time and effort.
intensive and requires advanced literacy skills. Also, in an acute emotional crisis, it is not feasible to offer immediate support via online programs.

**Communication**

Another central topic in online adult education is communication. Qualitative, exploratory studies have been conducted to examine this issue [Pastogianni and Koutsoukos, 2018; Zembylas et al., 2008; Jiang and Koo, 2020; Ch’ng, 2019]. In these studies, emotions are not predefined by the researcher, but rather described by the adult participants of (online) courses. This includes, among others, analyzed interviews, online journals, online and face-to-face group discussions, and e-mails. With the exception of one study [Pastogianni and Koutsoukos, 2018], all included studies related to this topic have been conducted in an e-learning environment. Most of the emotions described by the participants can be classified as achievement emotions, as they relate to (expected) results, difficulties in learning or the tasks, or demands of the courses [Pastogianni and Koutsoukos, 2018; Zembylas et al., 2008; Jiang and Koo, 2020; Ch’ng, 2019]. Nonetheless, it is noticeable that non-achievement emotions are mainly associated with interactions with other individuals. For instance, some studies discuss negative perceptions about the authenticity of online communication [Zembylas et al., 2008; Jiang and Koo, 2020] whereas others note that students wished emotional support and fostering of positive communication in the classroom from their instructors. The learners also wished their instructors to be encouraging, empathetic and emotionally intelligent, [Pastogianni and Koutsoukos, 2018]. On the other hand, positive sentiments were reported as result of a positive class atmosphere [Pastogianni and Koutsoukos, 2018], peer interactions and discussions [Jiang and Koo, 2020; Ch’ng, 2019; Zembylas et al., 2008] as well as easy communication or a strong rapport with the instructor [Jiang and Koo, 2020; Zembylas et al., 2008]. Furthermore, in Zembylas et al. [2008] the participants were required to record their emotions in a journal, which they found to be valuable, but acknowledged that it cannot substitute communication with others. Considering the significance of communication in online courses, Jiang and Koo [2020] propose the inclusion of additional communication components as the upload of personal pictures or a welcoming video by the instructor to facilitate relationship building.

**Emotion regulation (not specified context)**

Finally, there are studies on emotion regulation that are not stemming from educational research. Following Gross’ Process Model of Emotion Regulation, many studies examine the effectiveness of interventions by instructing participants to regulate upcoming emotions in an experimental setting. Webb et al. [2012] conducted a systematic literature review and identified 306 studies comparing emotion regulation strategies. The results of the review indicate that cognitive change is the most effective strategy. They also show that emotion regulation generally tends to be more effective in increasing positive feelings rather than decreasing negative ones. Furthermore, the impact of these strategies may vary depending on the experienced emotions. For instance, it is comparatively easier to regulate emotions induced by pictures or videos of other people than emotions elicited by personally relevant stimuli, as failure feedback or negative personal experiences [Webb et al., 2012, p. 781]. It is also important to note that most studies reviewed by Webb et al. [2012] mainly were not related to learning settings.

The studies considered in our paper also use pictures or videos to elicit negative emotions [Hayes et al., 2010; Kremer et al., 2023; Wolgast et al., 2011]. Therefore, it remains unclear whether emotions emerging in a real-life situation or stemming from emotionally distressing learning subjects, such as the confrontation with traumatizing experiences of potential clients, may be stronger and thus more challenging to regulate. On the other hand, a case study, investigating the effects of a digital mindfulness training, showed favorable impact on the well-being of a patient diagnosed with borderline personality disorder who prior experienced heavy negative self-referential emotions [Nararro-Haro et al., 2016]. But these positive effects required extended periods of training. It should also be noted that this finding cannot be generalized, as the study concentrates on the experiences of a single individual [ibid.]. The emotion regulation interventions in the analyzed studies, with exception of the case study, comprise of short written instructions for the participants to view the emotion-inducing material from a specific perspective. All of them are focusing on the effects of cognitive reappraisal as a regulating strategy [Hayes et al., 2010; Kremer et al., 2023; Wolgast et al., 2011], comparing
it with either suppression [cf. Hayes et al., 2010], acceptance [c.f. Wolgast et al., 2011] or no instruction for the regulation of emotions. While the studies demonstrate the effectiveness of cognitive reappraisal, it must be noted that they were conducted in experimental settings that involved participants being instructed on emotion regulation before experiencing the induced emotions [Hayes et al., 2010; Wolgast et al., 2011]. That is presumably, because accordingly to Gross’ Model the studied emotion regulation strategies are perceived as antecedent regulation strategies. Unlike in experimental settings, in real educational settings it is difficult to predict when negative emotions may arise during the course. Therefore, interventions in e-learning must be implemented after they have been detected respectively reported thus after emotions have already arisen.

V. IMPLICATIONS FOR E-LEARNING INTERVENTIONS

To answer the second question, how to design e-learning interventions to reduce emotional strain, we discuss the implications of the results presented above. Firstly, the learners’ emotions should be continually measured to propose timely interventions to avoid detrimental effects [D’Mello et al., 2010]. There are numerous possibilities to measure emotions in e-learning, as can be seen for example in Engelmann and Bannert [2019, pp. 8-9], D’Mello et al. [2010, p. 247], Engelmann [2019, pp. 72-82] or Reinmann et al. [2006].

Short instructions on emotion regulation

Concerning the design of potential interventions, several studies provide evidence for the effectiveness of short training sessions or impulses in regulating emotions. This particularly pertains to studies investigating the effects of attributional retraining [Hall et al., 2007, D’Mello et al., 2010]. In contrast, other studies suggest that utilizing emotion regulation strategies effectively requires time and practice [Lehr et al., 2014; Engelmann and Bannert, 2019; Fidler, 2004, Quay and Quay, 2018]. Despite that none of the studies address sensitive topics commonly taught in social sector learning programs, these findings are still valuable. Regarding individual differences in the effectivity of different emotion regulation strategies [Webb et al., 2012; D’Mello et al., 2010; Hall et al., 2007] a bundle of different strategies should be provided in online courses. The literature suggests different short-time interventions to aid distressed learners: some interventions may enhance motivation via impulses [D’Mello et al., 2010], while others involve presenting an alternative perspective [Kumschick et al., 2021] or short instructions for emotion regulation strategies such as cognitive reappraisal [Kremer, 2023]. Cognitive reappraisal appeared to be especially effective at regulating one’s emotions [Webb et al., 2012, Wolgast et al., 2011, Kremer et al., 2023, Nararro-Haro et al., 2016], and also demonstrated positive outcomes as strategy used in digital device assisted training [Nararro-Haro et al., 2016; Lehr et al., 2014]. An exemplary intervention instructing the learners to apply cognitive reappraisal could be, e.g. to identify the potential professional development benefits of the learning content.

Additional information and practice opportunities

Training programs designed to reduce stress and anxiety [Engelmann and Bannert, 2019; Quay and Quay 2018] show positive effects in terms of reducing negative emotions and increasing overall well-being. However, no effect on learning outcomes has been confirmed, presumably due to their brevity. Regarding the goal of providing immediate assistance to restore a functional learning state, short trainings sessions (20 min vs. 90 min) are already too time-intensive and require too much cognitive capacity. These sessions may not be effective in helping individuals in dysfunctional states but are still useful as a preventive measure or subsequent offer for learners interested in acquiring emotional skills. The interventions in online learning therefore should be based on the learners’ emotional state. Short content-related impulses or instructions for emotion regulation strategies should be provided if emotional strain is detected. If the strain is successfully reduced, the learners’ can be offered the possibility to get additional information on the emergence of negative emotions, the benefits of emotion regulation strategies, self-assessment of stress levels, attributions and practical exercises for enhanced learning. These resources should be suggested to individuals seeking to acquire and develop emotional competencies but not learners who experience acute emotional strain. Also, external emergency hotlines should be implemented for learners in need of professional help. This concerns individuals experiencing an acute existential crisis.

Opportunities and impulses for online communication
Results and reflections from the proposed training may be (voluntarily) discussed in groups, with learning buddies or the instructor. The literature focusing on stress management training suggests that group sessions are more effective due to the benefit of group dynamics [Lehr et al., 2014, Fidler, 2004]. Accordingly, other studies [Pastogianni and Koutsoukos, 2018; Jiang and Koo, 2020; Ch’ng, 2019; Zembylas, 2008] emphasize the significance of communication in both online and offline courses to enhance positive emotions. They posit that learners require quality communication with their peers and instructors. Although it appears to be challenging to replicate real-time group discussions in asynchronous learning, different channels for online communication can be implemented, since there are various options for synchronous and asynchronous online-communication. To overcome thresholds in using online communication tools, rules of conversation (e.g. being polite and respectful) should be established and their usage promoted through interventions if emotional strain is identified. Regarding the appropriateness of communication tools, it remains the responsibility of the research community to determine which form is suitable for discussing emotionally challenging subjects. Promising results can be reported, for instance by Döveling and Wasgien [2013], who found through their examination of grief forums that discussing sensitive topics in online forums is feasible. Besides forums, emotionally strained learners could also be prompted to contact either the instructor or another learner privately, if they do not feel comfortable with sharing their emotions with a group. Moreover, participants in online-environments found it crucial to establish a good rapport with their instructors and have their support readily available. To facilitate this, instructors should provide their students with friendly pictures and welcome messages as well as online office-hours and feedbacks, as recommended by Jiang and Koo [2020].

In addition, a variety of possible interventions installed to help learners to manage their emotions immediately without requiring interaction with other individuals, can still be discussed in a group afterwards.

Automatically generated emotion graph

Furthermore, the measured emotions can be shown to the individual as a graph depicting the various emotions they have reported throughout the course. By that, the learner can track changes of her or his emotional state, preferably concerning the learning content and applied interventions. This graph can provide an alternative to writing emotion journals, which require a high level of literacy as has been criticized by Lehr et al. [2014]. The instructor could then get an overview of the (anonymous) emotions of all learners in relation to the learning content instead of written emotion journals. Thus, the instructor will be able to identify emotionally challenging topics and discuss them (in synchronous sessions) or adapt the learning material.

Autonomy

Lastly, it is important to offer help only when needed and grant autonomy to learners in selecting the proposed interventions. As D’Mello et al. [2010] showed, emotional support should not be provided, unless it is required. Therefore, interventions should be offered voluntarily to avoid irritations or detrimental effects.

Recommendation System

Overall, it remains nonconclusive which emotion regulation strategy is most appropriate for the individual experiencing emotional distress in online learning. For some, it may be more effective to receive repeated short impulses that encourage the application of emotion regulation strategies (e. g. attributional retraining or cognitive reappraisal) throughout the course of an education program. For others it may be more effective to acquire different techniques through workshops or training programs. According to Gross’ Model, emotion regulation strategies differ in their effectiveness depending on the timing of the intervention in the emotion generation process as well as the situation [Gross, 1998, 2003]. But he also suggests that individuals actually use a combination of strategies to regulate their emotions. Meaning, that in real situations the process of regulating one’s emotions is more complex [Gross, 2015, p. 211]. Furthermore, there are interindividual differences in the effectiveness of different interventions [Webb et al., 2012; D’Mello et al., 2010; Hall et al., 2007]. To approach this problem, knowledge for a recommendation system could be compiled through continuous monitoring of (self-reported) emotional states and recording data on the interventions used throughout the course. As a result, the most suitable intervention to support emotional distress both generally and for
the individual learners would be provided. Finally, the recorded data may offer further insight into the relationship between emotion regulation and adult online learning. A proposal of how a concept for e-learning interventions can look like, is depicted in Figure 3.

**Figure 3: Proposal for e-learning intervention concept**

The process begins by gauging emotions, as illustrated at the top of Figure 3. If positive or neutral emotions have been assessed (right side of the illustration), the course may proceed, with the choice to use the provided interventions at any moment. For positive or neutral states, long-term training programs are suggested to foster emotional competencies, as indicated by the dashed line. When a negative emotional strain that may hinder the learning process is detected, learners are presented with a selection of short-term interventions to offer immediate aid (left side of the illustration). Learners always have the option to execute an intervention or not. Once an intervention is carried out, the emotional state is measured again to determine whether the intervention has had the desired effect of improving the emotional state. If the intervention proves effective, the course can progress. Additionally, a recommendation is made to strengthen emotional competencies through the available training programs.

In case negative, dysfunctional emotional state persists after the intervention, further interventions should be proposed to alleviate or diminish the intensity of the emotions. Assessment of post-intervention measures can ascertain the effectiveness of interventions for the individual and allow adjustments of intervention recommendations accordingly. Furthermore, gathering measurement results from all learners enables the analysis of the overall effectiveness of the intervention. These data can be used to tailor interventions for individual courses and to advance research by demonstrating which interventions yield the desired effect. Finally, the measured emotional states for individuals are depicted in a graph as shown at the bottom of the illustration, providing an overview of their emotional states throughout the course. This serves as a tool to help individuals better understand and categorize their own emotions.

**VI. CONCLUSION**

**Summary**

Based on the foregoing digitalization of education, this paper focuses on the unique challenges of vocational education in the social sector, as the learning content in this field can include emotionally challenging and complex topics. Firstly, Pekrun’s Theory was presented, which states that negative emotions can impede the learning process, was depicted. This emphasizes the necessity to develop a concept for preventing negative emotions in the digital environment to enhance the well-being and learning outcomes of the participants. Following that, another prominent theory concerning emotions was outlined, namely the Process Model of Emotion Regulation, for further comprehension of how emotions can be regulated to improve the learning process. The study then proceeded to present the findings of a non-systematic and systematic literature search. The objective of this paper was to review the existing literature on handling of emotional strain in adult education and suggest effective interventions in e-learning.
settings to prevent dysfunctional states caused by the exposure to emotionally distressing topics. The literature review revealed a notable gap in research on this area. This paper therefore highlights the need for both qualitative and quantitative research to bridge this gap. Most of the reviewed studies focus on achievement emotions. Negative emotions such as anxiety, stress and hopelessness have been hence examined in relation to issues as exams and expected learning outcomes rather than to emotionally challenging content within the learning materials. Research on emotion regulation based on the Process Model of Emotion Regulation is mostly not related to learning settings and often evoke emotions in the participants through pictures and video after they have been instructed how to regulate their emotions. They focus on emotions like fear, anxiety and disgust and also do not consider the emergence of emotions from sensitive topics such as dealing with trauma, injustices and difficult life situations in the social sector. Nevertheless, implications for interventions targeting emotional strain have been drawn. These consist of 1) short, repeatedly available instructions for emotion regulation, 2) additional information and exercises to practice emotion regulation strategies, 3) opportunities for online communication and giving impulses to get in touch with each other when experiencing emotional distress 4) an automatically generated overview of the emotions experienced throughout the course, 5) granting autonomy by letting the learners decide for themselves whether they need an intervention, and 6) suggesting interventions based on collected data about emotions and interventions used (while still always offering more than one option).

Future Research

The proposed framework is based on existing literature recommending interventions for adult online learning in the social sector, however, further research is necessary to determine its efficacy. Nevertheless, this paper launches a discussion on topic-induced emotions in online learning environments, thereby expanding the discourse on the relationship between learning and emotions. The findings of this work can be enhanced to facilitate digital education for emotionally distressing content. This would allow, for example, the conversion of courses in the social field into digital formats without leaving learners to manage with emotional distress on their own. Thus, learners in the social field could also benefit from online learning, through its inherent advantages such as scheduling flexibility and location independence.

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LIST OF REFERENCES

Editor’s Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that
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Kremer, T. et al. (2023) “Studying cognitive reappraisal as an antidote to the effect of negative emotions on medical residents’ learning: a randomized experiment”, BMC Medical Education, (23), article 72.


Lehr, D. et al. (2014): „Online-Trainings zur Stressbewältigung - eine neue Chance zur Gesundheitsförderung im Lehrerberuf?“, Lehrerbildung auf dem Prüfstand (7)2, pp. 190 - 212.


Abstract:
This research explores the feasibility of employing Comparative Judgement (CJ) as an alternative grading approach for academic essays written by Information Systems (IS) honours students. The study involved 81 participants from a fourth-year research module in the honours program. Students were tasked with composing an introduction for a Systematic Literature Review (SLR) under controlled conditions. This assignment was evaluated by three evaluators using the CJ method, facilitated by the No More Marking (NMM) platform. The findings indicate that while the CJ method is not notably more time-efficient than conventional rubric-based grading, it does alleviate cognitive strain on evaluators. Moreover, the method demonstrated high reliability and substantial validity when assessing academic writing assignments.

Keywords: Comparative Judgement (CJ), Information Systems (IS) students, academic writing

I. INTRODUCTION
There has been a significant surge in the enrolment of Information Systems (IS) honours students within the Department of Informatics in recent years. This surge has led to a noticeable escalation in the grading workload for lecturers. A considerable portion of the assignments in the honours modules entails academic writing, a process known to demand substantial time for assessment. Furthermore, these evaluations often assess competencies, leading to inherently subjective grading. Considering these challenges, the Department sought more efficient approaches to evaluate academic writing, aiming to maintain reliability while enhancing efficiency.

An alternative methodology in this context is the Comparative Judgement (CJ) grading approach. This method draws its foundation from Thurstone's Law of Comparative Judgement, which asserts that individuals are more dependable in comparing two assignments or demonstrations of competence than attributing a mark to an individual assignment [1928]. Consequently, this methodology entails the collaboration of a panel of judges. Each judge evaluates pairs of assignments, selecting the superior one based on demonstrated competence. Multiple judges evaluate each assignment, culminating in a final scaled score that reflects a collective consensus on the assignment quality [Lesterhuis et al., 2017]. Prior investigations have yielded encouraging outcomes in terms of the CJ method's reliability and validity [Bartholomew and Yoshikawa-Ruesch, 2018].

This paper seeks to investigate the appropriateness of employing the Comparative Judgement grading approach to evaluate the academic writing of IS honours students. The next section establishes the research's context, leading to an examination of the key concepts through a literature review in section III. Proceeding from this, section IV outlines the research methodology, while section V presents the findings. The data analysis is deliberated upon in section VI, while section VII delves into the research's limitations.
II. THE CONTEXT

The honours module of interest is a fundamental component of the Honours curriculum at the University of Pretoria’s Department of Informatics. Focused on research methods, this module’s educational objective is to familiarise students with research methodologies in the realm of Information Systems (IS). A pivotal requirement entails students undertaking a methodical literature review study on a specific subject and presenting a research report as the conclusive outcome of the module. The module’s assignments are designed in a cumulative manner, each building upon its predecessor, culminating in the submission of a comprehensive Systematic Literature Review (SLR) as the final examination task. In the South African academic context, students typically complete a three-year Baccalaureus degree before progressing to an Honours degree in the fourth year.

III. LITERATURE REVIEW

The evaluation of academic writing traditionally involves the utilisation of rubrics or predefined sets of criteria linked to numerical scores. Students’ grades are then determined based on how well they align with these criteria. The challenge arises when assessing assignments with open-ended questions, as judgement regarding criterion fulfilment tends to be subjective. This subjectivity is amplified when multiple assessors grade the same assignment, leading to issues of validity and reliability in grading [Bartholomew and Yoshikawa-Ruesch, 2018]. Often, rubrics are adjusted to fit the assessor’s intuition, leading to a somewhat reverse engineering process. Additionally, markers tend to compare the current assessment with past ones, but as Pollitt notes: “these imagined performances are unlikely to be truly representative of performances of that standard” [Pollitt, 2004].

During the 1920s, Thurstone introduced the concept of comparative judgement, aiming to gauge individuals’ preferences for various stimuli [1928]. Although Thurstone’s primary focus was on preference measurement rather than assessment, his work laid the foundation for subsequent developments in CJ. Technological advancements have facilitated the widespread implementation of CJ. Notably, several successful large-scale projects were conducted in the United Kingdom (UK). Among these was the pioneering e- scape project, which employed CJ to evaluate design activities presented as online portfolios. The project aimed to foster creativity and teamwork, involving participation from more than 11 schools across England [Kimbell, 2021]. Another significant endeavour, as reported by Wheadon et al. [2020], employed CJ to assess the writing skills of 55,599 primary school students in the UK. Further applications of CJ as a grading method encompass mathematical problem-solving [Jones, Swan and Pollitt, 2015], visual arts and design assessments [Tarricone and Newhouse, 2016], as well as academic writing evaluations [Van Daal et al., 2019]. This versatile grading approach has been deployed across diverse age groups, including university students [Bartholomew and Yoshikawa-Ruesch, 2018].

The systematic review conducted by Bartholomew and Yoshikawa-Ruesch [2018] on the application of CJ indicates that, on the surface, CJ might not exhibit greater efficiency than traditional grading methods. This is due to the requirement of multiple rounds of comparison for each script or portfolio to establish the final ranking. Nonetheless, there are instances where studies have reported a reduction in grading time compared to conventional methods. For instance, Steedle and Ferrara [2016] found that grading essays using the CJ approach consumed less time. In contrast, opinions varied among examiners in a study by Marshall et al. [2020]. They explored the time efficiency of CJ when evaluating secondary school summative statistics exams and English essay exams. Notably, statistics examiners spent less time per script, while essay examiners noted the time-intensive nature of the approach. Most of the existing CJ software employs Adaptive Comparative Judgement (ACJ) algorithms. ACJ leverages algorithms to optimise script pairing for evaluation. Consequently, the need for random pairing is eliminated, and instead, intentional and controlled pairing is employed to enhance efficiency in the process [Pollitt, 2012].

The consensus across reports on the reliability of the CJ grading method is prominent. Findings from the systematic review by Bartholomew and Yoshikawa-Ruesch [2018] consistently demonstrated reliability coefficients predominantly exceeding 0.80. In this context, reliability pertains to the confidence in attaining the same outcome during subsequent grading sessions.
Comparative Judgement as Grading Method

Bartholomew and Yoshikawa-Ruesch (2018), Marshall et al. (2020) pinpointed a contributing factor to the method’s reliability, highlighting that the judgments of both strict and lenient examiners are equalised since the outcome is determined by comparison, not marks. While examiners might hold diverse viewpoints regarding rubric details and deserved marks for each section, they are more likely to reach a consensus on identifying the superior assignment. This aligns with the primary advantage of achieving reliability. The iterative judgement process, fitted into a mathematical model, eventually yields a scaled score for each assessed piece. This score not only offers a hierarchical arrangement of the works but also indicates the extent of differentiation between them [No More Marking, n.d.].

Validity pertains to the degree of alignment between the assessment and what it aims to measure. Past research has examined validity by contrasting the rankings derived from CJ with outcomes obtained through conventional marking. For instance, the systematic review conducted by Bartholomew and Yoshikawa-Ruesch (2018) presented varying outcomes regarding the validity of the approach as indicated by the studies included. In their analysis, validity coefficients, often represented as correlation coefficients, consistently fell below the reliability coefficients.

Several software platforms catering for CJ have emerged, encompassing both commercial and internally developed options. An exemplary platform for advancing the CJ technique is the No More Marking (NMM) platform, established by Chris Wheadon in 2013. This web-based platform sought to streamline and optimise the application of CJ in evaluating student essays [No More Marking, n.d.]. Tanguy et al. (2018) pursued a Design Science Research approach to devise a CJ platform, incorporating their proprietary ACJ algorithm to enhance efficiency. This research endeavour entailed testing the platform’s efficacy across different competencies, domains, assessors, and assesses.

Notwithstanding the acknowledged drawbacks associated with CJ as an assessment method, its appeal endures as a viable strategy for addressing reliability concerns when appraising the performance competence of substantial cohorts of students or learners, particularly when multiple examiners are engaged. The subsequent section presents a concise outline of the research methodology applied in this study.

IV. METHODOLOGY

In this exploratory study where a mixed-method approach was employed, a sample of the honours research module students (n = 81) was utilised. The honours research module is explained in section II. The software platform for grading assignments was furnished by the UK-based company No More Marking. Ethical approval was obtained from the Ethics Committee of the Faculty of EBIT at the University of Pretoria.

The academic writing assignment

The assignment tasked students with creating an introduction for a Systematic Literature Review (SLR) while working with a predetermined research question. The research essay therefore entailed the writing of a comprehensive introduction to a SLR that incorporated all the necessary components. To assist them in this endeavor, students were given four article excerpts along with clear instructions detailing which articles related to the specific sections of the introduction they were required to compose. This material was provided one week prior to the assignment deadline. Figure 1 illustrates the initial page of the assignment.
The assignment activity took place in a supervised computer lab located on the university’s campus, with restricted internet access (only access to the Learning Management System (LMS)) and had to be completed within a 45-minute time frame. Students submitted their work in PDF format through the university’s LMS.

The grading process

The students’ SLR introductions, formatted as PDFs, were shared with NNM via a dedicated Google Drive folder. Subsequently, NNM uploaded these PDF files onto their platform. Their system then autonomously generated pairs of papers for comparison, with each pair consisting of two papers randomly selected.

In each pair, the judge’s task was to determine the superior paper without assigning numerical grades or scores; instead, a simple button press was used to select the superior one between the two (refer to Figure 2 on the next page). This process was repeated multiple times, generating numerous pairs of papers and collecting judgements from the three judges for each pair.

Through the accumulation of a significant number of these judgements, the platform could statistically infer the relative quality of all the papers in the dataset. Subsequently, it organised the papers based on these inferred judgements, ranking them in descending order of quality from highest to lowest.
This ranked list of papers enables teachers or educators to easily identify the best-performing and lowest-performing papers within the batch, eliminating the necessity for traditional grading.

NNM requires 10 judgements per script. The total can be divided up amongst all the available judges. For our study, a total of 81 papers needed assessment, which meant that each judge had to judge 270 papers ((81 x 10) / 3 = 270). Of these judges, two are instructors for the research methods module, while a third colleague generously volunteered to participate in the project.

