

Spaces of Joint Inquiry Through Visual Facilitation and Representations in Higher Education: An Exploratory case study

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DOI: 10.34190/JEL.18.5.001

Abstract: This study investigates how the use of visual facilitation and representations, e.g. visualisations and video productions, combined with peer-feedback sessions can create exploratory approaches to game design in online teaching. The article analyses an iterative game development process in an online learning context. The empirical data is primarily based on an explorative case study of “Games for change”; a course held in 2018 in which master students from the international Nordic Visual Studies and Art Education (NoVA) design games that address issues in society. Throughout the course, the students from universities in Finland, Sweden and Denmark engaged in a cross-cultural collaboration across campuses. The purpose of the study was to explore how to establish an online space for joint design inquiry in the context of ‘games for change’ across time and space as well as cultural and professional barriers. The data used for analysis includes teaching observations, videos of play sessions, photos and visual representations, students’ reflection papers and students’ written and oral evaluations after completion of the course. The analysis is based on different problem-based learning (PBL) activities; lectures, video instructions, presentation- and feedback sessions, reflexive exercises and students’ self-directed design and learning processes in groups. As part of the game course, teachers presented game theory and exercises through videos and visualisations to support the students’ iterative game design processes. The analysis of the PBL activities shows that teachers’ video instructions relating theoretical game concepts to the students’ actual group work supported the introduction to the game field as well as their design processes. The balance between the value of video instructions with specific feedback and teachers’ time for preparation is a relevant issue for further exploration in online teaching. Moreover, findings show that the students’ visualisations and video productions exemplifying game situations created a visible reference point for further discussions in feedback sessions across campuses, which guided game development. Thus, the combination of inquiry approaches, critical game theory and design processes combined with students’ visualisations and video productions provides interesting connections for bridging gaps between cultures and professions, e.g. in art and games. By the rich and visual descriptions of PBL activities, student work and reflective evaluations, the exploratory case study can function as inspiration for applying similar approaches to new local contexts in higher education.

Keywords: visual facilitation, visualisations, online learning, students as designers, design as inquiry, higher education

1. Introduction

This paper revolves around an exploratory case study on the use of visual facilitation and visual representations, e.g. visualisations and video productions, in online game-based learning at universities, specifically for the master program Nordic Visual Studies and Art Education (NoVA). The purpose of the study was to explore how to establish an online space for joint design inquiry in the context of ‘games for change’ across time and space as well as cultural and professional barriers. In a previous research and development project, we have explored the students’ design and learning experiences when adopting a pragmatic inquiry approach (Dewey, 1938) in the process of developing communication designs (Ejsing-Duun and Skovbjerg, 2018). During these iterative processes, the students had the role of designers working with different sketching techniques and prototypes (see e.g. Schön, 1983; Twersky and Suwa, 2009). In this way, an essential part of teaching was for students to materialise their ideas and understandings of a wicked problem and the domain of teaching as well as to obtain feedback from peers and teachers when presenting their materialised ideas (Ejsing-Duun and Skovbjerg, 2018).

Like the former study, in this exploratory case study, students were prompted to adopt a pragmatic inquiry approach in their design processes. The students had an end goal of developing *games for change*, which invites players to relate to a wicked problem and gives players opportunities, awareness and interesting choices in relation to the problem. Unlike our prior research project, the teaching setting for this case study was online, which demanded new ways to create shared spaces for lectures, peer-to-peer presentations, and feedback sessions.

In his book *Teaching in a Digital Age*, Bates (2017, p.260) emphasises new digital opportunities, which he refers to as ‘rich media’, media which “differ in terms of their formats, symbols systems, and cultural values”. Bates

claims that online teaching can incorporate a range of different media: text, graphics, audio, video, animation and simulations. According to Bates, the use of different media allows for individualisation and personalisation in learning, suiting learners with different learning styles and needs. Other studies show that teachers' production of videos and video instructions in online settings affect students' engagement and enable a flexible teaching style suiting learners with different needs (e.g. Wells, Barry and Spence, 2012; Guo, Kim and Rubin, 2014). Furthermore, video produced in an informal setting and with the teacher's talking head as a part of the video are more engaging than slides alone or high-fidelity studio recordings (Guo, Kim and Rubin, 2014). This exploratory case study explored both the teachers' and students' use of visualisations and video productions in an online game-based teaching setting and examined their value in these iterative design processes.