Data collection

The study gathered both quantitative and qualitative data, encompassing the following:

- Each judge documented the time taken to assess each script using the CJ approach.
- Judges made annotations about their experiences and observations during the grading process.
- NNM compiled outcomes from the comparative judgement procedure, providing vital insights into the process and grading’s consistency (refer to Figure 3).
- After the CJ grading, judges evaluated the same scripts utilising a rubric. During this process, they documented both the time taken for rubric-based marking and the scores assigned to each assignment.

V. FINDINGS

The findings stem from the analysis of both the quantitative and qualitative data. The quantitative data contributed to the assessment of the efficiency, reliability, and validity of the CJ grading method. Some of this data originated from the results of the comparative judgement process (see Figure 3). Simultaneously, the qualitative data was examined to gain insights into the judges’ user experience and to formulate potential applications of the method in the future.
The ranking result

Figure 3 below displays a screenshot showcasing the outcome of the CJ grading process done by the NMM judgement tool.

![Figure 3: Results of the CJ grading process](image)

The range for the final ranked results is set between 0 and 100. It should be noted that these values are adjustable. The conclusive assessment of each assignment’s quality is presented in the second column labelled ‘Scaled Score’.

The ‘Infit’ value serves as an indicator of the level of consensus among judges. Elevated Infit values might...
imply potential discrepancies among judges regarding the assessed quality of the work in question.

**Efficiency**

The average time spent per script using CJ was roughly 1.5 minutes, leading to a cumulative total of approximately 20 hours and 15 minutes required for grading the 81 papers (equivalent to 6 hours and 45 minutes per judge, given the three judges – recall that each judge had to evaluate \((81 \times 10)/3 = 270\) papers). On the other hand, the average time for marking per script using a rubric was 1.32 minutes. This suggests that an individual can complete the script marking in just under two hours (refer to Table 1). It is evident that the CJ grading process is comparatively less time-efficient than the traditional rubric-based marking. However, all judges confirmed that the process of simply comparing two scripts required significantly less cognitive effort compared to using a rubric for marking.

<table>
<thead>
<tr>
<th>Marking method</th>
<th>Number of assignments</th>
<th>Number of scripts to mark</th>
<th>Average time per script</th>
<th>Total time per marker</th>
<th>Approximate total time to mark all scripts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparative judgement</td>
<td>81</td>
<td>((81 \times 10)/3) judges = 270 per judge</td>
<td>1 min 30 seconds</td>
<td>6 hours 45 minutes</td>
<td>20 hours and 15 minutes</td>
</tr>
<tr>
<td>Rubric marking</td>
<td>81</td>
<td>81</td>
<td>1 min 20 seconds</td>
<td>1 hour 47 minutes</td>
<td>1 hour and 47 minutes</td>
</tr>
</tbody>
</table>

**Reliability**

The reliability coefficient stood at 0.84, underscoring a strong reliability level for the task. NMM employs the scale separation reliability, which gauges how effectively the assessment distinguishes the quality of scripts. This concept is akin to Cronbach’s alpha. An index of 0.8 or higher indicates substantial reliability [No More Marking, n.d.]. The table of results reveals notable dissension among the judges for only six papers (refer to the screenshot in Figure 3). These papers will be subject to re-evaluation by the panel of judges, and their rankings will be adjusted accordingly based on the resultant outcomes.

**Validity**

The authors employed SPSS to perform the Spearman correlation test, aiming to assess the validity of the CJ grading method for academic writing assignments. The Spearman rank order correlation coefficient revealed a notable positive correlation between the rankings generated by the CJ grading process and the scores obtained through rubric-based grading (refer to Figure 4 below). This finding underscores that the CJ method accurately reflects students’ proficiency in academic writing.

**Correlations**

<table>
<thead>
<tr>
<th>Scaled Score</th>
<th>Rubric score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman's rho</td>
<td>.719***</td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>1.000</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>N</td>
<td>81</td>
</tr>
<tr>
<td>Rubric score</td>
<td>Correlation Coefficient</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>N</td>
<td>81</td>
</tr>
</tbody>
</table>

**.** Correlation is significant at the 0.01 level (2-tailed).

Figure 4: Results from the Spearman correlation test
Interestingly, the averages of the ranking scores (Figure 5) and rubric scores (Figure 6) demonstrated remarkable similarity.

<table>
<thead>
<tr>
<th>Scaled Score</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>81</td>
<td>0</td>
<td>100</td>
<td>60.51</td>
<td>18.894</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td>81</td>
<td>0</td>
<td>100</td>
<td>60.51</td>
<td>18.894</td>
</tr>
</tbody>
</table>

Figure 5: Mean of the CJ ranking results

<table>
<thead>
<tr>
<th>Rubric score</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>81</td>
<td>12</td>
<td>88</td>
<td>59.40</td>
<td>16.022</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td>81</td>
<td>12</td>
<td>88</td>
<td>59.40</td>
<td>16.022</td>
</tr>
</tbody>
</table>

Figure 6: Mean of the Rubric Marking results

Judges’ reflections and observations

Comments from the judges included:

- “I have confidence in the process since I know that another judge will assess the same paper.”

- “One gains a comprehensive understanding of common issues.”

- “Distinguishing crucial components in a strong assignment and identifying shortcomings in a weaker one is straightforward.”

- “But, what about providing individual feedback?”

Upon exchanging insights, the judges recognised that, to streamline the process, they began to emphasise specific elements over others. To illustrate, while one judge concentrated on establishing a well-defined research objective, another placed priority on a coherent argument flow.

VI. DISCUSSION

The findings derived from this exploratory study highlight a method that is notably reliable and substantively valid, albeit with some efficiency drawbacks. Nonetheless, the user experience during the grading process was positive, characterised by a reduced cognitive load. This aligns with Bejar’s [2012] findings, which suggest that CJ can impose lower cognitive demands due to its holistic grading nature. The judges found solace in the fact that the final ranking is not contingent on a single individual. Furthermore, they recognised the judgement tool’s role in ensuring judgement consistency, thus enhancing trust in the process. Kimbell [2021] echoes similar sentiments, reflecting the judges’ experiences in this study. These reflections were shared by judges following the e-scape project, where the concept of holistic assessment was emphasised: “get a whole view much more readily”; “It gives more appropriate results than atomised approaches which can lead to inaccurate overall assessment especially when the overall attainment is more than the sum of the parts”. The fairness (reliability) of the system was underscored: “The assessment system feels equitable; it’s not dependent on a single assessor evaluating an individual piece of work.”

Similarly to the experiences of the judges in this study, the assessors mentioned in the research conducted by Jones et al. [2015] raised concerns about their tendency to prioritise certain aspects of assignments over others during the grading process. Notably, the judges in this study came to realise, after assessing the same scripts using the rubric, that some significant
components had been undervalued in the CJ grading process. However, the fact that multiple judges evaluated the same assignments helped mitigate this effect.

Research indicates that initially, the CJ grading method was primarily applied for summative assessment; however, its utilisation for formative assessment in learning is on the rise [Kimbell, 2021]. This aligns with our intended use of CJ – small, creative formative assessments such as the formulation of case studies, or even the use of peer review using the CJ system. We encountered an issue with the lack of capability to offer individual feedback when employing it for formative assessment. While CJ software platforms can be configured to enable judges to supply individual feedback, this modification significantly prolongs the process. A similar challenge is reported by Jones et al. [2015] in the context of assessing mathematical problem-solving.

VI. LIMITATIONS

It is important to highlight that the rubric-based marking occurred after the CJ grading. This implies that the judges had already encountered the assignments before. This factor could have influenced the time taken for script marking with the rubric. However, it is plausible that even with this consideration, the overall marking duration using rubrics would likely have remained notably shorter. Additionally, there has not been an assessment of inter-rater reliability when using rubrics to mark the scripts. The only aspect compared between the two grading methods was the time taken, which leaves the question of the reliability of the traditional marking process for these assignments unresolved. On the other hand, the reliability of the CJ process remains its strong point.

VII. CONCLUSION

This study presents the process and findings of an exploration into the application of CJ as a grading methodology for academic writing essays within the context of IS honours. The research was carried out using the essays written by 81 students enrolled for the honours research module at the University of Pretoria. The results indicated that CJ is a notably reliable and valid grading approach for academic writing among IS honours students, offering the advantage of reduced cognitive exertion when compared to rubric-based marking.

Similar to Jones et al. [2015], the judges in this study also recognise the prospect of enabling educators to create assignments that are not effortlessly evaluated through conventional methods. Particularly within the realm of IS honours courses, concise academic writing tasks can be appraised reliably and effectively, contingent on the number of judges involved. However, the labour-intensive nature of the grading process implies that, given substantial student cohorts and a finite number of assessors, the utilisation of CJ will only be used in exceptional cases.

VIII. REFERENCES


DESIGNING A BUSINESS MODEL IDEATION TOOL FOR ENTREPRENEURSHIP EDUCATION

Ricarda Schlimbach  
Heilbronn University, Germany  
ricarda.schlimbach@hs-heilbronn.de

Tim Lange  
Felix Wagner  
Susanne Robra-Bissantz  
Chair of Service Information Systems  
TU Braunschweig, Germany

Thorsten Schoormann  
University of Hildesheim &  
Fraunhofer ISST Dortmund, Germany

Abstract:
Promoting business model ideation skills is imperative in contemporary entrepreneurship education and beyond. Emerging (software-based) tooling for such innovations, however, often neglects the unique characteristics faced for educational purposes. To address this, we designed a novel artifact for teaching business model ideation in digital learning environments. By drawing on knowledge from pattern-based innovation, creativity, and conversational AI, we implemented a personal ideation companion (PICO). Our companion navigates students through five ideation phases, encouraging them to ideate business models in a divergent-convergent thinking style. The web-based tool covers diverse features on an educational, social, and motivational layer to teach business model basics and to promote creativity and versatile thinking along the ideation process. Based on our multi-year DSR project, we report on a situational instantiation and provide abstracted guidelines for its design and implementation in (entrepreneurship) education, which has been evaluated in several formal and informal learning scenarios.

Keywords: Entrepreneurship, Education, Conversational AI, Conversational Agent, Educational BMDT.

I. INTRODUCTION
"If at first, the idea is not absurd, then there is no hope for it."—Albert Einstein.

In today’s continuously transforming world, the ability to generate novel ideas is increasingly important. Ideas enable organizations to adapt outdated business models (BMs), react to exogenous shocks, and create alternatives to current ways of doing - for that reason ideation is a vital area of innovation (Frankenberger et al. 2013). Skills concerning idea generation are relevant beyond disciplinary boundaries. An entrepreneurial mindset, including spotting opportunities for businesses and being creative, does typically evolve already in the early stages of people’s lives, not only during professional endeavors (Lindner 2018). Training that mindset is particularly important to students because they will be confronted with spurring innovation all the time in their future careers (Bell and Bell 2023). Approaches to guide and practice corresponding skills are therefore a fundamental pillar in (entrepreneurship) education in order to put graduates in the position to start their own businesses or innovate incumbent companies (Hameed and Irfan 2019). While related areas already succeed in offering digital or hybrid education formats, online entrepreneurship faces only limited adoption. This is especially hard in times of growing remote learning and distributed work (Liguori and Winkler 2020).

Research on digital entrepreneurship (e.g., Nambisan 2017; Recker and Briel 2019) and BM innovation (e.g., Ebel, Bretschneider, and Leimeister 2016) have already pointed to the promising role of supporting digital infrastructure. In the context of BMs, so-called business model development tools (BMDTs) are among the prevailing software artifacts (e.g., Bouwman et al. 2020) that offer features for communication, collaboration, documentation, experimentation, and creativity regardless of time and location (Osterwalder and Pigneur 2013). Although several BMDTs exist (see overview in Szopinski et al. 2020), teaching BM ideation as part of entrepreneurial education has unique characteristics that need to be considered: First,
research often focuses on advanced phases of BM innovation, leading to a need for investigating the early phases which are relevant to prepare (future) entrepreneurs to develop, refine, and validate ideas (Hoveskog, Hallia, and Danilovic 2015). Second, while ideation should be taught systematically to increase its efficiency (Ogutveren-Gonul 2019), only a few BMDTs implement features to guide users through different innovation stages or benefit from disruptive technologies like generative AI. Third, Szopinski et al. (2020) call for research on investigating specific user characteristics and purposes in the context of education compared to general business settings. Against this backdrop, we seek to create a contextualized tool capable of teaching BM ideation and ask: How to design an educational BMDT that guides and trains the process of generating new ideas?

To answer this, we conducted a design science research (DSR) project in which we built an IT artifact in the form of a software tool entitled PICO (your personal ideation companion) that is enriched by conversational AI. In the tradition of knowledge accumulation, we applied pattern-based innovation, divergent-convergent thinking, and motivational theory to deduce general requirements and make informed decisions concerning its implementation. We evaluated the artifact’s usage and added value in several learning scenarios (altogether over 70 students and 10 practitioners) to then derive guidelines for implementing BMDTs in educational settings.

II. RESEARCH BACKGROUND

Business Model Ideation and Supporting Software-based Tools

Among different interpretations of the BM concept is the view that BMs enable innovation as they pose a valuable unit for analyzing a current business as well as a starting point for employing innovation approaches. Broadly speaking, BM innovation can be defined as a process of designing a new or modifying an existing way of doing business (Schneider and Spieth 2013). In this innovation process, several phases are crossed (e.g., Ebel et al. 2016; Hoveskog et al. 2015), including initiation to investigate the actual need and understanding of the environment, ideation to create possible solutions, integration to operationalize selected ideas, implementation to bring the solution into the market, and management to monitor and evaluate results. From a pedagogical perspective, the process covers the highest cognitive stages of evaluation and creation (see Bloom 1956). Although ideation is essential, prior literature pointed to the need for advancing the early phases in particular as our understanding of how to conduct ideation is rather limited (e.g., Björk 2012). This deficit hinders (future) innovators, such as students, from developing abilities to create, refine, and validate new BM ideas (Hoveskog et al. 2015).

Supporting tools provide a promising approach to overcoming these challenges. Like in adjacent innovation fields, scholars and practitioners stressed especially the potential of software, in the form of BMDTs (Szopinski et al. 2020; Veit et al. 2014). Existing BMDTs provide features that foster, for instance, creative business modeling (Voigt et al. 2013), BM validation (Dellermann et al. 2019), and BM reflection (Schoormann, Stadtländer, and Knackstedt 2021). Despite the growing availability of such tools, there is limited research on their abilities in educational settings. Bouwman et al. (2020) even called for “using tools in BM education [to investigate] what can be learned from student users [and how it can] be included in curricula, where there is less background knowledge on business topics” (p. 417).

A Three-Layered Framework as Conceptual Foundation

Any interaction is shaped by the interactors’ relationship, matched needs and provided services (Geiger, Robra-Bissantz, and Meyer 2020). Applied to our specific context of teaching and training BM ideation, we propose that a tool needs to cover aspects of educational, social, and motivational layers (Benner et al. 2022). The educational layer involves the selection of learning goals and the creation of corresponding tasks (Bloom 1956; Krathwohl 2002). Following Benner et al. (2022) the social layer determines the role and relationship of the tool to the user with underpinning theories, such as social presence theory (Lowenthal 2009) and social agency theory (Shapiro 2005). The motivational layer seeks to motivate and prompt users to apply a tool. This can be achieved by adapting game design elements that draw on the self-determination theory (Ryan and Deci 2000) and hexad player types (Tondello et al. 2016) to respect individual drivers and learning preferences (Steinherr and Reinelt 2022). Referring to our context, the interplay between these layers is crucial, as the selection of appropriate learning goals in the educational layer will influence the social and motivational
outcomes, too. In turn, the social layer will influence the motivational layer, as the role of how a user interacts with a tool depends on the selection of appropriate game design elements (Benner et al. 2022). Overall, our educational BMDT aims to provide a user-centered and engaging experience, by considering the interplay of these layers.

III. RESEARCH DESIGN

DSR is an auspicious approach for designing digital BM tools (Schoormann et al. 2021; Veit et al. 2014). To ensure relevance and rigor, we completed three design cycles (Kuechler and Vaishnavi 2008) lasting about half a year each to build our educational BMDT, PICO (see Figure 1).

![Figure 1. Iterative Artifact Design and Evaluation](image)

Design Cycle 1

We started with the formalization of the actual problem. As mentioned in the Introduction, a digital solution for learning BM ideation was required to respond to changing learning environments, such as due to the Covid-pandemic. From our review of prior research, we conceptualized design requirements for (1) more contextualized tools to respect students'/entrepreneurs' characteristics, (2) features for systematic guidance through ideation processes, and (3) tools that focus especially on the early stages of BM innovation, particularly ideation. To suggest a solution, we draw on knowledge from pattern-based innovation as well as divergent-convergent thinking, which was then implemented through a Java-based BMDT. During the evaluation, five potential users tested our initial BMDT individually, investigating user interface, functionality, comprehensibility, bugs and learning content by articulating their thoughts with the think-out-loud method (Someren, Barnard, and Sandberg 1994). Each run lasted 1-2 hours, followed by an open discussion on the evaluation criteria and improvement suggestions. We did this in three rounds (one per month) and embedded feedback into a revised artifact. This is then tested again by each of the participants to iteratively improve the BMDT’s design (Schlimbach, Christmann et al. 2022).

Design Cycle 2

Based on the evaluation of the learnings from the first cycle, we observed the need for an improved UI and additional motivation to enthuse students. Therefore, we made use of motivational hexad archetypes (Tondello et al. 2016). We reviewed the literature on motivational features from these hexad types and analyzed papers covering the educational context in particular (e.g., Steinherr and Reinelt 2022). We combined the findings with five interviews; practitioners and academics who had researched and/or implemented features from the hexad scale into digital learning tools. The transcribed interviews lasted 40 to 60 minutes and followed a semi-structured interview guide to cover motivational drivers and archetypes, suggested features, and potential hurdles for the given learning context. We then involved students as co-creators to design low-fidelity-prototypes in Figma for the derived motivational hexad design features, whereby each prototype covered two similar archetypes in learning (Steinherr and Reinelt 2022), namely ‘achievers & players’, ‘free spirits & disruptors’, and
‘philanthropists & socializers’. In doing this, we respond to calls for using software tools in BM education and curricula for students with varying backgrounds and course scenarios (e.g., Bouwman et al. 2020; Szopinski et al. 2020). The three prototypes were tested in a workshop with undergraduate students from various majors and prioritized features to be implemented (Schlimbach, Behne et al. 2023). As a result, the workshop revealed the need for additional social interaction and sparked the idea of embedding a socially bonding chatbot.

**Design Cycle 3**

To respect the need for social interaction, we followed the suggestion from the literature of chatbot-based learning companions and implemented a web application by reusing design knowledge (Khosrawi-Rad et al. 2022; Schlimbach, Windolf, and Robra-Bissantz 2023; Tolzin et al. 2023). We tested the artifact’s applicability in two entrepreneurship bachelor courses with 14 students each and observed the tool interaction before collecting feedback in a follow-up group discussion on impressions and learning experiences. As our educational BMDT achieved robust results, we started to perform a set of ex-post evaluation episodes to derive learnings from observed aspects that benefit successful implementation and the tool’s adoption in the respective ideation setting. In these episodes, groups of students and BM innovators were confronted with different (real-world) challenges, such as creating novel business ideas or redesigning existing BMs. We discussed with the participants involved the expected value in using the tool before and after its application in class to spot generalizable overlaps and differences that might be aligned to the specific setting. By reflecting across all building and evaluation activities, we were able to synthesize observations, tensions, as well as recommendations that guide the design and implementation of tools from a similar class within and beyond educational environments. In the next section, we present the consolidated results and findings across all design cycles.

**IV. ARTIFACT DESCRIPTION: AN EDUCATIONAL BMDT**

**Conceptualization: Design Requirements and Goals**

On the educational layer, a prerequisite is to establish a common understanding of BMs and the ideation process. Following Bloom’s taxonomy (1956) on learning levels, advanced knowledge and skills are built upon solid foundations (i.e., shared understanding of a topic). To help students get advanced BM ideation skills, a tool needs to teach them to understand the underlying value creation architecture of BMs and apply their constituting building blocks (e.g., Osterwalder and Pigneur 2013). Based thereupon, abilities to create new ideas and evaluate ideas are trained, whereby various knowledge dimensions (e.g., factual, conceptual, and strategic knowledge) are touched upon (Krathwohl 2002). Accordingly, we formulate the first requirement: **DR1 – Establish a common base of knowledge.**

Because ideation contains different activities, such as spotting opportunities, generating alternatives, creating initial ideas before validating and selecting among these (Lindner 2018), appropriate guidance is required. To navigate through the process, BMDTs should provide students with guiding structures, versatile perspectives and dynamic filtering (Müller-Wienbergen et al. 2011) to explore and evaluate ideas. Studies have shown that the use of multiple thinking methods as well as understanding the types and sequence of thinking methods improve the effectiveness of ideation (Ogutveren-Gonul 2019). Moreover, understanding different thinking styles, such as convergent (i.e., evaluating ideas) and divergent (i.e., opening the thinking process to surprising knowledge contexts) thinking contributes to exploring a broader range of options while ensuring that the ideas are evaluated and refined appropriately (Müller-Wienbergen et al. 2011). The distinction between the two thinking styles is reflected in numerous problem-solving models for creative solution finding (e.g., Gassmann, Csik, and Frankenberger 2014). Accordingly: **DR2 – Guide learners throughout the ideation process and thinking modes.**

Following Gassmann et al. (2014), many BMs emerged from the recombination of existing components. The idea of pattern-based innovation through analogy building and reusing has a long history. Until today, research assumes that less than one percent of innovative technologies are novel in their mechanics, but rather make use of existing patterns that are linked together in a novel way or embedded in other contexts (Gassmann et al. 2014). Schlimbach et al. (2022) conclude that connecting and recombining patterns is an evolutionary...
principle that leads to BM innovation. To facilitate the purposeful recombination of ideas, appropriate tools are needed. These, for instance, should allow for categorizing and organizing knowledge items (Müller-Wienbergen et al. 2011) to help learners identify, connect, and recombine ideas in a structured manner. Accordingly: **DR3 – Prompt learners to connect and recombine ideas.**

Ideation is a collective endeavor and research in ideation-related streams has stressed the importance of interaction and collaboration. On the *social layer*, socializing learning environments are demanded to support learners in interacting and collaborating. Social presence theory suggests that communication media (Short, Williams, and Christie 1976) can differ in the extent to which they convey a sense of social presence (i.e., the degree to which people perceive that they are interacting with real, live individuals). In the context of education, the theory posits that the level of social presence conveyed by a communication medium can impact how people perceive and respond to a tool. Social agency theory (Shapiro 2005) assumes that people’s sense of agency (their ability to influence their environment and bring about desired outcomes) is impacted by their interactions with others. The theory suggests that individuals have a variety of agency-related goals that they pursue in social interactions – for example, they may seek to establish their competence, build relationships, or exert control over their environment (Ryan and Deci 2000). Based on these theoretical lenses, a gamified conversational tutor to support learners in digital learning environments might be helpful (Benner et al. 2022). Research has shown that people behave socially towards machines and even bond with them as long as their design is humanoid (e.g., Nass et al. 1994).

Especially in educational settings, on a *motivational layer*, it is essential to reflect on different styles of learning (preferences), levels and individual drivers of motivation (Plass and Pawar 2020). Motivation drives IT adoption and recurring technology use (Davis 1993) and thus can prompt the use of educational BMDTs, too. Gamification has proven to be an effective approach to incentivize and motivate learners, drawing on established theories such as self-determination theory (Ryan and Deci 2000). The hexad model (Tondello et al. 2016) offers a standardized scale for user types that takes into account their motivational drivers and preferences beyond gaming, comprising six archetypes: Player, Free Spirit, Achiever, Disruptor, Socializer, and Philanthropist. Specific design recommendations for motivating each archetype in gaming are provided (Berehill 2022; Tondello et al. 2016) and recent research shows that different learning preferences (e.g., solving a task collaboratively vs. competitively) are also reflected in these hexad archetypes (Steinherr and Reinelt 2022). In consequence, from a motivational viewpoint, mechanisms to ensure learner motivation as well as functions to consider individual learner orientation and implement motivational design elements (Benner et al. 2022) are required. Accordingly: **DR5 – Consider different types of learners and their drivers for motivation.**

**Instantiation: Situational Artifact and Its Features**

We translated the five DRs into features to instantiate our educational BMDT, named PICO (see Figure 2).
The BMDT is built as a web application with five main components: Frontend, Backend, Database, Rasa and Rasa NLU. The Frontend handles the UI and user actions through JavaScript VUE Framework, while the Backend is built on a restful API using the Python Django framework to handle data requests and queries. The embedded chatbot uses Rasa NLU, which communicates text-based via natural language and is integrated with more specialized tasks through the Python Rasa SDK. The chatbot thus uses multiple frameworks to provide seamless natural language communication and dynamic data processing.

To establish a common base of knowledge (DR1), we embedded an introductory video tutorial (F1) that explains the core BM elements and BM ideation. Students then define a BM together with PICO (F2) to apply the gained knowledge or walk through a sample ideation journey exemplified for Amazon and Uber (F6). A joint innovation library (F3) with ideas from all users creates a common knowledge space beyond single teams. The ideas might be discussed in a broader setting. This way, students are guided (F1-F3) from the mere understanding of BM basics to advanced skills of evaluation (Krathwohl 2002). Moreover, PICO serves as an ideation companion that navigates throughout the tool (F4), tutoring key facts and providing advice for each phase along the ideation process (F5) (DR2). We reused design knowledge for LCs (Khosrawi-Rad et al. 2022) and integrated social cues, such as a human identity (avatar, self-referencing and introducing as ‘Pico’) and informal, natural language to create a social presence (Benbasat et al. 2010). The LC helps to connect and recombine ideas (DR3), as it is linked to a library with 61 BM pattern cards (Gassmann et al. 2014) (F8) and aligns the student’s idea with patterns via targeted interrogative questions on the business logic. PICO suggests still unconsidered BM patterns and encourages their transfer to further evolving BM ideas to be labeled by IDs (F7). Inspired by 21 questions wrapped around the four business logic’s core dimensions (what, who, how, value) (Gassmann et al. 2014), ideas are aligned with a BM’s core elements to then result in merged new ideas (F9).

As the interaction with real or digital entities is important (DR4), several social features were implemented. These include the option to prompt PICO in a chat with situational knowledge on
the ideation process or to interact with ChatGPT-4 or Dall-E as an embedded module to jointly elaborate on BM ideas and generate pictures, such as a logo (F10). Depending on the selected BM patterns, individualized and more detailed questions help inspire creativity (F11). PICO encourages learners to interact with peers by evaluating their ideas comparatively by setting sliders (F12) for assessing the impact and feasibility of each idea.

To consider different types of learners and their drivers for motivation (DR5), we employed gamified elements, such as badges and customizable user profiles (F13). Gamification motivates learners by providing a fun and engaging environment (Benner et al. 2022). Our BMDT responds to all motivational drivers of hexad (Tondello et al. 2016): We combine competitive elements (e.g., generating the best idea), with accomplishments (e.g., an innovator batch for a certain number of ideas), collaborative aspects (e.g., interacting in the chat), as well as knowledge sharing in the library, two learning modes (tutorials along well-known companies and their BMs versus free topic) and room for disruptive ideas (F14).

V. DEMONSTRATION AND EVALUATION

Overview
Considering the socio-technical nature of our artifact that captures technical, task-related, and learner aspects, we performed – besides ex-ante evaluations from each design cycle – three ex-post evaluation episodes (Venable, Pries-Heje, and Baskerville 2016) to investigate the artifact’s applicability and value as well as to obtain impulses for improvement.

We position episodes EP1-EP3 as naturalistic because they took place in real university courses and/or with practical partners that aimed to create BM ideas (see Figure 3).

Figure 3. Overview of Evaluation Episodes (Blue = This Paper’s Focus)

Episode EP1 – Workshop to Generate Business Model Ideas
To apply our educational BMDT in a setting without our supervision (i.e., applying the tool by external lecturers), we provided the tool and some instructions to two lecturers from another university in Austria. In a 3h workshop, 26 international students from a master course on ‘Entrepreneurship and Innovation’ developed a BM for an idea competition (with incentives from a company). As the students had no prior experience with our BMDT, a short introduction to PICO was provided in an analog setting. Then, they applied PICO and discussed its value, room for improvement and other experiences in a follow-up session. The latter provided us with their insights for using BMDTs in teaching scenarios.

The feedback revealed that the learners’ value-in-use (VIU) (Bruns and Jacob 2016) focuses on productivity and competitiveness. Students prioritize generating ideas quickly and winning the competition, valuing incentives over learning. Teams were hesitant to share ideas (F3) due to fear of “robbing our ideas to make the other team win the competition.” The lecturers noticed students lacked clarity on shared results’ viewing rights in PICO (not noticing that it is possible to share interim results only with their team). Enhancing transparency and restricting collaboration to the team level are thus important for the tool introduction. Improved UX/UI,
including chat capabilities matching or surpassing ChatGPT (F10), was named essential for its adoption. From the lecturers’ perspective, the V/U lies especially in artifact innovativeness and its social value in interacting (F4, F11). Both argue that hybrid interaction with digitally connected participants and engaging with chatbot Pico provide enhanced learning experiences “to not only talk about conversational AI in class but interact with it to learn hands-on”. However, lecturers observed that the guided ideation process (F5) became time-consuming, leading to “exhaustion and frustration” after a while, which might have been intensified by the workshops’ context (an evening course after a long workday). They thus suggest splitting up the ideation process (F5) into smaller parts and reducing the number of mandatory questions (F9, F11) to be answered per phase.

Overall, we see the necessity to balance students’ desire to win (for grades and prizes) with lectures’ aim for meaningful learning, requiring communication of expectations and the anticipated value in using PICO for everyone. Didactic guidance is crucial for maintaining a schedule and preventing exhaustion. Students struggle without clear instructional cues but benefit from the applied “hands-on approach” with PICO.

**Episode EP2 – Project to Develop a Business Model**

Besides, PICO accompanied larger projects across four weeks, in which a group of 15 students was confronted with the task of innovating the BM of the university’s cafeteria. We introduced the tool – see also EP1 – and attended the project to collect insights from the use and feedback from team discussions.

Students claimed to have walked through the sample ideation journeys of Uber (F6) for their semester projects “to quickly understand the core idea”. Besides, all students voluntarily engaged with our embedded conversational companion (F10), drawn by its ability to inspire and generate ideas that hadn’t been previously considered. Some even asked for an additional lecture (in their free time) to meet the developer because they were curious about the underpinning technology. They appreciated the “intuitive and social design” (F4) and perceived the interaction as more collaborative than ChatGPT. This might be attributed to its personalized addressing, use of emojis, and small talk that creates a “sense of social connection”. The contextual knowledge and multimedia integration (e.g., Dall-E (F10) and explanatory videos (F1)), coupled with a story-like progression and gamified elements (F14) through the ideation phases, enhanced the user immersion. Students noted increased productivity in idea generation and valued the linguistic capabilities as well as access to extensive data as “effective and inspiring”. Educators found PICO beneficial for digital team collaboration and gaining insights into students’ questions addressed to the learning companion.

Contrarily to the positive indications, we observed some tensions: It is important to balance the need for didactic guidance and a certain degree of freedom enabling to “explore the systems’ modules by ourselves” and “gain a better idea on conversational AI and how to use it purposefully”. Also, while some formulated concerns about replacing human relationships, engaging and empathic interactions were highlighted as their favorite feature (F2). Contrasting EP1, the students’ focus in the EP2 setting was on learning BM ideation without external incentives (e.g., winning prices), so we conclude that the way of the didactical integration in class has an impact on students’ motivational drivers and use.

**Episode EP3 – Industry Project to Innovate an Existing Business Model**

In addition to applying the BMDT through students, we also shed light on how a team of company employees uses the tool for innovating concrete BMs. Embedded in a three-day workshop, a group of ten employees with interdisciplinary backgrounds from an ideation department of a single industry partner used the principles of our artifact to create novel ideas concerning mobility challenges. The project goals comprise an increased inspiration and productivity of the idea generation process as well as triggers for thinking out of the box as intrapreneurs.

In EP3, we found that informal learning played a significant role, allowing participants to gain knowledge and insights alongside their daily operational responsibilities. However, due to privacy concerns, our conversational AI (F10) could not be utilized – data management and accessibility were key barriers. Contrarily to our observations in students’ formal learning settings, motivational and adaptable features (F13, F14) were barely given attention because
the employees showed an intrinsic motivation to find solutions efficiently in the limited time frame given "without being distracted by gamified elements". Despite rather limited tool use, the workshop succeeded in its aim to drive creative outcomes and foster a culture of innovation. Instead of an educator, there was a moderator who introduced the BMDT and the participants demonstrated a high self-efficacy in coming up with creative ideas facilitated by the tool; potentially due to their work experience and proficiency in finding solutions to a given problem. Employees attested a hedonic value as it “was fun to experiment again like a child, just with business model patterns instead of toy blocks”. Compared to the students, who came up with many creative BM ideation ideas, the employees focused on only two ideas to be specified in detail considering feasibility as well after just 20 minutes. They spent more time collaborating with the entire group in a physical setting using flipcharts to visualize their ideas from the digital tool with the pattern card library (F8) as the most extensively used feature. Although learning has never been a priority in the workshop, participants attested that they had learned a lot as they now “better understand BMs and how to ideate them”.

Observations and Reflections
As generalizability is a major concern in DSR (Baskerville et al. 2018), we sought to reflect on the observations from building and evaluating our artifact to inform future endeavors. Continuous reflection supports us in moving from building a specific instance to more abstract insights applicable to a class of problems and solutions (Schoormann, Möller, and Chandra Kruse 2023; Sein et al. 2011). In the following, we synthesize the observations that occurred in our research process and formulate recommendations along with two categories for designing educational BMDTs and implementing these in educational settings (see Figure 4). The abstracted design knowledge is mapped to the underpinning layers (i.e., social, motivational, educational) following Benner et al. (2022).
VI. DISCUSSION

The overall purpose of our research is to produce design knowledge for the class of educational tools that guide BM ideation. Training abilities for creating novel ideas are important for students and entrepreneurs beyond disciplinary boundaries to face today’s challenges for continuous innovation and the adaptation of organizations. By making use of justificatory knowledge from pattern-based innovation, thinking styles, and motivation theory to consider individual learning preferences and drivers, this paper iteratively designed PICO, an artifact in the form of an educational BMDT, and generalized insights from both the building and evaluation activities in various application contexts with the intention to make participants learn about BM ideation.
From a research viewpoint, (1) our web-based educational BMDT (i.e., situational artifact) and the more abstract knowledge (i.e., design requirements, features, and generalized guidelines) respond to recent calls for tooling in the realm of BM innovation (e.g., Bouwman et al. 2020). Our tool especially considers the educational domain and thus implements features, including teaching a basic understanding of BMs, navigating through different ideation stages, as well as motivating the use through gamification elements to increase engagement and respect individual learning styles. Moreover, (2) since existing tools tend to focus on advanced stages of innovation, our work contributes to the early stages in particular. The ideation phase itself consists of numerous activities, such as developing, refining, and validating ideas, that need to be performed systematically (Hoveskog et al. 2015). Herewith in line, we (3) provide design features relevant to a specific context and advance the current body of BMDT features. For instance, features to enable the use of pre-defined templates/patterns and generative AI, as well as being oriented via phase management are seldom provided by such tools (Szopinski et al. 2020).

From an educational practice perspective, our work (4) responds to entrepreneurial needs in terms of skills to jointly spot opportunities and create solutions (Hameed and Irfan 2019; Lindner 2018) via a structured ideation process. As learners are confronted with crafting and selecting their own ideas, we aim to (5) train advanced skills for applying, analyzing, evaluating, and creating outcomes that go beyond pure understanding through factual knowledge transfer (see Bloom’s Taxonomy (1956)). In this course, (6) our paper reports on a web-application and thus adds an important component to online formats of entrepreneurship education that face only limited adoption (Liguori and Winkler 2020). Its instantiation goes beyond a conceptual prototype, as the tool is already being used in real-world entrepreneurship courses and has even proven to facilitate informal learning in a business context. For that reason, (7) we condensed our experiences and observations into guidelines for the BMDT’s implementation to facilitate its adoption in further (educational) settings.

In line with Townsend and Hunt (2019), we view creativity as a cornerstone skill, essential not only throughout the general ideation process in entrepreneurship but also in effectively navigating the integrated conversational AI within our instantiated BMDT named ‘PICO’. This dynamic co-creation of BMs demands students' adeptness at critically evaluating outcomes and meticulously considering their pragmatic application within diverse contexts. To facilitate the attainment of the highest echelons of Bloom’s (1956) Taxonomy within the classroom, our paper stresses the indispensable role of educators in orchestrating a purpose-driven pedagogical trajectory that becomes pivotal for the seamless integration of educational BMDTs into the instructional framework. Beyond the realms of Entrepreneurship Education, this underscores the broader need to harness innovative technologies and reevaluate the competencies that students must be equipped with for their future vocations (Bell and Bell 2023). While our artifact is tailored for BM ideation in entrepreneurial education, its implications extend to various contexts and students with diverse disciplinary backgrounds. For example, computer science courses can employ coding patterns, and IS courses can build design patterns, thus demonstrating how to spur innovation with PICO across domains. Additionally, PICO's embedded interactions with conversational AI impart students with valuable experiential skills, promoting creativity, irrespective of their field of study. Thus, the tool fosters interdisciplinary interest in education empowered by IS.

Despite the promising indications gleaned from our ex-post evaluations, wherein students and practitioners demonstrated prowess in generating innovative ideas, it is important to acknowledge the limitations of our results in terms of representativeness. These findings can be further elucidated contingent on the characteristics of the target audience, the specific learning milieu, and additional factors such as cultural nuances or the legal landscape pertaining to its application (Mehta et al. 2021). Moving forward, we intend to investigate PICO’s impact on student’s learning outcomes and creativity, encompassing the quantitative and qualitative aspects of the generated skills in ideating BM concepts. We conclude that discourse on how to design and adopt innovative BMDTs context-specifically to reshape education is urgently needed (Bell and Bell 2023).

References


ABOUT THE AUTHORS

Ricarda Schlimbach is a teaching professor for Business Information Systems at Heilbronn University funded by the Gerhard and Ilse Schick Foundation. She has coordinated the research project ‘StudyBuddy’ for the development of AI-based Learning Companions to facilitate learning in higher education at TU Braunschweig. Ricarda has been working for 10 years in the Automotive industry and is passionate about bridging research and practice by teaching courses such as Digital Business Management.

Tim Lange is a PhD Student in Business Information Systems and supported the PICO project during his master studies at TU Braunschweig by deriving design knowledge and supporting the BMDT’s development in software engineering. He brings in practical experience from various roles in business consulting.

Felix Wagner is a master student in Computer Science at TU Braunschweig and supported the PICO project during his (undergraduate) studies at TU Braunschweig. He has developed the web application (backend and frontend).


Susanne Robra-Bissantz has been head of the Institute for Business Information Systems and the Chair for Service Information Systems at TU Braunschweig since 2007. She actively works on new forms of teaching like GamEducation or Flipped Classroom concepts and has implemented numerous third-party-funded projects in cooperation with industry. Her work on eServices, Collaboration Technology, eLearning, and context-aware Information Systems has been published in international conferences and recognized journals.

Thorsten Schoormann is a postdoctoral researcher at the University of Hildesheim. Thorsten’s research focuses on business model innovation, design science research, and (digital) tools that foster economic, ecological, and social sustainability. His work has been published in numerous recognized academic journals and he is passionate about teaching in IS.
DESIGN OF A COLLABORATIVE PLATFORM FOR VIRTUAL EXCHANGES

Christian Schlecht  
Institute for Applied Informatics (InfAI)  
schlecht@infai.org

Julia Friedrich  
Institute for Applied Informatics (InfAI)

Christian Zinke-Wehlmann  
Institute for Applied Informatics (InfAI)

Mihaela Markovic  
Herder Institute, Faculty of Philology  
University of Leipzig

Christine Magosch  
Herder Institute, Faculty of Philology  
University of Leipzig

Abstract

This research-in-progress paper suggests an approach on how to design and implement a web platform that facilitates knowledge acquisition of university teachers regarding the planning and design of Virtual Exchanges (VEs). In addition, the platform offers teachers concrete support in the form of step-by-step instructions during the actual planning process.

The presented work is the result of a Design Science Research (DSR) approach, whereby Design Principles (DPs) were first defined in an iterative process of workshops based on interviews and surveys and afterwards a solution was derived from these requirements. In a first step, the problem description, a determination of needs was carried out in form of an initial requirements analysis. Therefore, interviews with experts have been conducted and two surveys within the targeted audience (higher education teachers) have been carried out. Based on these interviews and surveys, two pillars of assistance could be identified, namely a customize-able and wizard-like planner that supports the planning process as well as the implementation of an online Community of Practice (oCoP) to communicate, network and find potential partners for VE activities. The surveys have shown different levels in experience, resulting in three different competence levels (novices, experienced, and experts) that all have individual requirements towards an assistance system and act differently within a community. Therefore, the assistance platform needs to carefully distinguish between the users, potentially adapt towards their requirements and allow them to facilitate their own perceived role within the community.

The suggested platform solution incorporates four components: a social network that enables the development of a self-maintained oCoP, a wizard-like planning assistant with a corresponding project storage to support the actual planning process of VE activities, and educational material for self-study on different competence levels, which aim to develop both hard skills (i.e., knowledge about VE) as well as relevant soft skills like collaborative working or digital literacy that are essential in the sense of future skills in a collaborative learning environment. By allowing many different forms of interaction between the components, a rich learning experience is ensured. The assistance system is implemented as a web platform architecture, allowing for low-threshold accessibility, and is accompanied by several other services, including the integration into a Germany-wide meta platform which allows for easier traceability by users who aim to incorporate VE into their lectures.
Keywords: Virtual Exchange, assistance platform, community of practice, higher education, collaboration, internationalization through digitalization

I. MOTIVATION

The COVID-19 pandemic, which came along with affordances for social distancing and contact restrictions, has significantly boosted the concept of virtual teaching. Especially in international study programmes, virtual learning was often the only possible way of communicating, both for teachers and students. Although teaching activities have largely returned to presence lessons, the advantages that come with virtual mobility are still considered highly relevant and will certainly gain an important part in our social and academic life. Virtual Exchanges (VEs) are effectively combining virtual mobility with collaborative working on given tasks, often “as an integrated part of (...) educational programmes” [O’Dowd, 2018]. By connecting classrooms on an international basis, they enable “sustained online intercultural interaction and collaboration with international partners under the guidance of their teachers” [O’Dowd and Dooly, 2022]. This way, VE learning scenarios hold considerable benefits, both for the students, e.g., in terms of intercultural competences, digital literacy and language skills [EVOLVE Project Team, 2020], and teachers, e.g., with regard to pedagogical competence growth [Nissen and Kurek, 2020]. VEs can thus be understood as a promising facilitator of skills that are required in a connected and collaborative working environment [EVOLVE Project Team, 2020].

Previous studies (e.g., [O’Dowd, 2015]) and the project's requirements analysis (surveys and interviews, see section 3) indicate that many university teachers lack relevant digital, media and higher education didactic competencies for designing and implementing VE. In addition, there is also an urgent need to prepare, qualify and enable teachers interested in conducting a VE since such projects are complex learning and teaching scenarios.

Existing platforms like Class2Class³ or UNICollaboration⁴ already offer good opportunities to find out about VE, search for partners, attend workshops or help implementing VE projects. However, the solutions are often associated with additional costs for licenses or memberships (individual or institutional) and only support active exchange in a community to a limited extent. There is currently a lack of suitable technical infrastructure that would support all VE phases and be freely available to teachers [Jager et al., 2021; Würffel, 2016].

The authors introduce an approach to designing and implementing a web platform to assist its users in planning their VEs and forming an online Community of Practise (oCoP). The paper aims at answering the question of how a digital assistance system must look like to build a collaborative environment to enable planning and conducting VEs in an academic context. It should be emphasized that the platform focuses on planning VE-activities, but not finally conducting them in this platform. The implementation of VEs is to be held in the Learning Content Management System (LCMS) of the participating institutions, e.g., Moodle. Consequently, this platform is not going to be a LCMS. Despite that strict separation, the platform is connected to the meta-platform “Mein Bildungsraum”⁵ which enables linkage possibilities and enhancement of the collaborative network. Consequently, the targeted audience for the planning tool are lecturers of higher education institutions, but not their students.

To answer the presented research question, the approach of design science research (DSR) is applied, whereby design principles were first defined based on a requirements analysis and afterwards an initial software architecture was derived. In this work-in-progress paper use cases, design principles (DPs) and their solutions are suggested together with a brief technical depiction of the associated software implications.

³ https://www.class2class.com/
⁴ https://www.unicollaboration.org/
⁵ https://www.meinbildungsraum.de/
II. METHODOLOGY

The presented work is the result of DSR activities, following the process as suggested by Peffers [Peffers et al., 2006]. In this paper, we present the findings from the first three steps of the approach which are problem analysis, objective description, and design & development as they represent the status of the research. Hence, the step of demonstration is in development, but evaluation is still pending.

The first step of DSR marks the problem identification and motivation (see section 1). Based on this initial motivation, the basic idea of a platform solution that aims at providing assistance and guiding teachers through the process of planning VEs in their courses, was formulated. Therefore, a requirements analysis was conducted (see section 3) in which two interviews with VE-experts and two surveys with individuals from the relevant audience (lecturers of higher education) had been carried out. Both interviewees redeem their VE expert status by working as project managers in an institution that deals with global exchange programmes.

The first survey focused on the state of the art of VE implementation and was conducted within the Arqus University Alliance. A total of 31 lecturers from five universities (Leipzig, Padua, Vilnius, Lyon, and Granada) participated. The participants work in different study programs, most of them from the foreign language field, followed by biology and other natural sciences, and medicine. Occasionally represented were also European and global studies, computer science, management, and sports. The second survey researched in detail, how VEs are designed and carried out and which exact needs the target group of higher education teachers have. In this survey a total of 56 people participated (54 lecturers and 2 International Office staff). The lecturers came from different universities: the majority from German universities, from European universities (Denmark, Slovakia, Malta, the Netherlands), from Canada and from South America (Colombia, Mexico). The main fields of study were foreign languages, followed by economics, humanities, and social and cultural sciences. Engineering, mechanical engineering, electrical engineering, exercise science, agriculture and forestry, and architecture were sporadically represented. Natural science disciplines (e.g., mathematics, physics, etc.) were not represented. The main objective of both surveys was to assess the special needs of teachers in higher education regarding VE in academic settings and possible assistance approaches in the context of VE that included mandatory features.

In a second step, it was necessary to detail the objectives and initiate the iterative development process. In our project team we held three workshops with the aim to conceptualize the assistance platform by adapting the customer journey analysis method. A customer journey map is a diagram that visualizes the different stages (in our case enticement, entry, engagement, exit, extend) and steps a (potential) customer has with a product or company. It is a marketing tool that helps to track touchpoints, KPIs and customer experiences in order to conceptualize a new or improve an existing business model. [Rosenbaum et al., 2017]

In our case, the method was used as a tool in the design process of the VE platform in which every user can be understood as a (non-paying) customer. After initial brainstorming with the help of a digital whiteboard, we dug deeper into the relevant concepts of VE and how their planning process can be represented in an online platform. Based on three different identified user groups (see section 3) and their corresponding customer journey maps, the components were designed iteratively to represent each of the user groups accordingly. In a follow-up step the findings and ideas from the workshops were transformed into formal design principles (DPs) (see section 3). An overview over the workshops and their topics can be found in the appendix (Table 1). DPs were chosen to be both action and materiality oriented [Chandra et al., 2015], because we “study the interaction between the social and the technological” [Chandra et al., 2015], i.e., how the teaching concept VE can be supported technically in terms of planning the activities. By analysing the DPs (problem space) from a technical point of view, a solution space was established that translated the requirements into software components that represent them. After each of the iterations, the previous solution space was further aggregated with the design concepts from the corresponding workshop. As a result, the DPs form the basis...
of the architecture modelling and design of components and their interactions within the platform (see section 4).

III. DESIGNING A COLLABORATIVE VIRTUAL EXCHANGE PLANNING PLATFORM

Requirements of an Assistance Systems for VE

As already described in the motivation, the current work aims to provide assistance for VE organizers (e.g., higher education teachers or lecturers) in the full range of experiences regarding the planning of VEs. In order to determine their general needs for VEs in the academic environment and possible support approaches within the framework of VE, a needs analysis was carried out in advance (duration 2021-2022), as described in section 2.

More than half of the respondents (58%) in the first survey indicated that they were not familiar with VE in higher education, but at the same time were very interested in learning more about it. The main challenges respondents identified in implementing VE in higher education were the amount of time and organization required. In addition, there is a lack of visibility and awareness of VE. The participants indicated that a broader range of further and advanced training opportunities, best practice examples, and professional and structural relief in the planning and implementation of VE would be helpful. In addition, they would like to see a digital platform as well as a network for partner search and exchange among teachers.

86% of participants from the second survey reported having previous experience with VE. In most cases, VE partners were found through professional contacts or partner universities. In this group, too, the organization and framework conditions of VE were mentioned as a challenge, as well as a lack of digital and didactic methodical competencies. Since this survey was more detailed and specific, concrete needs for methods and media formats of digital further education as well as thematic focuses of a platform for further education could be identified. In addition to traditional training formats (e.g., workshops), a modular self-learning offer (including e.g., explanatory videos and webinars) was particularly desired.

The identified key issues for implementing VE included the lack of opportunities for collaboration, digital tools, methods, task formats (e.g., a collection of methods), and best practice examples (both for whole VEs and for individual parts).

The wish for a LCMS-independent platform that accompanies and supports teachers in the planning and organization (from the search for partners to the implementation) (e.g., through a pool of methods and tools for cooperation and evaluation) was also mentioned as a priority in this group. In addition, the establishment of an oCoP for sharing experiences, professional exchange, insight into past and future VE projects of colleagues, as well as the initiation of joint projects was mentioned several times.

The study was supplemented by two expert interviews, designed to build upon the existing body of knowledge in VE programs and CoPs. In the first conversation with one of the experts, the inherent value of an online tool was underscored as a potential means to facilitate the development, design, and organization of VE initiatives. In this interview, too, the biggest challenges were seen in the organization and framework conditions as well as in the lack of digital and didactic competencies of the teachers, what confirmed the results of the previous survey. A CoP is seen as an added value and primarily serves the exchange of experiences and networking requirements.

The second expert interview yielded similar results. However, the interview clearly showed that the matchmaking process is challenging and needs to be simplified.

Based on the result of the surveys and the needs analysis with experts, we initially defined two pillars on which an assistance system for VE should be built. Firstly, a tool to assist in planning the actual VE activity from start to finish and secondly some kind of community network, find potential partners, as well as collaborate within the planning activities. Survey participants further indicated that the provision of material for a low-level education
about VEs in general would increase their willingness to start using VEs in their lectures, effectively spreading the word about the approach.