The new ways of creating shared online spaces had a focus on combining inquiry practices with visual practices. As an overall perspective, the concept of *visual facilitation* (Qvist-Sørensen and Baatrup, 2020) was applied to describe and discuss how teachers and students are constantly framing (Goffmann, 1986) the joint online inquiry space through visual representations. Western culture has consistently privileged the spoken and written word as the highest form of intellectual practice and seen visual representations as second-rate illustrations of ideas (Mirzoeff, 2002). In continuation of this perspective, studies argue that for too long, written text has been privileged as a communication form in education, over e.g. visual, kinesthetic and haptic modalities (Bowen and Evans, 2015). By combining inquiry- and visual approaches in this exploratory study, we also want to challenge traditional assumptions about academic practices in higher education.

2. Method and case description

The empirical data is primarily based on a 12-week online game-based learning course as part of Nordic Visual Studies and Art Education (hereafter NoVA). NoVA is a two-year master programme, which educates students in contemporary art and visual culture to achieve an understanding of Nordic practices and traditions in art education and visual communication. The aim is to provide students with relevant competencies and didactical interaction skills to work in cross-cultural and international educational environments. Three Nordic universities provide teaching including Aalto University in Helsinki, Konstfack, in Stockholm, and Aalborg University in Copenhagen. During the master programme, each NoVA student enrolls in the educational programme at two of these universities. The authors of this paper are teachers of the course analysed. Both are employed at Aalborg University, Copenhagen.

Due to the geographical distance, the NoVA master programme is based on a combination of e-learning, face-to-face meetings and a cross-campus symposium each semester. Thus, the concept of blended learning is the foundation of NoVA. Furthermore, the NoVA master programme relies on problem-based learning (PBL) approaches for students to develop 'criticality', meaning emotional, intellectual and practical independence (Savin-Baden, 2003). Moreover, for PBL, the teachers function as facilitators who organise a learning environment, which involves different activities, e.g. instructions, students' self-directed learning, presentations and feedback sessions (Newman, 2005; Bates, 2017). As part of the NoVA master programme, the use of multimodal approaches, including text, images, audio, and videos are central elements to teaching.

This was the context for developing the online game-based learning course (hereafter 'game course') as a part of the NoVA master programme in autumn 2018. The focus of the game course was for the students to use games and game elements to make a change. Prior to the online course in 2018, the course was provided in 2016. During the 2016 course, potentials were observed in the students' productions of visualisations as part of their game design and learning processes. One example was a student from 2016 who elaborated on how she and group members used visualisations and cartoon-like drawings when developing and presenting design ideas online across campuses: "*These visuals travelled through to the project I did make when gamifying an experience (...) we ended up by using visuals as prompts, e.g. collage and cartoon characters.*" The student explained how during collaboration, they discussed the potential of using visuals to engage participants in playful game activities. At the same time, she found it beneficial to use visual notetaking in her own learning and reflection processes: "*It made the design processes much more tangible for me when I was then applying the theory to the project that we were working on together.*" These examples show that the student and her group reflected on their use of visual productions, which indicates great potential. Thus, in the second iteration of the course, we included additional guidance and framing of students' visual productions to explore the potential of these methods in joint online inquiry processes.

As students were asked to adopt the role of game designers, we also consider our role as educators to be designers of teaching (Sørensen and Levinsen, 2018; Ejsing-Duun and Skovbjerg, 2018) when doing educational research. Therefore, the courses from 2016 and 2018 are two iterations in which the teaching has been re-designed based on experiences, and results from this exploratory study will function as inspiration for a new re-design of the course. As mentioned, experiences with the potential of visual productions from 2016 were given even more priority in our didactical considerations for the iteration of the game course in 2018.

Fifteen students attended the game course in 2018, and the data used for analysis included teaching observations, videos of play sessions, students' reflection papers and written and oral evaluations with participants after completion of the course in 2018. Due to the limited data foundation, the purpose of this paper is not to make generalisations about the use of visualisations and video productions in online game-based teaching but to investigate strategies for using visualisations and video productions by both students and teachers to establish a joint online design inquiry. Thus, learning potential and barriers in these online teaching settings were explored.

3. Theoretical perspectives

In this section, the design of the game course is concretised and related to online learning at PBL universities as a theoretical foundation to this approach in education. Furthermore, the pedagogical considerations of staging students as game designers, who materialise their inquiry processes through visualisations and video productions, is discussed. This theoretical section concludes with the notion of visual facilitation and framing, which is relevant when describing how the creative online learning environment is framed by both teachers and students.