The undergone surveys showed very different levels in experience regarding VE. While some had already done multiple VE activities in their lectures, a big portion reported to only having heard about VE or having no experience at all, but interest in the topic. This result led to the fact that the potential platform must distinguish between different levels of competence of the users because they require different levels of complexity of the content and different manifestations of guidance throughout the platform. Based on these insights, we have decided on three user groups: novices, intermediates, and experts to represent users with no experience and/or knowledge at all; basic knowledge about VE, but not necessarily practical experience; and users with practical experience and knowledge, respectively.

Even though all platform users are professional teachers, especially novices should be addressed as learners in the context of VE and the associated competencies and skill requirements. The platform itself does not only provide classical learning material to train hard skills like basic knowledge about VE. Rather, it also aims to train soft skills like collaborative working and digital literacy which are essential didactic competences in the sense of future skills in a future learning environment [Ehlers, 2020; Kipper et al., 2021]. Even though all types of users have already gone through the process of an academic degree, their learning process does not stop there (cf. “lifelong learning” [Aspin and Chapman, 2000]). They need to further develop those skills to be able to transfer them to their own students within their lectures.

Iterative Design Process of the Assistance Platform for Collaborative Planning of Virtual Exchanges

Planning of Virtual Exchanges

After the initial needs analysis that incorporated surveys and interviews, the iterative process of DSR was continued by holding multiple internal workshops together with VE-experts that addressed individual DPs of the assistance platform, which are described in the following sections.

Collaborative Planning of VE activities

The first workshop dealt with the aforementioned first established pillar of an assistance system for VE: a tool to collaboratively plan VE activities. VE lives on collaboration - collaboration with the VE partners, but also with the community, especially for novices, but also experienced people. While VE is a goal-oriented community, a guided planning process may foster collaboration, bringing novel efficiency into the planning processes, e.g., by providing suggestions on planning steps. Furthermore, a VE community enables novel forms of support or even fully guided experiences. To fulfill those needs, some kind of intelligent wizard needs to be implemented that guides the users through the process of planning a VE, i.e., requesting general information (participating institutions, audience, topic, etc.), mapping out a broad, date-oriented plan for the steps of the VE activity and lastly filling each step with necessary information like tasks, goals, workloads, social forms of interaction, etc. However, there also needs to be a mechanism to circumvent this wizard and plan a VE non-sequentially in a different order because VE-experts or people with prior experience already have a personal workflow that they probably want to continue perceiving.

DP1 enables collaborative planning and approaches of VE activities. The assistance platform supports collaborative didactical planning activities. It needs to distinguish between personal user preferences – some want to be guided through the planning procedure by a wizard, while others prefer a non-sequential approach to collaboratively establish a VE plan.

Exploring the collaborative network and finding potential partners

In our second workshop, the focus shifted towards the community aspect of the assistance platform: Since VEs require at least two parties, network building is crucial in the context of VE and must therefore be supported by the assistance platform. To do this, it is necessary to keep the different types of social network users in mind. Brandtzaeg and
Heim [Brandtzaeg and Heim, 2011] differentiate five types which are Socialisers, Debaters, Lurkers, Sporadics, and Actives. The assistance platform refers to these types and their ways of networking in two ways: “Friend of a friend” (FoaF) relations: One advantage that all social media and collaboration platforms bring with them is the social network effect. Matching interests and interactions connect users with one another. Socialisers, debaters, and actives like to engage in direct interaction with the community and, hereby, connect with other users by direct social interaction. Chaining this kind of behaviour across multiple individuals results in a “friend of a friend” (FoaF) relationship.

This process can most certainly be equivalently adapted to finding potential VE partners, since the workflow is basically the same, just the domain differs. Therefore, the assistance platform provides forms of social interactions via a social network, meaning facilities to post, comment, like and share thoughts, follow other users, and watch their posts in a timeline, and/or communicate with certain users or groups privately.

\textit{DP2 enables social interaction within the community that may ultimately lead to a joint VE activity. The assistance platform needs to be designed to enable the typical social features like posts, likes, comments, etc.}

However, not everybody likes to act publicly on a social network. In contrast to the first groups, sporadics and lurkers take the position of mostly being consumers rather than producers and therefore prefer a direct approach to finding potential partners without the need for ongoing participation in networking activities such as public debating. To also provide matching mechanics to those kinds of users, they can find potential partners via a matching algorithm that explicitly suggests certain users that are predestined for collaboration. Matching criteria are profile details as a simple case, and could be enhanced to include recent posts, planned VE-activities or other more subtle metrics that represent the individual.

On top of that, users potentially already know possible partners from the real world that are not (yet) registered on the platform. Some kind of personalized invitation system into the platform (e.g., via email) enables those partners to start planning a VE activity together in a collaborative environment despite not being matched automatically.

\textit{DP3 enables initiation of VE activities by explicitly mapping potential partners to each other. The assistance platform needs systematic or automated (but user-controlled) processes to represent learning experiences and activities for search and matching partners. Demands of different user mentalities (introverted and extroverted individuals) are considered by either participating in a matching procedure or pure social interaction within the community.}

\textbf{Incentivize Development of an online Community of Practise}

By encouraging users to engage in the above-mentioned use cases, but especially in social interaction, an oCoP can be formed to support growth of the topic of VE. Their experience can be further enhanced by letting the features that stand behind the cases interact with each other, e.g., share developed VE-plans into the social network and let users create “best practise examples” as references for other users based on their own plans and VEs that they conducted. By doing so, users become more and more experienced in VE to be able to assist other, less experienced users in the community. By incentivizing certain behaviours, such as sharing best practices or professional knowledge, with gamification aspects, users are motivated to actively participate on the platform and contribute to the community. Overall, the oCoP is gaining momentum for further, self-sustained development. This is also confirmed by the expert interview.

The participants in the second survey would also like to see a network for the exchange of experience (75%), best practice examples (34%), professional exchange (30%) and the initiation of further projects (30%).

\textit{DP4 enables implementation of a self-maintaining online community of practise that is fuelled by user interaction. Therefore, the assistance platform has to incentivize actions towards the community by implementing gamification elements such as e.g., achievements or badges, as well as non-gamified incentives, e.g., community feedback mechanisms or self-evaluation forms.}
Developing VE competencies and skills towards active community-based learning

The last workshop addressed the remaining aspect of the assistance platform, which is development of competencies: As a VE-novice that just heard about the term “Virtual Exchange”, people have a vast idea about what it is and how it could be implemented in teaching, but it potentially differs drastically across individuals. For example, 58% of respondents to the first survey said they were not familiar with VE in higher education, while in the second survey only 14% said they had no practical experience with VE at all. In addition, 60% of teachers report that they have never received any training on VE (100% of teachers without VE experience, 54% of teachers with VE experience). In order to get a clearer understanding of the topic, it is necessary to be provided with relevant material for (self-) study. Besides learning materials, it is also important to provide a touch point to open VE activities and best practices to get in touch with the active VE community.

DP5 enables VE competence development. The assistance platform needs to be designed to provide VE novices with access to information about VE and informal learning activities.

However, if some knowledge is already available to the individual (rendering them as “experienced” or “an intermediate” instead of a novice) it is crucial not to provide the person with the most basic information and touchpoints, but instead elevate the complexity and suggest more in-depth material, enable active content provision, or assign evaluator roles.

To achieve that kind of differentiation between novices and intermediates regarding what kind of material is suggested, a short assessment when entering the assistance platform for the first time seems suitable. Afterwards, the competence levels of the users are tracked automatically and evaluated based on their activities within the platform.

In addition to the different levels of knowledge and skills of the users, the desire for different training materials must also be taken into account. For example, in our survey, 57% of respondents preferred traditional workshops, 57% webinars, 58% instructional videos, 46% interactive presentations, and 60% best practice insights.

DP6 enables individuality of content, presuming given roles of the users. The assistance platform needs to be designed to provide experienced VE actors with possibilities of in-depth materials as well as create VE-related content. An enhancement of feedback mechanisms ensures a certain level of quality assessment of user-created content.

IV. DESIGNING SOLUTIONS SPACE – ARCHITECTURE AND COMPONENTS

The assistance platform can be logically clustered into four components based on the use cases and principles of the previous section. However, they should not be interpreted as separate and independent or loose-coupled components. Each of them interacts with another to provide an overall richer user experience.

Components

Social Network

The network component obviously is the main actor for user interactions (DP2, DP3, DP4) and therefore provides the expected social features, i.e., posts, comments, likes, messaging, follow-relationships between users and personalized timelines. On top of that, users can create topic related groups that are either public (everybody can join) or private (join only upon request) to interact with other users in a protected environment.

All artefacts that are user-created or appear on the platform itself (i.e., planned VE-activities or learning material) can be referenced in the network (preserving access control rules) to maintain easy navigation and an intuitive user experience. E.g., when users want to share a draft of a VE-plan with colleagues to gather feedback (DP6), they add a post to the group asking for feedback and reference the plan in it. All members of the group gain...
automatic read access to the plan and can assign comments to it that the original creator and initiator of this process uses to refine the plan.

**Learning Material**

The collection of learning material especially benefits novices, who are just approaching the VE topic, in building up competence (DP5). Learning materials range from basic definitions and examples to guides on how to implement VE in one's lectures and provide useful information on what kinds of obstacles and snares could appear throughout the process that could even be new to experienced users (DP6). In the long term, users should be able to request topics that they deem desirable to add to the collection or even suggest content to be added. However, in that case some form of moderation needs to be put into place to assure quality.

The content can be seen as static in terms of not adapting to the individual user, however different users receive individual recommendations on which material could be useful to them, mainly based on their experience level, making the presentation of material a dynamic process (DP6).

Design-wise learning materials are articles, containing anything from text and pictures to video, audio, and possibly other interactive widgets.

**VE-Planner**

The VE-planning-assistant lies at the heart of the assistance platform and is the most important feature that users can work with. It supports users in the planning of their VE activities (DP1). The interface guides the platform users through the process in which they gather all relevant parameters - ranging from general information about the activity like participating institutions and lectures, the audience and their skills, to planning out the phases of the activity and mapping corresponding fine-granular tasks to them.

Especially novices and inexperienced users can profit from a step-by-step query approach. They do not have to care about what to fill out at what point, because the order is suggested by a wizard.

Users that already have developed personal routines to plan their VE's have the possibility to skip the wizard and fill out the plan in whatever order they find suitable. Technically, also a novice user can do that, though it is not recommend as it could lead to confusion, ultimately resulting in a VE of less quality or at least a lot more effort to put into the planning process. Though, above all it is always personal preference of the user in what way the planner is used.

After planning a VE, a certain leap in time happens in which the user conducts the VE in their institutions. After that, the user is advised to come back to document the implementation of their plan. This step assures reflection on aspects that worked out well, but also those that have caused problems. Such critical reviews are crucial for others that want to implement similar steps (DP4) and supports the user's competence building.

This documentation can be seen as a summary of the plan and how the execution went. When being made publicly available for other users in the form of “best practise examples”, it provides the most useful information that can be translated to other VE activities. Users can search for them and, if desired, copy parts of the underlying plan into their own VE plans (access control rules are enforced as described in the Project Storage paragraph below). Ideally, hints are given to users by the planner itself to check suggested good practise examples that match the current content of the plan; however, such a feature requires deep automated analysis of the content. Outstanding best practise examples might also be candidates to flow back into the collection of learning materials to be accessible quicker to a broader range of users.

Evaluation and documentation work are often perceived as a duty with no immediate personal benefit, but self-reflection boosts competencies [Boekaerts, 1991] and good practise examples will benefit other users reading them in the future. Because of that, such behaviour is additionally incentivized by aspects of gamification like e.g., badges or achievements (DP4)
**Project Storage**

The project storage persists user generated content (i.e., plans and best practise examples) into a database and serves an organisational purpose to administrate individual access control to the content and can be visually interpreted as a file explorer, from which plans can be opened for viewing/editing (forwarded to the planning assistant, DP1).

Users find an overview over all their personal plans and those that they have read or write access to. They can share their plans with other users or groups of users, deciding to give them either read or write access respectively. Plans and best practise examples can also be set to public, granting everybody read permissions, which is especially helpful for users that want to “do their bit” towards the community (DP4). Those public plans and best practises are full-text and keyword searchable for users that seek for ideas or inspiration in their own planning processes. If the original creator allows it by setting an appropriate license, public plans can be forked into a private copy that can act as a baseline for other VE activities.

**Platform Architecture Design**

Although the components of the platform could be treated as separate resources in form of a microservice architecture, a decision was made explicitly against that in favour of a monolithic architecture. The reason lies in the many interactions that the components do. Some services would receive high amounts of extra load that is not caused by users working with this service, but other services needing data from it. Therefore, the network traffic could bottleneck the whole application in the worst case. Of course, this decision comes with a trade-off in scalability, which must be dealt with at the scope of effectively parallelising workflows and requests. Though, synthetic tests have shown that effects only start to appear once concurrent requests exceed rates in the hundreds of thousands. Below that, monolithic applications are able to handle the loads on sufficiently strong hardware, which at this point is more than enough for our platform case [Gos and Zabierowski, 2020].

Nevertheless, three services have been moved out of the core architecture as Figure 1 describes.

![Architecture of the assistance platform](image)

**Figure 1: Architecture of the assistance platform**

Firstly, authentication is not done by the core application itself but uses an instance of the open-source software Keycloak\(^6\) to move sensitive user data out of the core application.

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\(^6\) [https://www.keycloak.org/](https://www.keycloak.org/)
and to ensure that authentication protocols are implemented correctly without security flaws. Users authenticate towards the platform by using the OpenID Connect protocol.

The second outside-service that is integrated into the platform is a Content Management System (CMS, in particular Wordpress), which is mainly used for storing the learning material. Each material is stored as a post inside Wordpress and exposed via an API endpoint that is consumed by our platform. By doing that, we keep the neat editing possibilities that Wordpress provides, especially in hindsight that moderators should maintain and add new material, but on the other hand we can visualize the materials freely on our own core application and are not limited by Wordpress functionalities.

The third service used by the platform is somewhat different from the others, because it represents an established connection to the “Mein Bildungsraum”, which is a nationwide meta-platform aiming to provide access to different service providers. Therefore, the meta-platform functions as an Identity Provider, meaning users can use their accounts to sign into the connected service providers, like our assistance platform, or other learning support systems.

V. Discussion and Conclusion

This paper represents the current state of work of a research project that addresses the needs of stakeholders in higher education teaching who want to implement VE into their courses. Based on expert interviews and surveys with the targeted audience, requirements for an assistance system for VE were identified. The two pillars of assistance are (I) a customisable and wizard-like planer to support the process of collaboratively planning a VE activity and (II) the implementation of an oCoP to share artefacts, network, find potential new partners for VEs, and enabling informal learning. These pillars have been augmented with DPs that were derived through an iterative process of workshops, based on the interviews and surveys. It may be limited and biased, because the VE community is active globally, but fragmented and difficult to identify and access. However, these investigations are one of the first empirical DSR approaches for supporting and fostering those collaborative networks in terms of planning VE activities.

The DPs provide the baseline for a proposed solution: an assistance platform approach that consists of the four components social network, VE planning assistant, project storage, and learning materials.

The current state is best described as an early alpha development stage. The social network’s backend is nearly fully developed but it requires a full user interface rework to be considered feature complete. The overview of learning material exists as a proof of concept with some content pages to show that the integration of Wordpress posts as a data source works flawlessly. All other features, especially the planning assistant, are also being worked on in parallel towards a viable prototype.

As stated in the motivation of this paper, one of the key concepts that VEs foster is internationalization of education. To achieve that goal, supporting the native languages of the users in the community seems desirable. Therefore, providing the platform in multiple languages must be addressed in the future.

As the research project is still running, it is noted that features and the corresponding software architecture are subject to change and may be enhanced further or redesigned in the future development (iterative design cycles). Furthermore, demonstration and evaluation of the effectiveness of the proposed solution are pending. Since DSR is an iterative process, DPs may also change during the ongoing review process.

Furthermore, questions of the presented intervention may be generalized: Are the DPs also relevant and significant for any collaborative didactical planning activities? To answer that, more efforts within the research community need to be conducted.
LIST OF REFERENCES

Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that
1. these links existed as of the date of publication but are not guaranteed to be working thereafter.
2. the contents of Web pages may change over time. Where version information is provided in the References, different versions may not contain the information or the conclusions referenced.
3. the author(s) of the Web pages, not CAIS, is (are) responsible for the accuracy of their content.
4. the author(s) of this article, not CAIS, is (are) responsible for the accuracy of the URL and version information.

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Jager, S. et al. (2021) "Virtual Exchange as Innovative Practice across Europe: Awareness and Use in Higher Education : EVOLVE Project Monitoring Study 2020".
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Nissen, E. and M. Kurek (2020) "The Impact of Virtual Exchange on Teachers’ Pedagogical Competences and Pedagogical Approach in Higher Education".

APPENDIX I

Table 1: Summary of workshops and corresponding DPs that resulted from each one.
<table>
<thead>
<tr>
<th>Workshop Number</th>
<th>Content</th>
<th>Resulting DPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>● detailed VE introduction for all members</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>● requirements of planning processes of VEs and how assistance can be provided along this journey</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>● means and steps to build, develop and maintain an oCoP</td>
<td>2, 3, 4</td>
</tr>
<tr>
<td></td>
<td>● implicit and explicit matchmaking to find potential partners for VE activities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● interactions between the social networking and planning features of the platform</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>● knowledge and competence development regarding the VE topic</td>
<td>5, 6</td>
</tr>
</tbody>
</table>

**LIST OF ACRONYMS**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMS</td>
<td>Content Management System</td>
</tr>
<tr>
<td>DSR</td>
<td>Design Science Research</td>
</tr>
<tr>
<td>DP</td>
<td>Design Principle</td>
</tr>
<tr>
<td>LCMS</td>
<td>Learning Content Management System</td>
</tr>
<tr>
<td>(o)CoP</td>
<td>(online) Community of Practise</td>
</tr>
<tr>
<td>VE</td>
<td>Virtual Exchange</td>
</tr>
</tbody>
</table>

**ABOUT THE AUTHORS**

**Christian Schlecht** is a research associate at the KMI Competence Center (Artificial, Human, Intelligent) at the Institute for Applied Informatics (InfAI) in Leipzig. With a background in computer science, his focus lies in the technological implications that arise from different social and educational problems and requirements and how they can be implemented from a software engineering point of view.

**Christian Zinke-Wehlmann** is a sociologist with a doctorate in Computer Science. He serves as the Director of the KMI Competence Center (Artificial, Human, Intelligent). His work and research reside at the fascinating intersections of digital technology, education, work, and services. Employing his multi-disciplinary expertise, he investigates complex sociotechnical problems that occur within these realms.

**Christine Magosch** is a research associate at the Herder-Institute for German as a Foreign Language at the University of Leipzig and is responsible for the online community of practice and material development in the VE-Collab project. Her main research interests are global learning, education for sustainable development and cultural studies.
Julia Friedrich is a working group leader at the KMI Competence Center of the Institute for Applied Informatics (InfAI). She focuses on the human perspective of digitalization and the designing transformation processes in the learning, working, and living environments. In her work in application-oriented research projects, she addresses a wide range of topics in the field of human-technology interaction, in particular knowledge management, collaboration processes, and human-centered implementation of technologies.

Mihaela Markovic is a research associate at the Herder-Institute for German as a Foreign Language at the Leipzig University and works as the coordinator of the VE-Collab project. Her main research interests are computer-assisted foreign language learning, VE and cultural studies.
CULTURAL DIVERSITY IN CSCL ENVIRONMENTS: EXAMINING TECHNIQUES TO INCREASE CULTURAL AWARENESS AND INCLUSIVITY

Harry Nan  
Universiteit van Amsterdam  
harrynan94@gmail.com

Emőke Takács  
ERI Hungary – European Research Institute  
t.emoke@eri.net.in

Toon Abcouwer  
Universiteit van Amsterdam  
a.w.abcouwer@uva.nl

Abstract:
In our globalizing world, cultural diversity plays an increasingly significant role when shaping learning environments. To address the challenges and opportunities arising from this diversity, collaboration scripts have proven to be effective. This study investigates the impact of increased cultural awareness and inclusivity in online learning environments by examining techniques created by educators and designers to promote effective learning. A scoreboard for online CSCL environments was developed to indicate techniques and characteristics of environments, which analyzed nine cases. Interviews with educators further explored practical techniques. Results indicate that techniques emphasizing interaction and reflection on cultural assumptions are commonly used, while those focusing on multicultural education are less prevalent. Environments exclusively emphasizing cognitive and behaviorist approaches may neglect techniques addressing learners’ cultural assumptions. Researchers and teachers perceive the use of techniques that raise cultural awareness and inclusivity to be beneficial for the learning process and outcome for students.

Keywords: cultural diversity, cultural awareness, inclusivity, collaboration scripts, CSCL

I. INTRODUCTION

Computer-Supported Collaborative Learning (CSCL) is a pedagogical approach that involves the use of technology to facilitate collaboration and communication among learners in various educational settings. One of the main elements of CSCL is the ability for learners to interact with each other and collaborate to reach learning benefits. Cultural diversity and other differences among learners are perceived to have a significant impact on student achievements within CSCL environments, as well as shared knowledge creation. In a rapidly globalizing world, cultural diversity plays an increasingly significant role in designing learning environments. More and more cross-cultural interactions will take place in CSCL environments, and therefore it is increasingly important to design collaboration scripts in a way that decreases both communication and cultural barriers between learners. A method to deal with the challenges and opportunities of cultural diversity is by raising cultural awareness and inclusivity. It is generally unclear how and to what extent this is done in practice. This research aims to define what methods are being used in practice and what kind of considerations are being made when putting collaboration script theories into practice. The following research questions are developed:

1. To what extent does an increase in cultural awareness and inclusivity increase student achievements in CSCL environments?

2. What kind of methods can be used to increase cultural awareness and inclusivity in CSCL environments?

3. What kind of methods are used to increase cultural awareness and inclusivity in CSCL environments?
4. In what contexts are cultural awareness and inclusivity being raised in CSCL environments?

The theoretical framework aims to address the first two questions, which will be supported by a systematic literature review. The last two questions will be answered with interviews and analysis of CSCL-environments, supported by a developed scoreboard, which will be discussed later.
II. THEORETICAL FRAMEWORK

Computer-Supported Collaborative Learning

As stated earlier, Computer-Supported Collaborative Learning (CSCL) is a pedagogical approach that involves the use of technology to facilitate collaboration and communication among learners in various educational settings. Most authors, like Kirschner and Erkens (2013) and Jeong et al. (2019), state that CSCL is about learners learning together which is facilitated by an online or computer-supported environment. Multiple pieces of research show the versatility of CSCL and how CSCL can be implemented in various formats and how it can take many forms (e.g. Dillenbourg, 1999; Kirschner & Erkens, 2013).

For this research, CSCL is defined as a pedagogical approach that combines social interaction, technological tools, and instructional design principles to facilitate collaborative learning. Kirschner and Erkens (2013) identify key elements of a CSCL environment that include the pedagogical, social, and technological elements. The pedagogical element of CSCL involves designing and structuring specific tools to stimulate learners to fulfill the collaborative task, with a focus on including the provision of learning objectives, structured activities, and opportunities for reflection and feedback. The social element refers to how learners interact and collaborate during the learning process, which includes sharing knowledge and resources, providing feedback and support, and engaging in dialogue and debate. The technological element involves using technology to facilitate communication, coordination, and collaboration, with the importance of supporting collaborative learning. (Kirschner & Erkens; 2013).

The proposed framework by Abcouwer and Smit (2009) can help to define what kind of learning and teaching processes the learning environment can facilitate. This article argues how it can help teachers to find the right environment that facilitates the correct learning or teaching processes. The proposed framework will help to define the learning environment and the technology from four different perspectives. The behaviorist view focuses on observable behavior and how it is shaped by rewards and punishments, the cognitive view focuses on mental processes, the social constructivist view emphasizes the role of social interaction, and the connectivistic view emphasizes the importance of the group or community. This framework will be further defined in 3.2. (Abcouwer & Smit; 2009).

Scripting CSCL-environments

Various studies show how CSCL environments can be scripted in certain ways to tackle different kinds of problems or to stimulate a certain type of behavior. As shown in research like Yu and Yuizono (2021) instructional or technical approaches in CSCL environments that tackle social phenomena can be effective. Suthers (2006) and more recently Jeong et al. (2019) show how the usage of instructional approaches in CSCL environments has been heavily researched and is considered to be effective. The meta-analysis of Jeong et al. (2019) emphasizes the importance of designing effective instructional approaches in CSCL. By designing these instructional approaches in a way to effectively promote collaborative learning, CSCL is consistently effective.

Collaborative learning is defined by different authors like Dillenbourg (1999) and is described as a situation in which forms of interaction among people are expected to occur. These forms of interactions trigger learning mechanisms. Since there is no guarantee for these interactions to occur, Dillenbourg (1999) describes the importance of designing an environment that increases the probability of desired types of interaction occurring, which enhances collaborative learning. Multiple authors discuss the need for an instructional approach to increase the probability of desired types of interactions occurring, which is often referred to as collaboration scripts. As defined by scholars like Dillenbourg (2002), a collaboration script is a set of instructions prescribing how students should interact and collaborate with the learning environment and other learners. The use of collaboration scripts in CSCL environments has been researched thoroughly and can lead to multiple learning benefits, for example, the construction of argumentative knowledge (e.g. Stegmann et al., 2007; Weinberger et al., 2007).
Collaboration scripts can be complex to apply effectively, because of the versatile nature of CSCL. Reaching learning goals and designing effective environments is context dependent on multiple factors, such as individual background and the learning group. Scholars like Dillenbourg (1999) and Dascaalu et al. (2022) discuss the importance of constantly monitoring interactions and learning processes to ensure the quality of learning and the scripts. Dillenbourg (2002) also describes that the research and the application of an effective collaboration script are all about creating effective scripts for different contexts and that research should not focus on designing the perfect 'golden script' that can be applied to multiple contexts. Additionally, a good balance between freedom and guidance from scripts needs to be found to avoid over-scripting, which can hinder the learning process (Dillenbourg, 2002).

(Cultural Diversity in CSCL)

When designing learning environments, it is crucial to understand the group of learners and their context. CSCL environments and their (collaboration) scripts need to be designed and used flexibly, to be usable and effective for multiple different contexts. This can include different cultures and different backgrounds between learners, as this can influence the way people communicate or interact with each other. Scholars like Weinberger et al. (2007) describe how these individual differences in expected communication and interaction can be described as internal scripts, which are different for each learner and include ideas on how to interact with others and what the goal of the interaction is. External scripts in educational contexts, which are often designed by educators or designers, should include guidelines on how to interact and communicate with each other to ensure the effectiveness of the learning process and reach the learning outcome. To avoid conflict and misunderstanding between individuals it is essential to be aware of the different individual internal scripts and complement the external scripts to these accordingly so that shared collaboration scripts can be effectively created and used. Additionally, interculturally enriching collaboration scripts is an effective way to decrease conflict and misunderstanding between individuals, as it creates awareness of the different internal scripts of the learners (Popov et al., 2019).

Even though it might be complex for teachers and designers to implement these complex scripts for diverse learners, multiple authors in- and outside of the field of CSCL highlight the importance of having a (culturally) diverse environment. Having a culturally diverse environment can enable learning environments and collaboration environments to have multiple perspectives and ideas on certain topics. A broader worldview can be considered when constructing or creating knowledge. Weinberger et al. (2007) for example focus on the creation of shared knowledge and define how a diverse group of learners can increase the quality of the knowledge. Multiple diverse perspectives can be considered which can be helpful in the creation of shared knowledge. Additionally, different experiences and different views on knowledge have a significant impact on shared knowledge creation. Gay (2013) discusses the importance of teaching to and through cultural diversity in schools and argues that this is essential for ensuring that all students can succeed. However, the author states that teaching to and through cultural diversity is a complex and challenging process but is a necessary process to ensure that all students can succeed. Other scholars like Popov et al. (2013) suggest that cultural diversity within dyads in learning environments can enhance collaborative learning and that the use of a collaboration script can further support and improve the collaborative learning experience in computer-supported environments.

Raising Cultural Awareness and Inclusivity in CSCL

The described benefits of cultural diversity within classes raised the question for multiple researchers whether raising cultural awareness and ensuring inclusivity in classes can improve the collaborative learning experience and if it can enhance or increase the benefits of a culturally diverse environment. For example, the research of Ruggs and Hebi (2012) described how the promotion of cultural awareness can lead to multiple benefits. In this research cultural awareness is described as the ability to understand and appreciate the cultural experiences of others. Several benefits can occur when promoting cultural awareness, for example, an increase in student achievement, social-emotional skills, creativity, and innovation. Additionally,
to occur, Ruggs and Hebi (2012) describe the importance of creating a diverse and inclusive environment, where inclusion refers to the process of creating a welcoming and supportive environment for all students, regardless of their background. The importance of creating a supportive and inclusive environment aligns with the requirements for, for example effective knowledge creation, as described by Wu (2008). The research of Weinberger et al. (2007), as discussed earlier, stated that collaboration scripts can help to create a more inclusive and supportive learning environment. Based on for example Ruggs and Hebi (2012) and Wu (2008), these collaboration scripts can thus increase for example student achievements, creativity, and more effective knowledge creation.

Multiple pieces of research focussed on how to increase cultural awareness and inclusivity in learning environments, which can be done with the help of collaboration scripts. For example, the research of Sarraj et al. (2015) researched education that was multiculturally scripted and aimed to define the benefits of raising cultural awareness in this way. The research concluded that when scripting multicultural elements in classes, by for example facilitating discussions about different cultures, students can develop significantly more knowledge about different cultures and are more likely to express positive attitudes towards people from different cultures, which in turn increases inclusivity within the group. According to this research, one way to increase cultural awareness and inclusivity within a group is thus to facilitate discussions about different cultures and/or cultural assumptions.

Another way to increase cultural awareness and inclusivity is discussed by for example Bennett (2009). This author proposed a developmental model of intercultural learning, which is described as the process of developing an increased awareness and appreciation of cultural differences and similarities, and the ability to interact effectively and appropriately across cultures. The author argues that intercultural learning is a lifelong process and that it can be facilitated through for example multicultural education (as described earlier by Sarraj et al. (2015)), interacting with people from different cultures, and reflecting on one’s own cultural experience. Interacting with people from different cultures exposes people to other views and perspectives on certain topics and can create relationships with people, which can increase inclusivity and understanding of each other. By reflecting on your cultural assumptions, the individual is thinking critically about their own culture and how it shapes their worldview. This also increases cultural awareness and inclusivity within a group.

As discussed earlier, Popov et al. (2019) defined interculturally enriched collaboration scripts that can be used to raise cultural awareness and inclusivity in online and offline learning environments. These scripts can for example be multicultural enriched to expose learners to different types of learners, stimulate or force learners to interact with people from different cultures or with people with different perspectives, and can stimulate learners to reflect on their cultural assumptions and worldview and how these shape their ideas.

III. METHOD

As stated in section I, this research aims to answer the research questions through observations and interviews. The interviews are designed to explore how teachers perceive the theories proposed in section II and how they implement these theories in practice. The structure of the interviews aims to clarify the considerations made by teachers and designers when selecting and applying the theories. Questions three and four focus on understanding how the theories are practically implemented. To address these questions, a scoreboard has been developed to conceptualize and quantify how CSCL (Computer-Supported Collaborative Learning) environments apply the theories in different contexts. This scoreboard is based on analytical observations from multiple observations.

Interviews

To find out in what way teachers and people within learning environments look at the importance of cultural diversity and how they approach this, three semi-structured interviews have been conducted. The goal of these interviews was to define techniques used to raise
cultural awareness in CSCL environments or other similar educational environments and in what way collaboration scripts (or other instructional approaches that ensure the learning goal) are implemented and/or culturally enriched. Participants were also asked about their view of cultural diversity and their benefits as explained in section 2 and to what extent these theories are put into practice. The interviews were conducted online via Microsoft Teams. The automatically generated transcript from Microsoft Teams has been used as a transcript. When participants were unable to connect to Microsoft Teams, Zoom was used, which was recorded and automatically transcribed via Microsoft Word. The automated transcripts were slightly changed to create full sentences and remove stop words. The interviews were conducted between May and June of 2023 and were in Dutch where possible, and in English if the participant did not speak Dutch.

Participants
To gain a comprehensive understanding of the topic, a diverse range of teachers and designers were interviewed. Participants were either teachers or designers involved in educational settings and had at least five years of experience in the field. They had experience teaching or designing environments for various groups of people, which allowed learners to collaborate or interact with each other to achieve shared goals. Participants were found through network sampling, with an effort made to include individuals from different countries and cultures for a broader perspective. The participants were:

1. A professional with experience in developing and disseminating lessons to multiple schools and classes in the Netherlands and abroad.
2. An expert in teaching special needs students in the Netherlands and facilitating their effective interaction with society.
3. A teacher with experience in culturally diverse classrooms, having taught in various countries, such as Hungary and the Netherlands.

The participants provided valuable insights into handling diversity within learners, classes, and schools or countries, and their experiences shed light on the topic of cultural diversity and awareness.

Analysis
The interview transcripts have been analyzed using ATLAS.ti, where seven elements from the interview questions were generated as groups, after which codes were used to find out what the participants responded regarding these elements, after which short comments were added summarizing the importance and content of each quote. The analysis was guided by the research questions and aimed to provide meaningful insights. The additional knowledge gained through the interviews was also discussed in section 6. A report was created using the program, which was used for analysis. The report shows the codes and the content corresponding to these codes, including self-made comments summarizing the meaning of the content shortly.

Observations and Analysis
Nine CSCL environments were analyzed, categorized as Learning Management Systems (LMS), Collaboration Tools, and Communication Platforms. This categorization aimed to provide a broad and diverse view, making research conclusions applicable to various CSCL environments. A scoreboard has been developed to decrease, objectify and quantify the observations and is used by analyzing environments and their tools in real-time, while also considering personal experiences.

Observed and Analyzed CSCL environments
The following environments have been analyzed:

- **LMS (managing and delivering online courses and content):**
  - SOWISO: Web-based platform for interactive courses and collaboration between students and teachers.
  - Canvas: Cloud-based system for managing online courses and group projects.
  - sCoolmakers: Open-source collaborative repository for engaging and practical learning journeys.

- **Collaboration Tools (work together on projects or assignments in real-time):**
  - Google Drive (Google Docs): Cloud-based platform for collaborative document editing and sharing.
  - Slack: Communication tool facilitating collaborative projects and discussions.
  - GitHub: Web-based hosting service for collaborative software development and version control.

- **Communication Platforms (facilitate communication and discussion between users):**
  - Zoom: Video conferencing platform for online meetings and webinars.
  - Microsoft Teams: Integration with Microsoft Office suite for communication and document collaboration.
  - Kahoot! (Team mode): Interactive learning platform for quizzes and discussions in a gamified environment.

**Data Collection**

A scoring system has been developed to collect data from different environments and is scored by the researcher of this paper. The scoreboard, based on earlier studies, focused on three main elements: learning and teaching processes, the environment, and techniques for cultural awareness and diversity facilitation. Each element received a score representing its presence (fully, slightly, or not present), and does not reflect its effectiveness.

Learning and Teaching Processes (table 1) are derived from the framework developed by Abcouwer and Smit (2009). It offers distinct perspectives on learning and teaching, providing insights into their impact on the CSCL environment.
<table>
<thead>
<tr>
<th>Knowledge creation</th>
<th>Behaviorism</th>
<th>Cognitive</th>
<th>Social Constructivism</th>
<th>Connectivism</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Focus on internalization of objective knowledge.</td>
<td>Objective knowledge, knowledge absorption.</td>
<td>Subjective knowledge, determined by its context.</td>
<td>Diversity of opinions, group guided learning.</td>
</tr>
<tr>
<td>Communication and feedback</td>
<td>Communication focuses on the use of skills. Feedback is based on observed behavior. Fast feedback.</td>
<td>Communication is based on the exchange of facts. Feedback uses absolute measurements.</td>
<td>You learn more in the group than on your own. Feedback is based on individual learning progress (learning delta), no absolute scale.</td>
<td>Cycle of knowledge development. Learning is not an internal, individual activity. Feedback originates from the network.</td>
</tr>
<tr>
<td>Learning context</td>
<td>Teacher stimulates the pupil and sets goals. Guiding is based on behavior.</td>
<td>Absolute division between teacher and pupil. Knowledge is timeless. Goals are absolute.</td>
<td>Meaningful situation. Aimed at construction and design. Learning for now.</td>
<td>No difference between student and teacher. The process is the learning goal.</td>
</tr>
<tr>
<td>Multiple intelligence</td>
<td>Focus on a limited set of intelligences based on the skills of the student.</td>
<td>Limited set of intelligences chosen by the teacher.</td>
<td>Multiple intelligences based on personal preferences and interaction with others.</td>
<td>Multiple intelligences based on personal preferences and interaction with others.</td>
</tr>
<tr>
<td>Student motivation</td>
<td>Extrinsic</td>
<td>Extrinsic</td>
<td>Intrinsic</td>
<td>Intrinsic</td>
</tr>
</tbody>
</table>
| Role division | Learning-master: teacher.  
|              | Process-master: teacher/student | Learning-master: student  
|              | Process-master: student |

Facilitation of Environment, as defined by Abcouwer and Smit (2009).
Pedagogical, Social, and Technical Elements (table 2) build upon the research by Kirschner and Erkens (2013). This element defines the CSCL environment through its pedagogical, social, and technological elements. By analyzing these elements, a comprehensive understanding of the environment can be made and the influence on other elements can be analyzed.

Table 2: Defining Pedagogical, Social, and Technical Elements of the Environment, based on e.g. Kirschner and Erkens (2013).

<table>
<thead>
<tr>
<th>Pedagogical element</th>
<th>0 (not present)</th>
<th>1 (slightly present)</th>
<th>2 (present)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision of learning objectives</td>
<td>Objectives not stated or provided.</td>
<td>Objectives stated but not fully aligned with the task.</td>
<td>Clearly stated and aligned objectives with the task.</td>
</tr>
<tr>
<td>Structured activities</td>
<td>Unstructured, learner has freedom.</td>
<td>Semi-structured with some freedom for learner input, aligned with the task.</td>
<td>Structured activities aligned with the collaborative task.</td>
</tr>
<tr>
<td>Opportunities for reflection and feedback</td>
<td>No opportunities for reflection and feedback given.</td>
<td>Limited opportunities for reflection and feedback given.</td>
<td>Opportunities for reflection and feedback available to learners at any time.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social element</th>
<th>0 (not present)</th>
<th>1 (slightly present)</th>
<th>2 (present)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facilitation for sharing knowledge and resources</td>
<td>No stimulation for sharing among learners.</td>
<td>Limited sharing of knowledge and resources.</td>
<td>Active stimulation for sharing among learners.</td>
</tr>
<tr>
<td>Facilitating peer support</td>
<td>Platform does not support giving feedback or support.</td>
<td>Limited or not strongly encouraged peer support and feedback.</td>
<td>Learners are encouraged to provide constructive support and feedback.</td>
</tr>
<tr>
<td>Facilitation for engaging in dialogue and debate</td>
<td>Platform does not support engaging in dialogues or debates.</td>
<td>Limited or not strongly encouraged dialogue and debate.</td>
<td>Learners are encouraged to engage in dialogue and debate.</td>
</tr>
</tbody>
</table>
Data Analysis
Comparing CSCL environments based on the scoring system provides insights into cultural awareness and its facilitation. The analysis explores potential connections between

<table>
<thead>
<tr>
<th>Technological element</th>
<th>0 (not present)</th>
<th>1 (slightly present)</th>
<th>2 (present)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication facilitation</td>
<td>No support for student communication during collaboration.</td>
<td>Limited communication during collaboration.</td>
<td>Students can freely communicate during collaboration.</td>
</tr>
<tr>
<td>Interactivity of tools</td>
<td>Tools accessible mainly on an individual level.</td>
<td>Tools accessible mainly on a group level.</td>
<td>Tools accessible mainly on a community level.</td>
</tr>
<tr>
<td>Facilitation of participation / productivity tools</td>
<td>No facilitation of participation or productivity tools.</td>
<td>Facilitation of tools accessible by teachers.</td>
<td>Facilitation of tools accessible by both teachers and learners.</td>
</tr>
</tbody>
</table>

Cultural Awareness and Diversity Facilitation (table 3) draw on prior research on cultural diversity, focusing on techniques to raise cultural awareness and inclusivity. Elements are explored to identify the presence of techniques that are used, which can be compared to other elements to analyze their context dependency.

<table>
<thead>
<tr>
<th>Factor</th>
<th>0 (not present)</th>
<th>1 (slightly present)</th>
<th>2 (present)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facilitating intercultural interactions</td>
<td>No opportunities for collaboration or work together.</td>
<td>Some opportunities for collaboration, not consistent.</td>
<td>Regular and effective collaboration between diverse group members.</td>
</tr>
<tr>
<td>Encouraging multicultural perspectives</td>
<td>No encouragement or promotion of multicultural perspectives.</td>
<td>Some encouragement, not consistent.</td>
<td>Regular and effective promotion of multicultural perspectives.</td>
</tr>
<tr>
<td>Providing opportunities for cross-cultural learning</td>
<td>No opportunities to learn about other cultures.</td>
<td>Some learning opportunities, not consistent.</td>
<td>Regular and effective opportunities for cross-cultural learning.</td>
</tr>
<tr>
<td>Encouraging critical reflection on cultural assumptions</td>
<td>No opportunities for critical reflection on cultural assumptions.</td>
<td>Some opportunities for reflection, not consistent.</td>
<td>Regular and effective opportunities for critical reflection.</td>
</tr>
<tr>
<td>Promoting inclusive communication</td>
<td>No guidelines for inclusive communication.</td>
<td>Some guidelines, not consistent.</td>
<td>Clear and effective guidelines for inclusive communication.</td>
</tr>
</tbody>
</table>
learning/teaching perspectives and techniques to raise cultural awareness or facilitate cultural diversity. Conclusions drawn from the scoring system contribute to answering research questions 3 and 4 with a quantitative and objective approach.

IV. RESULTS

Interviews
The outcome of the interviews is shown in table 4. Teachers constantly re-evaluate their collaboration scripts or approaches and adjust the approach accordingly. Interactivity and engagement of students are often emphasized in scripts. High levels of freedom are aimed by offering multiple pathways towards the same learning goal, which can be necessary to suit learners. This can be challenging due to the inability of the learners or because of the assurance of reaching the desired learning outcome.

Participants share a positive view of cultural diversity and strive for diverse and inclusive environments. However, large differences between learners can make this ineffective. Raising cultural awareness was perceived to be effective and was often done by mixing groups where possible, exposing learners to different people. Other techniques include following pre-made courses or using collaboration tools.

In diverse environments, techniques are applied to counter-cultural barriers, like frameworks for students in their learning process. When shaping the learning path, individual cultural backgrounds were not considered. Balancing adjustability while considering learners' abilities, learning processes, and different levels were identified challenges.

<table>
<thead>
<tr>
<th>Element</th>
<th>ID: 1</th>
<th>ID: 2</th>
<th>ID: 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant</td>
<td>Teacher and designer of lessons. Lower school students.</td>
<td>Teacher for special needs children, focusses on technology.</td>
<td>Professor for university, active in research. International bachelor's students in Europe.</td>
</tr>
<tr>
<td>Collaboration script</td>
<td>Interactivity, creating memories, constant evaluation.</td>
<td>Constant re-evaluation of the script, learner ability, and enjoyment.</td>
<td>Intrinsic motivation creation, re-evaluation.</td>
</tr>
<tr>
<td>Level of freedom</td>
<td>High level of freedom, and multiple scripts to choose from.</td>
<td>Low level of freedom due to learners' inability to decide.</td>
<td>High level of freedom, multiple scripts, adjustable framework.</td>
</tr>
<tr>
<td>Cultural diversity</td>
<td>Embraces cultural diversity in classes.</td>
<td>Diverse environment creation, challenging.</td>
<td>Creation of an inclusive environment.</td>
</tr>
<tr>
<td>Techniques</td>
<td>Mixing groups, raises awareness through collaboration.</td>
<td>Collaboration is important.</td>
<td>Opportunities to reflect on cultural assumptions.</td>
</tr>
</tbody>
</table>

Observations
The observations and analysis have been conceptualized and objectified with the use of the scoring system, as shown in Figure 1.
SOWISO and Canvas suggest that they could efficiently facilitate a learning process context that fits in the behavioristics and cognitive perspective of learning. Kahoot! best fits the cognitive view on learning processes, while the environments of sCoolmakers, Google Drive, and Zoom best fit the connectivist and social constructivist view on learning processes. Other environments like Slack, GitHub, and Microsoft Teams can facilitate all four different perspectives of learning processes.

The defined social and technological elements are mostly present in the learning environments. All environments facilitate ways for people to share their knowledge with other people (FSK) and to engage in dialogue and debate with other people (FDD), and most facilitate ways for learner support and learner feedback (FPS). Most platforms facilitate technology to communicate with each other through the environment (CA) and offer participation and/or productivity tools (FPT). The interactivity of the tools that are facilitated (IT) in the CSCL environments is either group or community focused. The presence of the pedagogical element differs for each of the CSCL environments. Environments like SOWISO,
Canvas, and Kahoot!, which all mainly apply to behavioristic/cognitive learning perspectives, do have the defined pedagogical elements present, while environments like Zoom, Google Drive, and Slack do not have all of these pedagogical elements present.

Most environments facilitate engagement in intercultural interactions (FII) and encourage the promotion of multicultural perspectives (EMP). Opportunities for cross-cultural learning (CCL) were only observed by sCoolmakers. The presence of critical reflection on cultural assumptions (RCA) differs, but a trend can be seen that environments that mostly focus on cognitive and behaviorist perspectives of learning processes generally score low. Critical reflection on cultural assumptions is typically found in environments that focus on other perspectives as well, where the effectiveness of this differs. Inclusive communication (PIC) is promoted in all environments except for Kahoot!, which is also the only environment that does not facilitate communication within their environment between learners.

V. RESULT ANALYSIS

Based on the results in section 4, this section aims to find answers to the research questions. Connections between the interviews and the observations and between observations have been made.

Perceived Influence of Cultural Awareness and Inclusivity on Achievements

The results of the interviews showed that teachers and designers are positive about the benefits cultural diversity and cultural awareness/inclusivity bring to the (online) classroom. The reason for this was found to be mainly the possibility for students to learn from each other and to help each other. Raising cultural awareness was found to be beneficial for students to understand other people and perspectives, which increases inclusivity. An increase in cultural awareness can lead to more efficient shared knowledge creation and a more inclusive environment where students are perceived to be more open to helping other students. The results indicate that this leads to an increase in student achievements.

Techniques Used in Practice

Based on the interviews and the observations, it can be concluded that collaboration scripts in practice are usually not multiculturally scripted. No participant stated they design their collaboration scripts in a multicultural way, and only one environment scripted their collaboration scripts in this way, whilst this can be facilitated by most other environments (CCL). This lies in the hands of the teacher and is very context related. The interviews show that teachers generally have learning goals in mind, which is often hard to adjust in a multicultural way.

Techniques that facilitate student interaction with people from different cultures or different perspectives are used the most, by for example mixing groups between classes or schools. Most environments facilitate ways for people to share their knowledge with other people (FSK) and facilitate ways for students to engage in dialogue and debate with other people (FDD), which creates possibilities for learners to engage in intercultural interactions (FII), while also encouraging the promotion of multicultural perspectives (EMP). The effectiveness of these techniques is unclear. Participants showed that mixing groups to facilitate intercultural or diverse interaction can be challenging and sometimes impossible due to significant differences. In practice, it is found that cultural backgrounds are usually not considered, as cultural differences are negligible when educating in one location. Considering cultural backgrounds is said to be ineffective, as it might not be the best indicator for an individual. In practice, it is seen that groups are often mixed randomly or mixed based on skills, abilities, or earlier experiences.

Environments that focus mainly on behaviorist and cognitive perspectives on learning, such as Kahoot! and SOWISO, do not use techniques that facilitate of critical reflection on
cultural assumptions. This can be explained by the way these perspectives think about knowledge and information, as knowledge and information are seen as factual and not subjective, which does not support critical reflection on cultural assumptions. It can be concluded that environments that (also) facilitate other perspectives on learning (connectivist and social constructivist perspectives) do include elements that facilitate reflection on critical assumptions. Techniques to reflect on cultural assumptions relied on the existence of communication platforms that allowed other learners to expand on, change, or make comments on the knowledge of others. This idea is confirmed by the results of the interviews, as the results highlighted the perceived importance for students to collaborate and help each other where possible.

Furthermore, when an environment is not effective in facilitating a cognitive or behaviorist perspective on learning, fewer pedagogical elements are present. For environments that see knowledge solely as subjective and constructed by a group, such as Zoom and Google Drive, the pedagogical elements are often not present. The creation of subjective knowledge usually means there is an unclear vision of learning objectives and learning processes. New knowledge is constructed based on input from other students, which means learning activities are hard to structure and the outcome is unknown. The environment of sCoolmakers has the same vision of knowledge creation but, in contrast to similar environments, does have pedagogical elements present. This can be explained by the way users interact with sCoolmakers, as it is a collaborative repository on which inputs of the users are standardized and thus structured. This leads to the presence of pedagogical elements but does not mean learning goals or learning directions are known beforehand.

The technique to multiculturally script collaboration scripts by facilitating possibilities for students to learn about other cultures (CCL) is rarely present for these observations. However, most environments can facilitate this. The use of CCL is thus very context-sensitive: depending on the choices of the teacher scripts can be multiculturally scripted but can be facilitated by most environments. A similar conclusion can be made for the promotion of inclusive language (PIC), as this is also context-dependent and is mainly the responsibility of the teacher. Most environments facilitated teachers and/or students with guidelines for communication to increase inclusivity. The results of the interviews indicate that inclusivity and inclusive language are of importance, but it is unclear in what way communication guidelines or moderation are done in practice, as this is highly context dependent.

VI. LIMITATIONS

This research aims to identify techniques used to raise cultural awareness and inclusivity in CSCL and educational settings. No conclusions can be made about the effectiveness of the researched techniques, as this research focused on the usage of the techniques in practice and in what contexts these techniques were used. Interviews provided insights into perceived effectiveness, but these alone cannot provide definite answers. Future research is needed to assure the effectiveness of these techniques across diverse learning environments.

The techniques discussed in this research are a subset of all possible techniques, and there may be other potentially more effective techniques that fall outside the scope. Further research can expand on this by exploring other techniques. The research analyzed nine CSCL environments and interviewed three teachers, aiming for scientific saturation. However, context-dependency suggests that different results may arise in various contexts or with different participants. Further research with additional environments and diverse interviews can increase the saturation of findings.

The scoreboard used to quantify and analyze the environments was based on previous literature and interview elements, designed to objectify the qualitative analysis and minimize subjectivity. However, it is unclear how accurately this scoreboard captures the entirety of the qualitative analysis. Future research might consider adjusting or expanding the elements for a more complete representation or validate the scoring system's quality and effectiveness.
Additionally, averaging the scores from multiple scorers would reduce the possibility of individual bias and personal influence for an environment.