3.1 Course content: Critical game design

In order to provide insight into what the students were taught, this section presents the course content. The purpose of the game course was for students to investigate the game phenomenon in relation to their background in art and to explore how game elements can spur change by engaging players in certain issues. As mentioned, the objective of PBL is for students to develop 'criticality' (Savin-Baden, 2003). This was also a purpose of the game course, and therefore it included critical play design (Flanagan, 2013) as a main theme. As Flanagan (2013, p.6) emphasises, 'Critical play means to create or occupy play environments and activities that represent one or more questions about aspects of human life'. Through this lens, students were encouraged to consider game scenarios that could foster questioning and dialogues about issues normally taken for granted (Flanagan, 2013). In line with the concept that to nurture PBL, teaching must be ill-structured, open and real-world orientated (Savery, 2006), we introduced the course by openly asking: *'Games for change!? Let's explore the possibilities of using games and play for change!'*

The course was designed as an iterative design process and joint reflection guided by five different themes: Critical Play - games and activism; Game mechanics; Framing; Place and space; and Participation. In addition to critical play, the game course also introduced 'game mechanics' through the notion of the *endogenous meaning* of games, where interactive structures in games require players to struggle towards a goal (Costikyan, 2002). Accordingly, students should reflect upon the endogenous meaning of games they played in relation to game mechanics. Game mechanics include rules, goals, challenges, struggles, possibilities of interactions and collaborations between players (Costikyan, 2002). Framing was introduced through 'performing disbelief' (McGonigal, 2003) and 'ambiguity' (Gaver, Beaver and Benford, 2003). Theory about place and space included location-based games (Ejsing-Duun, 2011) and 'games for urban exploration' (Pinder, 2005). Participation included how to engage players in games (Jensen and Lenskjold, 2004). Through these five themes, we aimed to set students as reflective game designers using visualisations and video productions as part of iterative game design processes.

3.2 Educational design - visualisations and video productions as inquiry approaches

NoVA students typically have a background in art, design and communication before they join the master programme. Thus, many of the students are familiar with visualisations as part of their work practices; however, the students are in general unfamiliar with theoretical and methodological frameworks for games. Educational studies show that applying visualisation tools and techniques supports design students with an entrance to theoretical fields because it constitutes a familiar way for students to explore and to make sense of situations (see e.g. Bang, Friis and Gelting, 2015). Additionally, a study showed that visualisations support the

communication of design ideas and collaboration (Twersky and Suwa, 2009). Drawings, pictures and other symbolic tools are important elements of the human repertoire for meaning-making, which also form a joint memory relevant for specific practices (Ivarsson, Linderöth and Säljö, 2009). Pink (2007) explains that researchers can use photographs to document experiences and as concrete reference points in dialogues of experiences afterwards. Thus, we consider the use of visualisations and photos are familiar symbolic tools for students to use when entering the game field as well as when investigating and presenting their design ideas. As mentioned in the introduction, the point of departure for the game course was for the students to adopt a pragmatic approach (Ejsing-Duun and Skovbjerg, 2018) when exploring games for change through design. This approach is based on John Dewey's (1938) concept of *inquiry*. Dewey proposes that 'doing' is central to understanding how we think and learn by reflecting on our practices (Dewey, 1938). Donald Schön (1983) brings Dewey's thinking into professional practice by creating language that makes it possible for designers to make their knowledge of their own practice visible. By using visualisations, students can externalise tentative and imprecise ideas in *sketches* (Twersky and Suwa, 2009), leading to a *conversation with materials* and with peers (Schön, 1983) and thus to refinements in their designs.

Facilitators of education (Newman, 2005) are obligated to create a learning environment for inquiry processes and dialogues. Other educational research has focused on organising learning environments that place the *students as learning designers*, where the teachers scaffold students' subject-related inquiry, agency, reflection and learning (Sørensen and Levinsen, 2018). In the game course, the students were encouraged to adopt the role of learning designers when designing games with a specific purpose and target group. To scaffold the students' subject-related inquiry (Sørensen and Levinsen, 2018), we organised exercises where students first adopt the role of gamers, experiencing different digital games and location-based games. Second, the students were encouraged to adopt the role of game designers using their own personal game experiences in the collaborative process of developing a game. This approach was inspired by auto-ethnography, where personal experiences are used to understand different cultural phenomena (Ellis, Adams and Borchner, 2011), in this case games.