This research primarily focused on Western-developed environments and participants, leading to results influenced by a Western perspective on cultural diversity. It is unclear to what extent these findings can be made for other cultures. Future research in different parts of the world can define the applicability of this study's results beyond Western contexts.

Lastly, this research chose to focus on collaboration scripts to explore how the benefits of cultural diversity can be enhanced within (online) learning environments. This approach was widely used by researchers to understand and explain how to address challenges brought about by cultural diversity. There are multiple alternative approaches to explore and explain this topic that does not center around collaboration scripts, which are hypothesized to produce the same results.

VII. CONCLUSION

This research discussed the importance of cultural diversity in educational settings and defined the perceived impact of raising cultural awareness and inclusivity on student achievements. Furthermore, techniques were defined that can be and are used to raise cultural awareness and inclusivity in CSCL environments, after which the influence of the context of the CSCL environment was researched. It discussed how cultural diversity is seen as beneficial for learners, as it can for example lead to an increase in shared knowledge creation. Raising cultural awareness and inclusivity is perceived to be an effective way to embrace and facilitate cultural diversity by teachers and other researchers. Different techniques are used in practice and are perceived to be effective by teachers, which include mixing groups to facilitate intercultural interactions and encourage multicultural perspectives. Multicultural collaboration scripts are techniques that were not found, as the use of this technique is context-dependent and the responsibility of the teacher. Most CSCL environments can facilitate these multicultural collaboration scripts. Additionally, CSCL environments that focus solely on facilitating cognitive and behaviorist perspectives on learning, with a focus on objective knowledge, do not use techniques that encourage critical reflection on cultural assumptions. CSCL environments that do not put focus on these perspectives are less likely to consist of pedagogical elements. In sum, the context of the environment can influence the facilitation of raising cultural awareness and inclusivity, but the teacher and the specific context within the learning environment have the most influence on whether and how cultural awareness and inclusivity are being raised, which can lead to effective collaboration scripts and an effective and inclusive learning environment.

VIII. REFERENCES


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A CASE STUDY OF HIGHER EDUCATION PROGRAM ACCREDITATION

Andreas Savva1
savva.a@unic.ac.cy

Vasso Stylianou1
stylianou.v@unic.ac.cy

Florent Domenach2
fdomenach@aiu.ac.jp

George Portides1
portides.g@unic.ac.cy

1 Department of Computer Science, University of Nicosia, Nicosia, Cyprus
2 Basic Education, Akita International University, Akita, Japan

Abstract:
Most universities around the world have the freedom to implement their own programs of studies. In most countries there is an educational body responsible for accrediting the programs and making sure that certain criteria are met. This paper presents a suggested breakdown of steps to follow in the case of accreditation of a newly-developed program or re-accreditation of an existing one. It is a case study that has been successfully applied at the University of Nicosia in the Republic of Cyprus. Even though educational systems in different countries have different laws and practices, this case study can be used as a guideline in order to assist institutions when such a process is necessary.

Keywords: Case Study, Programs of Study, Accreditation Procedures, Computer Science, Curriculum Reform

I. INTRODUCTION

Higher Education Institutions (HEIs) are responsible for ensuring that their programs of study, new and existing, offer high quality education. Existing programs undergo continuous improvements and upgrading through procedures provided by the institution itself, or by some government body responsible for HEIs quality assurance.

The Cyprus Agency of Quality Assurance and Accreditation in Higher Education (CYQAA) [CYQAA, 2023], is the competent independent authority responsible to safeguard standards through procedures provided by the relevant legislation, and to ensure that HEIs in Cyprus offer high quality education.

CYQAA share the vision of the Bologna Process for the creation of the European Higher Education area. The process of quality assurance and accreditation, showcases the quality of the education provided, but also increases transparency, thus contributing to better recognition of the academic qualifications of programs of study.

Accreditation works for the benefit of students, HEIs, employers, and the society in general as it ensures that the graduates will have the necessary knowledge, skills and abilities, that is the learning outcomes reflected in the criteria of external evaluation.

The University of Nicosia [UNIC, 2023] is one of the leading comprehensive research-oriented universities in the Mediterranean region, committed to teaching, research and innovation, sustainability, societal engagement and contribution to culture. It has been ranked by the World University Ranking (THE WUR) among the Top 501-600 Universities in the world and has also received numerous other recognitions:

#1 in Cyprus and Greece | Times Higher Education World University Rankings 2024
#1 in Cyprus in Research Quality and International Outlook | Times Higher Education World University Rankings 2024
#101-150 in the World | Times Higher Education World University Rankings 2023 Young
The university offers more than 100 conventional face-to-face (on campus) and distance learning online programs at the Bachelor’s, Master’s and Doctoral degree level, hosting more than 12,500 students from over 100 countries.

This paper presents a case study of the procedure followed by the Department of Computer Science at the University of Nicosia, in order to update and accredit the Computer Science program.

Section II discusses the need for upgrading the Computer Science program, whereas section III describes a step-by-step procedure for re-engineering the program. Section IV presents the CYQAA accreditation procedure that took place in this case study and section V concludes.

II. THE COMPUTER SCIENCE PROGRAM

The Computer Science program has been designed around a core of computer technology, problem solving, systematic program development and modern approaches to systems analysis and design with the theoretical and practical knowledge and skills, needed to produce designers of the complex software systems that our society requires.

Throughout the years the program has gone through many quality assurance and accreditation visits by the CYQAA, like any other program in higher institutions in Cyprus. In order to align the program with new technologies and requirements, many changes have taken place within the program’s structure, such as the introduction of new courses, the withdrawal of outdated, non-popular courses, and the modification of some others.

Most of the department faculty members have taken part in many such accreditation visits making them, if not experts, most familiar with their procedures.

Due to the faculty’s experience on quality assurance and accreditation procedures the department follows its own procedure in the development of new programs or in the re-engineering of existing ones, from the moment where the department council decides whether to implement a new program or modify one, until it gains accreditation by the CYQAA.

Thus, this paper presents a step-by-step guideline on how to go through such an accreditation procedure. It presents as a case study the steps taken for successfully re-accrediting the Computer Science BSc program a number of times during the last years.

III. THE ACCREDITATION PROCEDURE

The CYQAA accredits programs of studies over a period of time. Therefore, accreditations have an expiration date. For example, the current CS program accreditation will be expired in the Spring semester of 2026, when a new accreditation procedure will need to take place.

The entire process for updating the Computer Science program during the last time, took around 18 months to be successfully completed. The following phases took place:

Phase 1 – Decision for re-engineering

Eighteen months before the SC-program accreditation expired, the department council decided to re-engineer it in order to comply with the new trends and needs.

Phase 2 – Student questionnaire

A questionnaire was given to students to analyze their expectations and 70 valid responses were collected. Such questionnaires are common in the literature [Voss, et. al., 2007; Sander, et. al., 2000]. The questionnaire was tailored to comply with specific computer science skills and competencies [Martin-Moreno, et. al., 2007]. There were 10 paired questions for which students had to rate, on a Likert Scale of 1 to 6 (1 – no importance, 6 – highest importance), what they were expecting from the Computer Science Bachelor degree, and what they have experienced so far.
The sample data was processed using the paired t-test and a significant difference between what the students were experiencing and what they were expecting in almost all skills was obvious. More precisely, in relation to curriculum development, Programming skills, Computer Hardware Knowledge, Capacity for applying knowledge in practice, and Ability to learn new software and techniques stood out as areas in which focus needed to be given in the re-engineering efforts.

**Phase 3 – Updating the CS Program**

The Department Council which comprises all members of the faculty body of Computer Science and Mathematics, decided to form an ad-hoc committee in order to investigate and recommend possible changes and improvements and submit their recommendations to the Department council. The ad-hoc committee was composed of five faculty members: the Department Head, the Associate Head, and 3 other senior faculty members.

As stated by [Nemeth, et. al., 2001a] and [Nemeth, et. al., 2001b], it is very important in group decision making to encourage critical evaluation, either in the group or from outside experts. Also, the recommendations of [Janis, J.L., 1971; Turner, M.E. and Pratkanis, A.R., 1994; Turner, M.E., et al., 1992; Janis, J.L. [ed.], 1982], are important in order to avoid groupthink syndromes, by encouraging dissenters. The described approach achieves stimulated original thinking, subdividing and reuniting to air differences, calling for a "second-chance" meeting to air any lingering doubts.

It was decided to adapt the recommendations of ACM and IEEE in updating the CS program. These recommendations provide a “Body of Knowledge” which is divided into 14 areas. Within each area, topics related to the area are listed. There are two types of topics namely the core and non-core. Non-core topics are defined as topics that could be added to the program depending on the faculty expertise, the focus of the program, or the skill-set that the local employers are seeking. The committee identified at first the core and optional subjects. Core subjects have developed into Major Requirement courses and optional subjects were covered in Major Elective courses.

Following the creation of this first draft a number of sub-committees were formed to analyze the different aspects of the program development such as:

- Feedback of industry professionals
- Feedback from students
- Feedback from faculty
- A comparison of the program with other universities
- Cross-validation with ACM/IEEE guidelines

The same questionnaire was used to receive feedback from industry professionals, students and faculty members in respect to the skills and/or competences acquired in a CS program in Cyprus.

The questionnaire involved ratings of 19 attributes of fundamental CS skills. Each skill was on a 5-point Likert scale, from 1: Not important to 5: Extremely Important. The data were analyzed using the paired t-test for comparing means. More precisely, the means for each attribute between the Expectation and the Updated pathway were tested for equality. A 1% and 5% significance were used throughout, i.e., p-values less or equal to 0.01 or 0.05 indicate a significant difference between the means.

**Feedback from Industry Experts**

The survey involved 8 firms operating in Cyprus. It provided a means of comparison between the updated new program and the industry’s expectations for a CS program. It is acknowledged that the sample size is small, and caution is required in interpreting the statistical results. At a 5% significance level, it gave a significant difference in a number of attributes, showing the discrepancy of academic degrees and industry expectations. For many other attributes, no significant differences between the means of the underlying variables were found.

**Feedback from Students**
A random sample of 50 CS students answered the questionnaire. At the 1% significance level, it was noted that students wanted less social science and humanity electives and less business electives than what was required at the time by the program. However, emphasis was clearly stated on improving skills related to practical implementations, on both 1% or 5% significance levels.

**Feedback from Faculty Members**

The survey was also conducted among the full-time faculty of the department. The questionnaire was distributed to all 15 full-time faculty members. Ten completed questionnaires were received which was 67% of the population.

No attribute was statistically significant at the 1% level, showing that the expectations of the CS department faculty members were aligned with the updated BSc. program’s offerings. This means that the program was close to what they would like it to be. However, it is interesting to notice that faculty members agreed with the students that social science and humanity electives and business electives should be reduced, and emphasis to be given on more practical problem solving courses. The main difference compared to students’ evaluation concerned basic general knowledge in the field of study and understanding of computer ethics and professional conduct, which were considered more important by faculty members than by students. The overall conclusion was that the updated program was satisfactory to the faculty members.

**Similarities with Programs of Other Universities**

Due to the fact that University of Nicosia follows mainly the USA, and then the British and Greek educational systems, emphasis was given to the curricula coming from the above regions. The purpose of this survey was to compare similar or same courses and not the metric system of the courses. The comparison was with 12 randomly selected universities, 2 in the USA (University of Wisconsin Madison, University of Texas at Austin), 2 in Greece (University of Ioannina, University of Crete), 3 in Cyprus (University of Cyprus, Frederick University, European University) and 5 in the UK (Oxford University, Kings College London, University of Manchester, University College London, University of Liverpool). Results showed that the updated proposed program was very similar to the universities considered. Some minor differences only existed.

**Cross-validation with ACM Body of Knowledge**

To complete and complement the above process, a data analysis was conducted in order to evaluate the consistency of the program’s courses learning outcomes relatively to ACM guidelines. Each faculty member was asked to indicate the ACM bodies of knowledge corresponding to the learning outcomes of each of hers/his course.

This exercise was completed to evaluate if the new pathway covered the entire ACM core, but also to study the structural dependencies between courses. It also helped to validate the list of prerequisites between courses.

Out of the 65 core topics recommended by the ACM, only 16 were not covered directly by the core courses, and, by factoring elective courses, there were only 8 core topics that were not covered.

Most of these topics (6 out of 8) concerned social and professional issues. A course covering these issues could be introduced, though the absence of such a course could also be explained by cultural differences between EU and United States academia.

**Phase 4 – Feedback from External Evaluators**

Two external evaluators from the CS department of the University of Cyprus, both experienced in curriculum development, were invited to review the CS program under development. The external evaluators have made detailed comments and presented them in a meeting with the ad-hoc re-engineering committee. Each and every course and syllabus were examined in detail and the necessary revisions were made. As a result of this review, the program developed further both in its structure as well as its content.
After implementing most of the external comments a final draft of the program was generated. The Ad-hoc committee had a fourth meeting in which it finalized the program to be presented to the Department Council for approval.

**Phase 5 – Feedback from Professional Associations**

After the Department Council approved the program, it was decided to also seek validation from professional associations. As such, the new program was sent to the Cyprus Scientific and Technical Chamber [ETEK, 2023].

The Cyprus Scientific and Technical Chamber (ETEK) is the statutory Technical Advisor to the State and is the umbrella organization for all Cypriot Engineers. It was established by Law 224/1990 and is a Public Law Body with an elected Governing Body [18].

The objective of ETEK is to promote science in the various sectors related to the fields of specialization of its members, engineering and technology in general and to develop them with a view to the self-sufficient economic, social and cultural development of the Republic. All of the recommendations received from ETEK were fully observed in the new program without further changes being required.

**IV. ACCREDITATION VISIT BY CYQAA**

When the final form of the program was formed which resulted after the evaluations by different stakeholders, the Curriculum Committee sent the proposed changes to CYQAA.

CYQAA formed a committee (Visiting Team) of well-known professors from around the world, but mainly from Europe and the USA, with high experience in program development, to accredit the program.

They scheduled a full day and visited the University premises where they had interviews mainly with the CS department faculty who presented the program to them and answered their queries. They also had meetings with students, individual faculty members, administration members, visited the classrooms, the computer labs, the library, etc.

The visiting team reported positively on the program’s aims, objectives, learning outcomes, competences and skills, and found these to be in line with the current CS curriculum recommendations whilst at the same time satisfying market needs. It also examined the evaluation mechanism which led to the development of the revised CS program.

Overall, the only negative comment in the report was the number of faculty members in the CS department which should be increased considering the present teaching load. They also suggested the inclusion of more contemporary courses towards Web-based and Service-Oriented Computing (SOC).

Their report concluded that the updated CS program was adequate and sufficiently good and thereof given “Final Approval” if their recommendations regarding the inclusion in the program of some additional courses and the hiring of more senior and specialized faculty were met.

**V. CONCLUSIONS**

Finally, the program was approved by the Department Council, then by the School Council, and lastly by the Senate, the ultimate academic body of the university.

In this re-engineering effort, the CS department had followed a very systematic approach which involved a number of internal and external to the university contributors who were invited to submit their feedback. The re-engineering approach from the start until it arrived at the CYQAA agency for accreditation could be outlined by the following steps:

a) Formation of a number of faculty sub-committees assigned tasks outlined by the ECTS process.

b) The Program Committee identified at first the core and optional CS subjects. An initial program pathway was developed.
c) Two external evaluators with experience in curriculum development, were invited to review the CS program under development. Following their recommendations, the program developed further both in its structure as well as its content.

d) Feedback on the updated program was received from the Cyprus Scientific and Technical Chamber (ETEK) and other industry professionals as well as from students and faculty members. A comparison with other universities’ programs was also made. The feedback received from all stakeholders was incorporated into the new program.

e) The output of all committees’ work was combined towards the formation of the final program.

f) The program was presented to the department faculty members for feedback. The CS program was again revised as necessary.

g) Finally, in a Department Council meeting the new program was approved and sent to the CYQAA for accreditation.

Re-engineering a program is a balancing act between scientific requirements and practical constraints. By nature, such work is imperfect, and our program is no exception but the thorough process which is described in this case study ensures that top-quality programs of study can be designed which satisfy all the educational stakeholders.

VI. REFERENCES


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EMPOWERING COMPETENCE DEVELOPMENT IN A DYNAMIC AND NETWORKED WORLD

Emőke Takács
ERI Hungary – European Research Institute
t.emoke@eri.net.in

Toon Abcouwer
Universiteit van Amsterdam
a.w.abcouwer@uva.nl

Abstract
Our world is not only full of short and simple but also long-term and complex challenges, where everything is constantly changing. Without information technology, life is no longer possible. It makes us reconsider our education, with more focus on life-long learning. In current education, there is a tendency towards focusing on competence-based learning with growing attention to 21st-century competences and skills. In the light of the above, we highlight three important aspects of learning in this article:

1. learning as knowledge transfer
2. learning as cooperative activity for exchanging information, knowledge and insights
3. learning as autonomous exploring new insights by combining knowledge.

How to deal with change and develop competences in such circumstances that our changing and complex world requests from us?
Our approach of an on-going research makes people understand change, suggests competences and educational focuses in its different phases. This way, this discussion paper will sketch some thoughts to deal with the challenges of our ever-changing society. Combining several concepts and experiences, we develop a vision to serve as a starting point for discussion and follow-up research.

The main objective is contributing to better able to create a sustainable world for us and future generations.

I. INTRODUCTION
The world is in constant change. We can look at this development from different perspectives. One, that external challenges bring growing anxiety about the future (Beck, 2009; Posen & Levinthal, 2012), and another that internal developments increase the uncertainty about the future of us and the next generations(Pearson & Mitroff, 1993). Current dynamics force us to prepare for unforeseeable futures in contemporary society.

These unpredictable changes limit our abilities to solve single problems, because they do not exist independently but converge and interfere. The concept of intersectionality (Runyan, 2018) developed within feminism (recognising that gender inequality is not a singular problem but an interplay of many underlying issues) is also applicable. Dealing with challenges one-by-one offers only limited insight to arrive to solutions with networked, dynamic, complex and open challenges we face today. No boundaries force many elements working together in ever-changing circumstances, where different competences are needed. It shows that a broader perspective is necessary, as we explain it in chapter 4.

Any (combination of) cause(s) we presume for the dynamic societal changes, people all agree that something should happen. With any means we should ensure that problems stay manageable. Unfortunately, the proposed solutions are highly contradictory. Understanding our world is far more complicated. There is no general ’one size fits all’ solution (Masys, 2012).

In the next paragraph we will explore the theoretical building blocks.
II. THEORETICAL CONCEPTS

II.1. ACoR

The Adaptive Cycle of Resilience (ACoR) model is a method to understand an organisation’s situation in a world facing unforeseen developments and uncertain future(s) and supports managers and leaders to govern their organisations in any circumstances our changing dynamic life brings (Abcouwer, Takács, & Banga, 2022). The model is based on the “Want-Must-Can” dilemma (Heene, 2002), seeking a new balance within what an organisation wants and must (directions) and can do (abilities) in a changing environment, on the theoretical insights of Thompson as developed in his book Organisations in action (Thompson, 1967) and on the ecological view on resilience (Folke et al., 2002; Gunderson et al., 2010; Holling, 2001; Holling et al., 2002). Organisations regularly face changes, and according to Prigogine and Stengers (1987), it creates instability, (threatening) chaos and perpetual motion. After each challenge, a new equilibrium must be developed for optimal functioning.

The model (Figure 2) highlights the importance of adaptivity in the cyclical development of an organisation. Four quadrants recognise the development. The infinite cycle starts from an assumed ‘Equilibrium’ state, where relatively small disturbances appear, which we want and can deal with. However, when external influences severely disrupt this equilibrium, the organisation climbs to the ‘Challenge’ quadrant, where managers, leaders (and their teams) face uncertainty and are forced to search for new solutions. This leads to the ‘New Combinations’, where awareness, leadership and governance are crucial. After determining several options for the case, the most suitable solution must be chosen to reduce uncertainty. The transition to the so-called ‘Operationalisation’ quadrant requires innovation capacity. It is challenging because we cannot predict whether the final choices will be successful. The model suggests tips and tricks on what managers and leaders can do in the different quadrants.

![Figure 2: Developments and the Adaptive Cycle of Resilience (Takacs & Abcouwer, 2021)](image)

We also identified four traps that threaten organisations during going through the cycle (see arrows in figure 3) (based a.o. on Allison & Hobbs, 2004; Gunderson et al., 2010).

1. **Lock-in**, when management does not see the crises or challenges coming, when heading from equilibrium to the phase of challenge
2. **Poverty**, when they lack creativity to come up with new solutions after facing the challenge,
3. **Isolation**, when they cannot convince the organisation to initiate the change, as suggested in new combinations,
4. **Rigidity**, when there is resistance to change when operationalising.

The ACoR model mainly focuses on going through disruptive change, whether on an individual, organisational, or societal level with a repetitive short-term change trajectory. However, it emerges to care for long-term social developments and their effects on Earth.
II.2. The Eight ways of learning

In the complex life we live now, we try to innovate, and at the same time, we keep falling back to already invented educational practices. The 8 Aboriginal Ways of Learning\(^7\) is an excellent example for reinventing good practices, which also can contribute to innovation and development. One issue Yunkaporta (2011) questions is the difference between growth and increase. Failure is believed to come from lacking unified objectives and goals, the assumed solution and a leader to follow. Mission statements, KPIs and bosses are supposed to organise us. But, according to Yunkaporta, we must hand over and share all our wealth of knowledge and relationships. The way to save the planet is to “bring everybody back under the law of the land, and be very generous with our social systems, open them up and bring everybody back in.” Diversity is vital in finding solutions.

Indigenous thinking is based on self-identification, remembering, and collaborating which are key issues in our society.

The Aboriginal eight ways of learning are eight interconnected pedagogies, that are always changing in the different settings. The descriptions of the indigenous learning styles are adapted from Romano et al. (2021):

1. *Story sharing*: narrative-driven learning, approaching learning through telling a narrative story and connecting through the shared stories.
2. *Learning Maps*: a learning journey, a map with points of understanding, visualising the learning processes and picturing the pathways of knowledge.

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\(^7\) [https://www.8ways.online/](https://www.8ways.online/)
3. **Non-verbal learning** is gestures, expressions, observing, hands-on reflective techniques, applying intra-personal and kinaesthetic skills to thinking and learning. See, think, act, make and share without words. The deeper knowledge is unspoken.

4. **Symbols and Images**: draw, use of symbols, metaphors, images to understand concepts and content. Translate knowledge to one’s own cultural meaning. Keep and share knowledge with art and objects.

5. **Land Links**: the knowledge of land and nature ensuring cultural integrity. Land-based learning links content to local land and place.

6. **Non-linear processes**: try a new way, find your own, indirect/synergistic logic, produce innovations, and understand by thinking laterally or combining systems. Put different ideas together and create new knowledge.

7. **Deconstruct/Reconstruct**: Watch first, then do, modelling and scaffolding, working from wholes to parts.

8. **Community Links**: share, give and take, connect, centring local viewpoints, apply learning for community benefit.

The joining lines are evenly important as the different pedagogical ways. Values, protocols, systems and processes refer to the ways of valuing (axiology), being (ontology – protocols, rules), knowing (epistemology) and doing (methodology).

The eight ways of learning supports the acquisition of various knowledge and skills of the persons, teams or organisations and facilitates the change management by the movement through the Adaptive Cycle of Resilience. It highlights cultural values and practices that influence motivation and subsequent achievement in learners. This is also true in moving through the ACoR and acquiring the necessary knowledge and skills for each phase.

### II.3. Competences

In 2006, the European Parliament and the Council of the European Union adopted a recommendation on key competences for Lifelong Learning: Key Competences for Lifelong Learning (European Communities, 2006, 2006/962/EC). In 2017 the European Commission launched a consultation to revise the old Key Competences. The Education Committee discussed the proposed recommendations during the Bulgarian presidency and the Education Council made the final decision on the 22nd of May, 2018. The development of the Digital Competence Framework and the Entrepreneurship Competence Framework (Bacigalupo et al., 2016) has proven to be valuable for supporting competence development. We are using the text of the legislation for describing the competences.

- **Literacy competence (C1)**
  Literacy is the ability to identify, understand, express, create, and interpret concepts, feelings, facts and opinions in both oral and written forms, using visual, sound/audio and digital materials across disciplines and contexts.

- **Multilingual competence (C2)**
  It shares the main skill dimensions of literacy. Based on the ability to understand, express and interpret concepts, thoughts, feelings, facts and opinions, an appropriate range of societal and cultural contexts according to wants or needs happen in any form (listening, speaking, reading or writing).

- **Mathematical competence and competence in science, technology, and engineering (C3)**
  Necessary knowledge in mathematics includes a sound knowledge of numbers, measures and structures, basic operations and basic mathematical presentations, an understanding of mathematical terms and concepts, and an awareness of the questions to which mathematics can offer answers.

- **Digital competence (C4)**
  It is the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society.

- **Personal, social and learning to learn competence (C5)**
  Personal, social and learning to learn competence is the ability to self-reflect, manage time and information, cooperate with others, remain resilient and manage personal self-development and career.

- **Citizenship competence (C6)**
Citizenship competence is the ability to act as responsible citizens and to fully participate in civic and social life, based on understanding of social, economic, legal and political concepts and structures, as well as global developments and sustainability.

- **Entrepreneurship competence (C7)**
  Entrepreneurship is founded upon creativity, imagination, critical and strategic thinking and problem solving, taking initiative and perseverance, giving critical and constructive reflection within evolving creative processes and innovation.

- **Cultural awareness and expression competence (C8)**
  This competence involves understanding and respecting how ideas and meanings are creatively expressed and communicated in different cultures and through a range of arts and other forms.

These 21st century skills (Collins, 2009) and competences are relevant in every phase of the change process. However, as always, some competences are more equal than others, or during the process of change the focus is not always the same. In the table below, we link the 8 ways of learning theory with the European Competence Framework. In the next paragraph these links will be worked out in more detail.

<table>
<thead>
<tr>
<th>8 ways</th>
<th>8 ways of learning</th>
<th>Comp</th>
<th>Key Competences 2018</th>
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<tbody>
<tr>
<td>1</td>
<td>Story sharing</td>
<td>C6</td>
<td>Citizenship competence</td>
</tr>
<tr>
<td>2</td>
<td>Learning Maps</td>
<td>C5</td>
<td>Personal, social and learning to learn competence</td>
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<td>3</td>
<td>Non-verbal learning</td>
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<td>Digital competence</td>
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<td>4</td>
<td>Symbols and Images</td>
<td>C1</td>
<td>Literacy competence</td>
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<tr>
<td>5</td>
<td>Land Links</td>
<td>C3</td>
<td>Mathematical competence and competence in science, technology, and engineering</td>
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<tr>
<td>6</td>
<td>Non-linear processes</td>
<td>C8</td>
<td>Cultural awareness and expression competence</td>
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<td>7</td>
<td>Deconstruct/Reconstruct</td>
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<td>Entrepreneurship competence</td>
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<tr>
<td>8</td>
<td>Community Links</td>
<td>C2</td>
<td>Multilingual competence</td>
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Fig 5: The 8 ways colour codes linked to competences

### III. Competence development in lifelong learning

Building successfully new competences, people and the members of organisations (managers, leaders and staff) should understand the ‘what’, ‘why’ and ‘how’ the learning (competence development in
lifelong learning) should take place (Rehm et al., 2016). In the previous paragraph we already defined the what of the 8-ways approach and the competences. In a previous publication we already linked the ACoR model with the 8-ways of learning approach (Takács et al., 2022). In this paragraph, we go through the Adaptive Cycle of Resilience and look at the most relevant competences required in the specific phase and find a suitable way of learning from the before-mentioned 8-ways.

We describe the logic of this integration starting with the state of Equilibrium, facing a Challenge, searching for ways to overcome the challenge, developing New combinations, Exploiting the solution, Operationalising it then trying to Conserve and reaching a New Equilibrium.

**III.1. Significant competences in Equilibrium**

**Literacy** (C1) is a competence that may have a larger role when organisations are able to keep their Equilibrium.

WHY to develop the competence of Literacy? It is an ability to **communicate and connect** effectively with others, in an appropriate and creative way. Literacy development forms the basis for further learning (lifelong learning) and further interaction. A positive attitude towards literacy involves a disposition to critical and constructive dialogue, an appreciation of aesthetic qualities and an interest in
interaction with others. This implies an awareness of the impact of language on others and a need to understand and use language in a positive and socially responsible manner.

HOW to develop the competence of Literacy? Depending on the context, it can be developed in different languages and forms. When we look at the Eight ways of learning, we recognise that Symbols and images fit well to develop the key competence for Literacy, because it uses different tools (images and metaphors) to understand concepts and content, keep and share knowledge. Besides linguistic (oral) understanding, a visual metalanguage can be the building blocks for memory and the making of meaning, which is cross-cultural and dynamic. It is a useful way to understand and remember new concepts.

In the Adaptive Cycle of Resilience (ACOR) the equilibrium state provides suitable circumstances for the Literacy competence development, where communication and understanding are key for keeping the well-working way of operation.

III.2. Significant competences when facing Challenges

Personal, social learning to learn competence (C5) is useful when facing a Challenge. Motivated, resilient, confident, curious people are better able to manage the unexpected and find the way out from difficulties, handle obstacles and change. We also can learn from challenges throughout our lives.

WHY? For successful interpersonal relations and social participation, it is essential to understand the codes of conduct and rules of communication generally accepted in different societies and environments. This competence requires knowledge of a healthy mind, body and lifestyle. It involves knowing the preferred learning strategies, competence development needs and the ways to develop competences. A problem-solving attitude supports both the learning process and the participants. The desire to apply prior learning and life experiences and the curiosity to look for opportunities to learn and develop in a variety of life contexts helps us manage challenges.

HOW? The competence is based on a positive attitude toward one’s personal, social and physical wellbeing and learning throughout life. It is based on collaboration, assertiveness and integrity, respecting diversity and others’ needs. Leaving the known ways in operation when facing a disruptive challenge, we release using the ACoR terms. Here we need to find our ways and draw our Learning maps as described at the Eight ways of learning. Explicitly mapping, visualising processes, we can picture our pathways of knowledge. Such learning is also a tool for planning and communicating explicit quality criteria.
III.3. Significant competences when leaving the Challenges and reorganise towards New combinations

Today, in the era of change, we cannot proceed without Digital competences (C4), which are the driving force for change. Digital competence is required for managing any coming challenge and reorganisation in the ACoR model.

WHY? Digital technologies support communication, creativity and innovation, active citizenship social inclusion, collaboration, and to be aware of opportunities, limitations, effects and risks. Reorganisation is also a lot more efficient using digital tools and technologies.

HOW? Non-verbal learning is a possible way to develop digital competences. We see, think, act, make and share without words. It relates and connects to knowledge reflectively, critically, ancestrally and physically. Engagement with digital technologies and content requires a reflective and critical, yet curious, open-minded and forward-looking attitude. Ethical, safe and responsible approach is required to use these tools. Non-verbal learning is primarily used for behaviour management and problematic knowledge, which we face after trying to solve a critical challenge. Such learning applies intra-personal and kinaesthetic skills to thinking and learning.

III.4. Significant competences to reaching New combinations

Cultural awareness and expression (C8) are a competence necessary for designing new combinations for responding to challenges. Non-linear processes help us to put different ideas together and create new knowledge, supporting the change management and problem-solving within the organisation.

WHY? When dealing with challenges and working on solutions towards new combinations, it is important to have an open attitude towards, and respect for diversity of cultural expression together with an ethical and responsible approach to intellectual and cultural ownership. A positive attitude also includes curiosity about the world, openness to imagine new possibilities, and willingness to participate in cultural experiences. Developing skills for different ways of communicating ideas between stakeholders: creator, participant and audience within written, printed and digital texts, theatre, film, dance, games, art and design, music, rituals, and architecture, as well as hybrid forms.

HOW? The competence in cultural awareness and expression requires an understanding of own developing identity within a world of cultural diversity and how arts and other cultural forms can be a way to both view and shape the world. Using the Non-linear pedagogy can support producing
innovations and understanding by thinking laterally or combining systems. Innovation happens through the interaction of cultural systems, which can be applied today to a more productive integration of community and school knowledge. It also approaches higher order thinking by incorporating seemingly unrelated domains to create complex, real-life problems to be solved by learners using holistic thinking and innovative processes.

### III.5. Significant competences when Exploiting new combinations, stepping towards Operationalisation

![Figure 6.5: Significant competences and recommended pedagogy in Exploitation in ACoR terms](image)

**Citizenship competence** (C6) supports social and cultural diversity, gender equality, social cohesion, sustainable lifestyles, promotes culture of peace and nonviolence, and to take responsibility for the environment.

**WHY?** Citizenship competence is based on knowledge of basic concepts and phenomena relating to individuals, groups, work organisations, society, economy and culture. Understanding common values, developments, movements, sustainable systems, in particular climate and demographic change at the global level and their underlying causes, an awareness of diversity and cultural identities may support in the diversity of choices for solving problems.

**Skills for citizenship competence** relate to the ability to engage effectively with others, also in common or public interest, including the sustainable development of society. This involves critical thinking and integrated problem-solving skills, skills to develop arguments, participate constructively in community activities and make decisions. This also involves the ability to use media in democratic societies.

**HOW?** Participating in decision-making requires respect, responsible and constructive attitude. In the ACoR model once new combinations are set, decisions to exploit will lead to operationalization. For such an important decision all aspects have to be checked, so a diversity of reasons require the specialists to connect through stories to share. Story sharing approaches learn through narrative and connect through the shared stories.
III.6. Significant competences when Operationalising new ways of working

**Entrepreneurship competence (C7)** includes the ability to work collaboratively and individually, mobilize resources in order to plan, manage and sustain projects that are of cultural, social or commercial value. This includes the ability to make financial decisions relating to cost and value.

**WHY?** There are different contexts and opportunities for turning ideas into action in personal, social and professional activities, and Entrepreneurship competence ensures an understanding of how these arise. People should know and understand approaches to planning and management of projects, understand social and economic opportunities and challenges facing an employer, organisation or society. This competence supports awareness of ethical principles and challenges of sustainable development and self-awareness of own strengths and weaknesses.

**HOW to develop Entrepreneurship?** An entrepreneurial attitude is characterised by a sense of initiative and agency, pro-activity, being forward-looking, courage and perseverance in achieving objectives. A desire to motivate others and value their ideas, empathy and taking care of people and the world, accepting responsibility, taking ethical approaches throughout the process. Deconstruct/Reconstruct models and scaffolds, works from wholes to parts (watch then do). Such way of learning uses Aboriginal scaffolding methodologies and engage with whole processes and texts, modelling and building upon students' basic skills and identities and then transferring these successfully from familiar to unfamiliar contexts, which we need when operationalising new ways of working.

III.7. Significant competences in Conservation

**Mathematical competence and competence in science, technology, engineering (C3)** is important when conserving any new ideas. We should link to the land, stay on the ground to be successful.

**WHY?** Developing and applying mathematical thinking and insight is needed to solve a range of problems in everyday situations. Building on numeracy, with emphasis on process, activity and knowledge, we can develop the ability and willingness to use mathematical modes of thought and presentation (formulas, models, constructs, graphs, charts). Applying basic mathematical principles and
processes in everyday contexts at home and work (e.g., financial skills), is useful for following and assessing chains of arguments, proving and reasoning. It also supports the use of appropriate aids including statistical data and graphs and to understand the mathematical aspects of digitalisation. Positive attitude in mathematics is based on the respect for truth and a willingness to look for reasons and to assess their validity.

The understanding of science as a process for the investigation through specific methodologies, including observations and controlled experiments, and with the ability to use logical and rational thought we can verify a hypothesis and the readiness to discard one’s own convictions when they contradict new experimental findings. By using technological tools and machines and scientific data, we can achieve a goal or reach an evidence-based decision or conclusion. These competences help us to recognise the essential features of scientific inquiry and have the ability to communicate the conclusions and reasoning that led to them.

HOW? Competences in sciences are needed for conserving new technics, to create land links. Using a Place (or situation) -based learning, we link content to local land and place, to lessons from real life.

Developing an attitude of critical appreciation and curiosity, a concern for ethical issues and support for both safety and environmental sustainability, and the scientific and technological progress in relation to ‘Me’ (oneself), ‘We’ (family, community, organisations), and ‘All’ (global issues, the environment).

A dynamic set of relationships containing vast schematics, knowledge systems and intellectual processes can guide and enrich education systems and curricula.

For science, technology and engineering, essential knowledge comprises the basic principles of the natural world, fundamental scientific concepts, theories, principles and methods, technology and technological products and processes, as well as an understanding of the impact of science, technology, engineering and human activity in general on the natural world. These competences should enable individuals to better understand the advances, limitations and risks of scientific theories, applications and technology in societies at large (in relation to decision-making, values, moral questions, culture, etc.).

III.8. Significant competences to reach a New Equilibrium

Multilingual competence (C2) is the ability to use new languages appropriately and effectively for communication. We see one of its main importance when implementing new concepts in the traditional well-operating way of working, so moving from Operationalisation to a new Equilibrium.

WHY to develop this competence? A positive attitude is necessary to make any change. Accepting the new ways of working requires appreciation, cultural diversity, an interest and curiosity and communication. It also involves respect for other persons, belonging to any background.

HOW to develop this competence? From the Eight ways of learning, we recognise the use of community links to practice and further develop the Multilingual competence. Community links is about the centrality of relationships to the development and acquisition of all knowledge, centring local viewpoints, bringing new knowledge to the organisation and applying learning for community benefit.

A new Equilibrium will only be reached when we connect it to the system of information and relationships, today with the support of information and technology. It leads to a specific insight on learning for people behaviour, their role in organisations and their contributions in reaching for a better world.
IV. THE ROLE OF INFORMATION AND A PROPOSED SOLUTION

The role of information is inevitable in current society. We can distinguish information as crucial for knowledge transfer (1) and facilitating cooperation in solving well-defined understandable problems (2), or challenges without known characteristics (3). The ACoR model identifies these roles of information and link it to our insights for education and learning.

![Figure 7: Different focuses of education in different situations](image)

Knowledge transfer, the good old way of learning is getting outdated in a world where information is easily accessible. Everyday challenges are easier solved in cooperation, exchanging information, knowledge and insights, while unknown problems make us explore new insights by combining knowledge.

An intelligent information system can handle these focuses and changes and facilitates learning in the changing environment. We call this tool the Adaptive Cycle iSolution, consisting of four elements (Abcouwer & Takács, 2018; Abcouwer et al., 2018):

1. (KSB) Building up a knowledge base with stakeholders considering ‘Me-We-All’, including their priorities and needs, collecting available information and best practices facilitates knowledge transfer throughout the world.
2. (CI) An innovative communication infrastructure facilitates the exchange of knowledge between partners.
3. (MI) Providing opportunities to enhance the marketability of people via tools and resources for traditional and self-education supports competence development and with digital innovation methodologies facilitates co-creation.
4. (CC) Engaging active dialogue with others to identify future needs and facilitate co-creation to develop new insights for unknown future requirements.

The requirements for education are changing while the general structures in our educational systems rear rolling. We indicate the relevance of these issues by returning to the identified characteristics (see figure 1) of the challenges of today.

**Dynamic**, as highlighted by the Adaptive Cycle of Resilience stressing that any new solution would probably lead to the initiation of a new challenge, as disruptions keep arising either internally or outside the system. The cyclical aspect of consecutive challenges is one of the main reasons for the need for flexibility in education. Based on this, learning is also a continuous concept.

**Open**, because of the relevant probability for determining the solution for the appearing problems. Regarding the availability of solutions, Gigerenzer (2014) identifies three forms of probability: Certain, Risk and Uncertain. In case of certainty, exact solutions are possible. Risk arises when there are several solutions and it is hard to make the right choice, and there is also an unpredictability regarding the outcome of the countermeasure. We face uncertainty when the nature of the problem, the solutions, the impacts of any countermeasure are all unknown, and the knowledge necessary to find a solution is neither known. It requires openness to find solutions to open problems, and information and education should adapt to that.
Complex challenges require a variety of knowledge to find a fitting solution (Chandler, 2014). Regarding the required competence and expertise, we can distinguish between the ACoR phases (see figure 7). Due to unpredictability, people need to trust their creative capabilities and sometimes Do first, instead of Think-first. Educational requirements are more difficult, but an iSolution system could be a solution.

Networked, because dealing with uncertain challenges require flexibility and adaptive capabilities up to a great extent. A single person or a single organisation is less and less able to deal with today’s challenges (Rehm et al., 2016).

Using the iSolution in different ways may support linking and networking the available knowledge and information to deal with any of the identified challenges in any ACoR stage.

In Equilibrium (left in figure 9) and Operationalisation, the iSolution support us to check competent people: MI (1) to work with: CI (2) and cooperate in the solutions: CC (3). Facing the Challenge and figuring out New combinations (right in figure 9), iSolution helps looking for solutions: CC (1), communicate them: CI (2) and work with them with competent people: MI (3). Moving from certainty to risk or from uncertainty to certainty (see the middle part in figure 9) we communicate the issue: CI (1), find people: MI (2) to work with: CC (3). Such a tool can be a very helpful educational solution for networked, dynamic, complex and open challenges.

V. CONCLUSION

We recognise that single challenges do not exist, so solving problems one by one will not lead to sustainable solution. ACoR shows the ever-changing circumstances phase by phase, with skills, competences, learning styles to handle them appropriately. We see how complex it is to live with and manage changes and how important information management and education are. Just like intersectionality, we must consider different aspects and look at problems with a broader view to identify competence development opportunities for everyone. When decisions consider all stakeholders, ‘Me-We-All’, - “Me”: the People, “We”: the organisations and “All”: the society or our environment, - they can intersect to reach resilience, sustainability in dynamics (Abcouwer, Takács, Schilstra, et al., 2022).

Intersectionality also teaches that differences need to be accepted and included. The iSolution platform facilitates the exchange of knowledge, find the required expertise and cooperate for solutions. A sustainable society for everyone requires acceptance, trust and a broader view of reality than only for the privileged ones. Information Systems, Education and Research are key for competence development to deal with constantly changing challenges.

In this discussion paper, we showed a way to understand change, the required competences and educational focuses. The combination of the used concepts along with our experiences served as a starting point for discussion and needs follow-up research.
REFERENCES


Abstract:
Efficient data management and lifecycle strategies are critical for online educational platforms to maintain content quality, avoid redundancy, and ensure long-term viability.

This research studies the challenges of an online educational platform managing its database system while maintaining data ownership and a clear structure. We identified the need for strategies to prevent redundant content, the use of non-relational databases for managing educational content’s lifecycle. Data lifecycle management, long-term data practices and determining responsibilities have emerged as critical components of effective data management.

The findings help to develop a comprehensive data lifecycle management strategy for online educational platforms, improve content quality, reduce redundancy, and realize long-term, sustainable data management effectiveness. They highlight the importance of incorporating non-relational databases into the platform to track changes, maintain data integrity, and inform content updates. Developing a save-state mechanism and establishing ownership and responsibility frameworks ensure data consistency and content duplication.

Keywords: Data Management, Data Lifecycle, Online Educational Platforms, Temporal Databases, Redundancy Prevention, Data Integrity, Ownership and Responsibility

I. INTRODUCTION
Since the beginning of this century, there has been a growing interest in sustainability and the circular economy. Educational institutes are increasingly incorporating these concepts into their curricula to educate students on their importance and relevance for the future [Brown, 2014]. To facilitate this process, various online platforms have been developed. An example is the sCoolMakers platform, which allows schools and other institutions to create, share, and download lessons on topics such as sustainability and circularity. These terms have gained an increase in popularity over the past decade, due to growing global awareness of environmental challenges, and the recognition of the need for long-term resource management.

The platform aims to address this need by allowing institutes to create and upload lessons that are tailored to their specific needs and preferences. This also means that similar or identical lessons may be uploaded by different institutes, causing the database to become cluttered and difficult to navigate through [Brown, 2014; Korhonen et al., 2018]. While customization and flexibility are valuable to institutes, it can also lead to the duplication of content on the platform and make it difficult for users to find the specific lessons they need. Brown [2014] states that digital education is a powerful tool for promoting sustainability but highlights the importance of designing educational resources in a way that is engaging and accessible to learners. Institutes inadvertently creating almost identical lessons can lead to wasted resources [Brown, 2014].

This raises the critical question of how to prevent or circumvent this problem, to ensure that educational platforms remain useful resources for the users. This research aims to explore possible...
solutions by analysing literature and conducting a case study of the sCoolMakers platform. Our goal is to propose practical and effective strategies for managing lesson content on the platform, while maintaining the flexibility and customization that is valued by its users. We promote sustainability and circular economy in education by ensuring that educational resources are accessible and efficient. We also address the problem of data lifecycle management (DLM), which refers to the systematic management of data throughout its entire lifecycle, starting from its creation until its disposal. The data divided into various phases based on specific criteria progresses through these stages fulfilling many requirements or performs different tasks. An efficient DLM approach offers a well-organized and structured approach to managing a company’s data, leading to improved data security and availability, among other key objectives ["Data Lifecycle Management | IBM", n.d.; Marques, 2013]. DLM plays a critical role in the sustainable and secure operation of online platforms. As the database grows and potentially becomes flooded with similar lessons, it is increasingly challenging to manage and organize the content effectively [Marques, 2013; Zhenjia, 2019]. An efficient DLM strategy can provide a systematic approach to data management, ensuring that it remains well-organized and easily accessible for users. Moreover, data accuracy, consistency, and quality are paramount in the context of an educational platform like sCoolMakers. An effective DLM process helps maintain these qualities throughout the data lifecycle, ensuring that the lessons remain accurate, relevant, and effective.

In addition, sCoolMakers must comply with data protection regulations to mitigate the risks associated with data breaches or loss. As online platforms deal with sensitive educational data, ensuring data security and privacy is essential [Zhenjia, 2019]. By implementing a robust DLM strategy, sCoolMakers can streamline data management, enhance quality, and ensure security, which is crucial for long-term success. Therefore, DLM is of paramount importance for sCoolMakers, enabling the platform to effectively manage and secure its data while ensuring accuracy and relevance throughout the data lifecycle.

This paper will look into already existing literature on topics we thought useful, after which stakeholder interviews are discussed. Based on the outcomes of both researches, a framework is formulated and tested, and its limitations discussed.

II. THEORETICAL GROUNDING

We reviewed theories in three aspects: [1] Temporal databases and save-state mechanisms, and [2] data lifecycle management, and then identified knowledge gaps [3].

TEMPORAL DATABASES

A temporal database stores data with an explicit time component, allowing the management of changing data [Jensen and Snodgrass, 2009], dealing with historical or time-sensitive data. Temporal database management system (DBMS) requires temporal query and data manipulation language and temporal constraints [Steiner and Norrie, 1997]. The data of a temporal database is time-stamped. There are two prominent temporal aspects. The time references may capture either the database’s past or the current states, leading to a transaction-time database; the states of the reality modelled by the data results in a valid-time database; or both aspects creating a bitemporal database [Jensen and Snodgrass, 2009].

Transaction-time databases record the timestamp of the transactions that modifies the data, then associates with the data changes resulted. Valid time denotes the period during a fact is true with respect to the real world. Transaction time is the period during a fact is stored in the database. These two time periods do not have to be the same for a single fact to be true [Steiner, 1998; Steiner and Norrie, 1997].

The two distinct concepts of time - valid time and transaction time - allow to differentiate various types of temporal databases [Steiner, 1998; Steiner and Norrie, 1997]. Historical databases store data in terms of valid time, whereas rollback databases store transaction time data. Bitemporal databases store both valid and transaction time data. Non-temporal DBMS stores only one state of the real world,
typically the most recent one. Such databases are commonly referred to as snapshot databases, see figure 1 [Steiner and Norrie, 1997].

**Figure 1. Depiction of a snapshot database**

Bitemporal DBMS preserve data history both valid time and transaction time. The history of saved data [transaction time] is restricted to past and present database states because it is controlled directly by the system, which has no knowledge of future states. A table in a bitemporal relational DBMS can be a snapshot table [which stores only current data], a valid-time table [which stores data when is valid in relation to reality], a transaction-time table [which stores data when recorded], or a bitemporal table [stores both valid and transaction time] [Steiner, 1998; Steiner and Norrie, 1997]. When creating a table, a more complex version of SQL enables users to define the required type of table. Existing tables can also be modified. It accommodates temporal inquiries, temporal modification statements, and temporal constraints [Steiner, 1998; Steiner and Norrie, 1997].

**Figure 2 [Steiner and Norrie, 1997]** depicts the states saved in a bitemporal database. Of course, a temporal DBMS does not maintain each database state independently. It saves valid time and/or transaction time for each tuple separately.

**Figure 2. Depiction of states stored in a bitemporal database**

Transaction-time temporal databases may also store information about the transaction itself, such as the user executed it or the reason for change [Jensen and Snodgrass, 2009]. This is useful for many reasons. They allow the retrieval of past versions of data, which is helpful for auditing, debugging, or analysing changes to data over time [Steiner and Norrie, 1997; Jensen and Snodgrass, 2009]. They ensure data integrity by providing a complete history of changes to data and allowing the identification of changes made in error [Steiner and Norrie, 1997; Lorie, 1977]. They can track the performance of transactions and identify potential bottlenecks or inefficiencies in a database system [Jensen and Snodgrass, 2009].

In the context of the sCoolMakers platform, temporal databases may be useful to provide a means to store and manage data that changes over time, like the stored educational classes. They could track changes made to the lessons by different schools by implementing a temporal database, ensuring that it contains a complete history of all versions of each lesson. This allows users to access and compare different lesson versions without creating multiple copies of the same content, which would clog the database and make it difficult to use. [Jensen and Snodgrass, 2009].
However, implementing a transaction-time database will not solve all the issues. To address the problem of similar contents, developing a save-state mechanism can be a solution [Lorie, 1977]. It ensures that the database remains in a consistent state by detecting and correcting inconsistencies in real-time [Lorie, 1977]. It prevents the flooding of identical content by maintaining a transaction-time database that captures past and current states [Lorie, 1977]. Whenever a new lesson is added or modified, the save-state mechanism can be triggered to detect and correct inconsistencies in the database [Jensen and Snodgrass, 2009].

DATA LIFECYCLE MANAGEMENT

Data - information, facts, statistics, or figures that can be collected, stored, and analysed to gain insights and make informed decisions - is an essential component of our modern society. Data collection is the systematic process of gathering observations or measurements. Data is used in a variety of fields, including business, healthcare, finance, and education, to name a few. It can assist organizations in making more informed decisions, understanding trends, identifying patterns, and solving problems.

As data is becoming increasingly important in many industries, so does managing them. In higher education ecosystems, it is essential that the data within and its life cycle is properly managed [Sant-Geronikolou, 2018]. As libraries are abandoning their old norms and traditional structures, new ideas and breakthroughs are required to create new practices [Anglada, 2014]: building accurate knowledge about user behaviour for improving existing services or create new ones, reshaping data collection procedures in libraries to provide rigorous, transparent, and reliable data for efficient and trustworthy service evaluation; and investigating novel approaches to capitalizing on these procedures within a broader educational context [Sant-Geronikolou, 2018].

Content sustainability proper data lifecycle management [DLM], the process of managing data throughout its lifecycle, including its creation, storage, maintenance, use, sharing, and eventual disposal - is vital in new libraries. It ensures high quality data, managed and protected properly, and complies with legal and ethical requirements. Effective DLM necessitates the use of appropriate technologies, policies, and procedures, and the participation of stakeholders throughout the data lifecycle. DLM should either be a shared responsibility between both users and hosts, or could potentially be outsourced, depending on the context of the entity.

Data is a valuable asset that organizations rely on to make informed decisions, so ensuring its sustainability is critical. Sustainable data management practices help ensure that data is accurate, reliable, and trustworthy, reusable and effectively shared. Long-term DM practices reduce the risks of data breaches, data loss and data misuse.

Libraries' sustainability is assessed using the relationship established between the values added and their costs. Anglada [2014] analyses this relationship and proposed a ‘sustainability formula’, seen in figure 3, to figure out whether the data that is stored sustainably or not.

\[
\text{Sustainability} = \frac{\text{Value}}{\text{Cost}} = \frac{\text{Use} - \text{Dysfunctions} + (2 \times \text{Perception})}{\text{Cost}}
\]

Figure 3. Anglada's Sustainability formula

Two of the formula's elements, costs and use, are self-explanatory, but including 'perception' and the weight assigned to it must be justified. Anglada [2014] states that cognitive biases or prejudices are not always grounded. Dysfunctions are ‘unfulfilled expectations’ [Anglada, 2014]; a gap between expectations and reality.

The formula originally supported the argument of physical libraries replaced by their digital counterparts [Anglada, 2014; Sant- Geronikolou, 2018] but can be applied to their contents, too. Applying the first half of the formula to data, we gain new insights on data sustainability, and thus essentiality to remain in the database. Considering the relationship between the value of the data (e.g. what unique information does the data store) and the cost of the data (e.g. size of the data in regards to storage waste) is vital.
The valuable data asset of online educational platforms like sCoolMakers, create, deliver, and improve educational content. Because of this, we believe these platforms can be seen as their own libraries, full of content that should adhere to the same formula. Implementing effective DLM practices ensure the platform’s success and address challenges of maintaining data flexibility, ownership, and structural integrity.

sCoolMakers manage data at various stages of its lifecycle. It creates educational content, stores data, maintains, shares and updates them with other parties, and disposes them when outdated or irrelevant. Each stage must be managed properly to ensure data availability, quality, and compliance with relevant regulations and guidelines.

KNOWLEDGE GAPS

There are no explicit knowledge gaps related to strategies for preventing redundant content on the sCoolMakers platform based on the text on temporal databases. The text primarily focuses on the concept and characteristics of temporal databases, including valid time and transaction time definitions and temporal database types. However, one potential knowledge gap related to the use of temporal databases could be to investigate how temporal databases can be used to manage the lifecycle of educational content on the platform. How to track changes in educational content over time and ensure that outdated or redundant content is removed from the platform to avoid duplication, or how temporal databases can be used to analyse educational content usage on the platform and inform decisions about content prioritization for updates or revisions.

Incorporating a temporal database into the platform can be useful for tracking changes of educational lessons over time. It can ensure data integrity; assist detect errors and improve database performance. A save-state mechanism, however, can be developed and integrated into the database to avoid the flooding of similar content. This can detect and correct inconsistencies in real-time, ensuring that the database maintains consistency while capturing changes made by various schools. However, implementing these mechanisms require responsibility to work for sCoolMakers’ and the end users’ needs.

Conducting exploratory interviews with experts in [temporal] database design is key to solving these knowledge gaps.

III. METHODS

HEVNER DESIGN SCIENCE RESEARCH MODEL

Hevner model [Hevner et al., 2004; Hevner, 2007; Hevner and Chatterjee, 2010] is a framework for designing and evaluating information systems research. It emphasizes the importance of the design science paradigm, which involves iterative cycles of designing, implementing, and evaluating information systems. It is applied in a variety of contexts, including e-learning, healthcare, and supply chain management [Hevner and Chatterjee, 2010; Maiztegui, 2023]. Its main objective is to create knowledge that experts in the relevant field can use to create solutions for practical problems. They concentrate on the decision-making process for feasible and useful construction of potential futures. Hevner’s design science research cycle [Hevner and Chatterjee, 2010] goes through three different cycles, giving unique insights for creating and designing an artifact as shown in figure 4 [Hevner, 2007].
Using this IS research framework, we incorporate a focus on three essential research cycles. The Relevance Cycle serves as a link between the design science activities and the context of the research project. The Rigor Cycle acts as a link between the design science activities and the body of knowledge, experience, and expertise that underpins the research project. The main activity of creating and assessing design artifacts and research processes is iterated upon during the framework's central Design Cycle.

The Hevner model is used to guide the development of instructional design models and to evaluate the effectiveness of e-learning interventions [Maiztegui, 2023]. The design science paradigm is particularly relevant in the context of e-learning, where the design of effective online educational resources requires iterative cycles of design, implementation, and evaluation [Hevner and Chatterjee, 2010; Maiztegui, 2023].

For practical applications, the model is used to guide the development of strategies for managing online contents, such as sCoolMakers. The iterative cycles of designing and evaluating its database with a focus on data lifecycle management can provide a framework for developing and testing strategies for preventing identical or redundant content, still allowing the customization of lessons to meet the needs of users. This way, we can potentially improve the quality and accessibility of sustainability education.

This method was used in the cycles below, where firstly stakeholder interviews were conducted (environment), and together with the theoretical grounding (knowledge base), a framework was designed.

IV. FIRST DESIGN CYCLE

HISTORY

The origins and problems of the sCoolMakers platform influenced our design choices. The first interview with a key figure in the development of its database emphasized the platform's mission. "Our primary goal is to provide schools with a user-friendly platform that facilitates knowledge sharing on sustainability and circularity." The dedication to empower sustainable education has been the driving force of the evolution of sCoolMakers.

One of the key strengths of sCoolMakers lies in its flexibility, allowing institutes to customize lessons according to their unique needs and preferences. "We wanted to offer institutes the flexibility to tailor the lessons according to their specific needs and preferences." This approach empowers schools to deliver content that is relevant to their students and addresses their specific curriculum requirements. This customization causes content duplication. Multiple versions of similar or identical lessons uploaded by different institutes, clutter the database, hindering users' ability to find the specific content they seek.

sCoolMakers uses Bubble.io, a no-code development software that allows building diverse applications without the use of traditional coding. The default structure and functionality of Bubble's databases did not perfectly correspond with the requirements of sCoolMakers. "We needed a more robust system to handle the customization and avoid content duplication.", indicating the need for a more powerful mechanism to handle modification and eliminate duplicate content. Prewritten codes and styles make users relying on Bubble software and the fully customized program runs into issues. Despite the obstacles, sCoolMakers remains committed to providing a unified user experience. The developer stated, "We are actively exploring potential solutions to improve the database and eliminate content duplication." sCoolMakers hopes to improve the platform's user experience by addressing this issue, saving time and providing simple access to relevant content.

Bubble.io appears to be a suitable software for building a small application that may only display information or have a minimal UI, especially for those who lack skills in programming. Bubble's simplicity and instructions are helpful, but when the goal is to construct a larger, more complicated, customizable application, it is advisable to reevaluate its suitability and explore more bespoke alternatives.
PROLIFERATION OF IDENTICAL CONTENT

The second interviewee, a database architect, suggested to tackle the problem by creating a ‘Make your own menu’ restaurant type database, a complex multi-layered application.

![Figure 5.](image)

Construction of the ‘Make your own menu’-restaurant type database

Its hefty disadvantage is the lack of dynamic freedom. "It forces a structure that may work well in certain cases but adding 'addable content' may not solve the problem. We don't know how this content will look, or the created menus solve things in a dynamic way. It is a 'solution', but not a practical one."

Due to this major risk of losing flexibility, ideating other solutions, DBMS could make use of reflective programming, a technique that allows a code to manipulate itself during runtime, flexibility and less code duplication. A non-relational DBMS is a more complex solution and infinitely expandable.

By storing it in a format such as XML, JSON, TOML, or, if necessary, a document-oriented database, the problem can be approached in a more flexible manner. Data can be structured on a case-by-case basis, with a general overarching structure established by using fixed tags within an XML specification. This structured data can then be processed in the business layer to create a user-friendly product. "Adopting this approach allows for the easy assembly of lessons through an internal conversion process that can rely on POCO, POJO, POPO, PORO, etc." This approach offers the advantage of enabling the implementation of elegant solutions using Design Patterns and Reflection [Reflective Programming], which can subsequently be passed to a presentation layer.

Because the data is stored and structured in a more flexible matter with adding tags, it is possible to add and store tags together. This, in turn, can create one ‘older’ file per lesson with a bonus of creating a lesson and a reference or path to its parent file. Extra lessons can be created, which is done by writing additional parsers within the business layer.
For each sCoolMakers topic there is a main lesson, acting as a skeleton: a bareboned shell with a basic content. The remainder of the main lesson consists of different pieces of content, created by either the creator of the main lesson or the corresponding sub-lessons. These blocks need labels and tags. If other parties want to use the lesson or its pieces, they can customize and build upon the original, whilst the main lesson stays the same. These sub-lessons will exist of only specific pieces of content of the main lesson and can add new pieces. Instead of changing the original content block, it would result in the creation of a new one. This way, the main lesson and the sub-lessons are independent.

The problem of this solution is the dilemma how to balance the scales of content. The platform could allow practically infinite amount of options for users, where everyone can customize their own lessons into the finest of details. However, this would result in an abundance of data points, which would be near impossible to maintain [with current technologies]. To resolve this problem, the platform needs to limit the amount of data points the user can create and access. This would of course result in less flexibility for the user but an important balance to figure. Does sCoolMakers want more flexibility at the cost of data management, or would they rather lessen the dynamic experience to minimize the management of data?

**DATA MANAGEMENT**

To determine which way the scales of balance tip, it is critical to gather additional understanding on data management of online education. The next interview focused on the question how to effectively manage the retention and deletion of outdated content while ensuring that relevant content is maintained.

Given how important flexibility is to sCoolMakers, limiting the number of data points users can use seems contradictory. “Finding the right balance is key. By defining specific criteria for identifying outdated content, such as relevance, accuracy, and curriculum changes, [sCoolMakers] can establish guidelines for whether content is still relevant. Once content no longer meets these criteria, it should be flagged for review or deletion.”
Creating the criteria and acting on them are difficult tasks, especially when dealing with massive amounts of data. A suggested automation through artificial intelligence algorithms or machine learning models can assist identifying information that requires inspection based on the criteria. Algorithms can assess the relevance and quality of material by analysing characteristics such as content usage, user comments, and metadata. This would aid in identifying and prioritizing older materials for review or removal.

Another approach was suggested, one which ensures that sCoolMakers' valuable and up-to-date content is preserved while outdated content is appropriately managed. It's essential to engage the platform's user community in this process. "Encouraging users to flag outdated or inaccurate content, providing a reporting mechanism, or implementing a user-driven content review system can be effective." By implementing a community-driven moderation system, the criteria of whether data is still relevant or not are put up by the user's. Additionally, sCoolMakers could establish a team of moderators or subject matter experts who regularly review and curate the content. This approach would help maintain the platform's integrity and ensure that relevant and reliable content is preserved. This method could be properly deployed if the amount of data is not overwhelming.

sCoolMakers must find a balance between allowing maximal flexibility to users and ensuring effective data management. "One approach to addressing this challenge would be to limit the number of data points users can create and access. By establishing realistic restrictions, the platform may save a manageable amount of data while still allowing users to significantly tailor their lessons." This strategy recognizes the significance of data management while still allowing users some flexibility. A moderation crew could handle all the content, while the platform controls the amount of data.

It is ultimately up to sCoolMakers' developers and administrators to determine the optimum balance of flexibility and data control. They must measure the benefits of personalization against the challenges of data management and examine the trade-offs. Finding a solution that fits the demands of both users and the platform itself is critical. By striking this balance, sCoolMakers will be able to provide a dynamic and personalized experience while maintaining good data management within the present technology restrictions.

Another major aspect raised during the interview was the matter of ensuring compliance with data privacy standards and preserving user data throughout the DLM process. "Data privacy and security are paramount in today's digital landscape." It was suggested that sCoolMakers employ strong data protection measures, such as encryption of sensitive information, role-based access controls, and frequent audits to ensure compliance with relevant data protection standards. sCoolMakers should establish clear and transparent policies surrounding data retention and deletion, and seek for informed consent from users, giving them control over their data.

NEW CONCEPTUAL FRAMEWORK

sCoolMakers provides a user-friendly platform for knowledge sharing on sustainability and circularity in schools. Currently it uses a less robust system. Switching to a more powerful one is required to handle customization, eliminate content duplication, and provide greater dynamic freedom. Improving the database will also enhance the user experience, save time and simplify access to relevant content.

A main lesson for each topic should contain essential facts and necessary information with labelled and tagged content blocks. By associating the main lesson with the content, users are free to create and add their own lessons to it. Users could tailor lessons according to their specific needs and preferences, empowering them to deliver relevant content aligned with their curriculum.

Finding a balance between flexibility and data management, sCoolMakers should establish specific criteria, such as relevance, accuracy, and curriculum changes, to identify outdated content. Content that no longer meets the criteria should be flagged for review or deletion with user-driven content reviews. Users should be encouraged to flag outdated or inaccurate content, report issues, or participate in a user-driven content review system. The criteria for content relevance can be determined by the active community of users with their input playing a significant role.

However, merely managing the existing content will not be enough to manage the data effectively in the long run. sCoolMakers should apply some realistic restrictions on the number of data points users can create and access.
V. SECOND DESIGN CYCLE

For the second design cycle, the new conceptual framework was verified with another expert, who has had years of working experience with content management and data engineering.

CONFIRMATORY INTERVIEW

The confirmatory interview was positive with the proposed system. It was mentioned that there is a need for a more robust system to handle customization, eliminate content duplication, and provide greater dynamic freedom. The idea of a non-relational DBMS combined with reflective programming and a flexible storage format was found to be a viable option. “It allows for a more adaptable and expandable approach while minimizing data duplication.” However, further consideration and evaluation may be necessary to assess the feasibility and implementation details of this solution.

The main critique was on the data management section of the framework. Merely allowing users to manage the data will not be an effective strategy in the long run. “In general, you lack a clear data governance strategy. You mention allowing the users to manage your data for you, but I do not think this is a scalable solution.” Furthermore, there is currently an absence of discussion on data analytics and insights. How will it be decided what data is truly not relevant anymore? “Data quality management involves processes such as data cleansing, validation, and monitoring to ensure the accuracy, completeness, and consistency of data.”

We were given plenty of suggestions on how to circumvent some of the difficulties, ensure effective data management, and recommended to develop a comprehensive data governance framework that outlines data quality standards, data ownership, roles, and responsibilities. Additionally, implementing data stewardship programs can help foster data accountability and enforce data governance policies. There should be clear limits to the amount of data. To ensure the accuracy and completeness of incoming data, they recommended to implement data validation rules and checks during data ingestion. Regularly conducting data quality audits and performing data cleansing activities can help identify and rectify any data inconsistencies. In addition to this, proper data integration architecture should be implemented. “Steps such as the cleaning, filtering, transforming and allocating of the right data are all important to data integration. Especially if you are working with content made by users themselves, how will you make sure all users submit the same quality of data?”

There should be a focus on data privacy. “As you deal with user-generated content and potentially sensitive data, it is essential to have a strong focus on data privacy and security.” There are many difficulties with data privacy, such as how user data will be protected, secured, and managed to comply with relevant data protection regulations. To protect sensitive user data, it is critical to develop and enforce strong data privacy policies and procedures that comply with applicable regulations. Managing this would ensure that data handling and processing adhere to legal requirements and best practices. “Implementing strict access controls, encryption techniques, and data anonymization methods should improve the security of sensitive user data. These safeguards can help to prevent unauthorized access and safeguard individuals' privacy.” Also, conducting regular security audits and penetration testing will allow for a proactive identification of vulnerabilities in the data management infrastructure. Potential security risks can thus be detected and addressed quickly, ensuring a high level of data security.

FINAL CONCEPTUAL FRAMEWORK

Based on these inputs, we expect a solid advice for sCoolMakers and potential other platforms who are facing the same issues.

For sCoolMakers’ DBMS, as suggested, each topic should be accompanied by a main lesson that serves as a foundational structure with limited content. The existing content in the main lesson is accurate and relevant. The remainder of the main lesson is made up of various content blocks that can be created by either the creator of the main lesson or the creators of the corresponding sub-lessons. These content blocks must be labelled and tagged appropriately. Other parties can customize and expand on the original lesson while leaving the main lesson unchanged. These sub-lessons include specific content blocks from the main lesson as well as new content. Instead of changing the original content block, changing it would result in the creation of a new one. This method ensures that the main lesson and sub-lessons remain distinct from one another. Because the sub-lessons are built with specific content blocks, even if the main lesson changes, the content blocks within the sub-lessons remain unaffected.
A proper data governance system, where both the integration and quality management of data is warranted, establishing a suitable data management lifecycle are necessary to map out a series of well-defined steps, like appropriate guidelines for quality standards, data ownership and responsibilities, an effective data integration architecture, scalability and privacy policies with procedures.

VI. DISCUSSION

The conceptual framework developed in this study provides useful insights and recommendations for sCoolMakers and other educational platforms looking to improve their content management and data governance. Platforms can improve customization, ensure data quality, and prioritize data privacy by implementing the suggested approaches, ultimately providing a better user experience and supporting the mission of knowledge sharing on sustainability and circularity in schools.

The design science research conducted in this research has more applications than that of ScoolMakers and can be applied to a wider audience. For example, information system educators and researchers could use this research design as a way of showcasing the importance of stakeholder engagement, and to identify gaps within artifacts.

It can close the education gap and increase access to high-quality educational resources. The platform's ability to customize and localize content allows it to meet a wide range of educational needs, including those of poverty-stricken communities or regions with limited educational resources. This can help to reduce educational disparities and promote equal opportunities for all students.

The proposed platform improves the learning experience and empowers individuals to become lifelong learners by encouraging educators and students to actively contribute and share their expertise. It can foster a growth mindset and a lifelong pursuit of knowledge, skills, and personal development outside of formal education.

Educational platforms foster digital literacy and 21st-century skills among educators and students. Users gain digital competency, information literacy, critical thinking, and problem-solving skills by creating and customizing content. These abilities are critical for thriving in the digital age and preparing individuals for the demands of today's workforce.

We emphasise collaboration and knowledge sharing aids in the development of a collaborative culture within the education community and foster a sense of collective intelligence and shared ownership of knowledge by encouraging educators and students to contribute and build upon existing educational content. Collaborative culture encourages cooperation, empathy, and a sense of community, ultimately improving the learning experience.

Customization and expansion of educational content within the proposed framework encourages educators and students to be innovative and creative. The platform encourages creative teaching approaches and allows learners to express their ideas and insights in unique ways by allowing them to adapt lessons and content blocks. This creates an environment that encourages creativity, problem-solving, and the exploration of alternative learning paths.

One key part both we and the creators behind sCoolMakers find essential, is that the use of educational platforms crosses borders, allowing for global knowledge exchange and cross-cultural learning. Educators and students from all over the world can contribute, access, and benefit from a diverse range of educational content by leveraging the framework's capabilities. This fosters cultural understanding, intercultural communication, and appreciation for diverse viewpoints, resulting in a more interconnected and globalized society.

Our research bridges the gap between theoretical concepts and practical application in educational technology and using the Hevner model, the study provides a solid theoretical foundation by grounding the research in existing literature and theories on content management, data governance, and educational design. It provides practical recommendations and guidelines for implementing the proposed framework by incorporating real-world challenges and stakeholder perspectives.

The scientific impact of this study is that it advances educational technology research, bridges theory and practice, informs best practices in platform development, and opens avenues for future research. This study promotes evidence-based decision-making, fosters interdisciplinary collaborations, and drives innovation in the field of educational technology by contributing to the scientific knowledge base.
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ABOUT THE AUTHOR

Jonathan Hombroek is a Master's student at the University of Amsterdam. He has a Bachelor’s degree in Information Sciences and is now pursuing a Master’s degree in Data Science, both at the University of Amsterdam. His interests lie in the field of Information Systems and Machine Learning.
PANEL DISCUSSION: IS LEADERSHIP EDUCATION FOR DIGITAL TRANSFORMATION: EFFECTIVENESS IN ENTERPRISE ARCHITECTURE AND SOFTWARE DESIGN

Yoshimasa Masuda  
Carnegie Mellon University, Pittsburgh, USA / Tokyo University of Science, Tokyo, Japan  
Graduate school, Keio University, Yokohama, Japan  
ymasuda@andrew.cmu.edu

Scott Bernard  
Carnegie Mellon University, Pittsburgh, USA / Syracuse University, New York, USA  
sbernard@andrew.cmu.edu

Rashmi Jain  
Montclair State University, USA  
jainra@mail.montclair.edu

Stephane Gagnon  
Quebec University, Canada  
Stephane.Gagnon@uqo.ca

Ivar Jacobson  
Royal Institute of Technology, Essence, Sweden  
ivar@ivarjacobson.com

Abstract

The number of digital startup companies increased while many global companies has proceeded with Digital Transformation for a decade. This panel is related to the education for the practice of IS Leadership roles in Digital Transformation with a given framework of Digital Strategy and Enterprise Architecture. As members of education and collaborative research teams that have been studying and teaching the correct direction of IS leadership roles under Digital Transformation in global organizations while applying Enterprise Architecture (EA) Framework – the "Adaptive Integrated Digital Architecture Framework (AIDAF)" with Holistic EA Framework, the panelists understand that the above roles have difficulties during Digital Transformation. Thus, the panelists will discuss the theory, practice, and extent of educator’s precise guidance in the leadership roles and correct directions in Digital Transformation. This panel of senior IS educators, researchers with industry, government experience will discuss the effectiveness of “IS Leadership Education with Digital Transformation, EA and Software Design” in the new era of Digital IT.

Keywords: Digital Transformation, IS Leadership, Enterprise Architecture, Software Architecture, IS education.

Introduction and Discussion Topics

A number of digital startup companies appeared these days, where structure and functions need to address the digital business environment and holistic EA can be focused them of an organization throughout the lifecycle of startup (Bernard 2020). Many global companies have undertaken enormous changes in response to dynamic economic environments, such as the progress of new disruptive technologies, big data, globalization, shifts in customer needs, and new business models (Masuda, et al. 2021). Digital Transformation is the key driver for companies to align their Digital IT Strategies for leveraging the above-mentioned technology trends. However, existing leadership talent and skillsets should be enhanced to new global leadership capabilities for driving the digital transformation, to cope with the diversity and complexities in global societies and ecosystems (Ernest Gundling 2011).

In this panel, we propose and discuss the approach to educate desirable leadership skills and behaviors that can lead EA and Software Design under Digital Transformation successfully. Moreover, since last 3 years, the COVID19 virus had spread in the world and increased demands for digitalization. Therefore, this panel can contribute to improved understanding of leadership education demands for undertaking EA and software design in digital transformations and helping realization of digitalization in global enterprises.
The purpose of this panel is to debate the theory, practice, and extent of educator’s considerations when performing leadership roles and studying their directions during Digital Transformation. This interactive panel discussion will assess various kinds of educational and professional ideas critically. Experienced and knowledgeable IS researchers and educational practitioners with diverse backgrounds covering global companies and government will participate and share their personal experiences and ideas.

**Panel structure**

This panel on senior IS educator and practitioner perspectives is a part of panels at SIG Education in ICIS2023, for the purpose of providing a multi-stakeholder perspective on these topics, that explores the effectiveness of the “EA and Software Architecture for Digital Transformation with IS Leadership Education.”

Yoshimasa Masuda will chair a panel of senior IS educators, researchers and practitioners who will discuss the effectiveness for these IS-related educational practices, and for future graduates to get insights for the new era of Digital Transformation. The panelists and their perspectives are:

- Scott Bernard, Faculty, Carnegie Mellon University, USA
- Stephane Gagnon, Faculty, Quebec University, Canada
- Rashmi Jain, Faculty, Montclair State University, USA
- Ivar Jacobson, Faculty, Royal Institute of Technology, Essence, Sweden

The chair will start with sharing the needs to address questions by each panelist from the standpoints of their global and local situation or academic position covering the following items. We will ask the above panelists to comment on the following topics:

1. How can the IS Leadership education covering Digital Transformation, EA and Software Design use digital IT technologies, AI related analytics and platforms in innovative ways?
2. What kind of effectiveness and challenges are shown in these education programs when teaching in international class across institutions to ensure sustainability and ethics in long-term learning?
3. What kinds of IS Strategies can contribute to innovation and technological competitiveness in Digital Transformation?
4. What kinds of outcome are expected in software design under Digital Transformation while applying risk management methods and appropriate cybersecurity frameworks there?
5. What kinds of education programs are effective for bachelor or master course in the Digital IT era?

Approximately 25% of the time will be allocated for panelist to share their “opening perspectives” on one or more of the above suggested questions. About 40% of the allocated time will be assigned to discussions among experts. For the remaining 35% of the allocated time, we will embrace the functionality offered by an online live session platform to actively engage participants in offering commentary. Each panelist will present and discuss necessary topics. As appropriate, after the ICIS conference, results of the panel discussion will be posted to share the insights and lessons learned with the broader IS community.

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