The game course was taught online. In this context, we explored how students' video productions can expand the time frame of the students design ideas in addition to their more static visualisations and photos. Specifically, in the students' final iteration of their game design exemplifying the game experiences and narrative of the game, still receiving feedback on their design ideas. Based on prior studies, we advocate for video-sketching techniques (Ørngreen, Henningsen, Gundersen and Hautopp, 2017) where the tentative and unfinished 'sketchy' feeling of the materials (Twersky & Suwa, 2009) is still in focus. Thus, the learning *process* of making video productions is central to developing a game design with less focus on making aesthetic video productions (Ørngreen, et al., 2017). As the focus was students using different media in their inquiry processes, there was also an increasing focus on teachers using visuals and videos when designing online teaching (McKeachie and Svinicki, 2006; Bates, 2017). In order to 'walk the talk', we also engaged in an iterative process exploring the use of visualisations and video productions as a central part of online teaching with an iterative focus on process over product (Guo, Kim and Rubin, 2014; Ørngreen et al, 2017).

3.3 Visual facilitation: framing and creating the online inquiry space

Throughout this paper, the ways visualisations and video productions were applied by both teachers and students to create a joint online space for game design inquiry, are presented and discussed. To describe these applications, the notion of *visual facilitation* is introduced as a way to discuss the dynamic *framing* of the learning environment.

Visual facilitation stems from the concept of graphic facilitation (Hautopp, 2018; Qvist-Sørensen and Baastrup, 2020) which was formulated in the 1970s by a group of organisational consultants in California who used visual techniques and tools in groups to find solutions to complex issues (Sibbet, 2019; Qvist-Sørensen and Baastrup, 2020). Initially, the method was inspired by the way designers and architects utilise visualisations and sketching with clients (Sibbet, 2001; 2008). Visual facilitation is a growing practice internationally (e.g. Blijssie, Hamons and Smith, 2019; Sibbet and Wendling, 2019; Qvist-Sørensen and Baastrup, 2020). In 2019, stories were gathered from 50 leading visual facilitators around the world in the book *The World of Visual Facilitation* (Blijssie, Hamons and Smith, 2019). They are richly cross-disciplinary and practice-based stories but there is limited empirical research in the field, especially related to formal educational settings (Hautopp and Ørngreen, 2018).

Visual facilitation that “uses visual representations to facilitate interaction in a group of people using structured visual content” (Qvist-Sørensen and Baastrup, 2020, p.20) was included to facilitate the joint online space for game design inquiry. Thus, our purpose was to apply visual facilitation to a formal educational setting: the NoVA game course.

Blijssie, Hamons and Smith (2019) emphasise three main strategies of visual facilitation: 1) Draw live, 2) Use templates and 3) Get a marker in people’s hands. In this case study, the focus was not on drawing live as part of the game course as much of the activity was asynchrony. Instead, we created visual templates for the students to act upon, and we encouraged them to draw and to produce visual materials to capture, develop and present their design processes and game design throughout the course. This is in line with the pragmatic approach of the students testing ideas and reflecting upon their practices (Ejsing-Duun and Skovbjerg, 2018). Thus, we argue that the use of visual facilitation strategies can make design processes more explicit and can prompt reflection on the domain of inquiry: here, games as agents for change.

Visual facilitation is originally facilitation with the structured use of pen and paper (Sibbet, 2001; Qvist-Sørensen and Baastrup, 2020), but technology is mentioned as providing “new means to draw, adjust and share our drawings with one another” (Qvist-Sørensen and Baastrup, 2020, p.17). As the NoVA students were widely distributed but needed to share visual products with their peers, digital tools that support visual facilitation in groups were used (Pohl, 2019). Other facilitators suggest that the involvement of participants in drawing and creating videos as part of their online learning processes is crucial (e.g. Lenzo, 2019). Digital tools also enable quick processing and online sharing of visual results (Pohl, 2019), supporting the iterative approach to the game course.

As the concept of visual facilitation in this online learning environment is introduced, different types of analogue and digital visual representations; sketching and visualisations in group work; drawings, video instructions, video recordings of game experiences and video presentations of game design is explored. Thus, the concept of visual facilitation is applied in a formal online setting of higher education where students *draw*, *adjust* and *share* their game design ideas as part of the game course.

As an analytical strategy of the joint inquiry space, the notion of framing should be introduced. According to Goffman (1986), framing is a dynamic and interactional concept for describing participants’ activities of defining what is occurring in a specific situation. In line with this perspective, social practices are not predefined or given but are something that participants create and recreate through interactions (Lantz-Andersson, 2009). Applying the concept of framing in the analysis, PBL activities in the game course are viewed as social practices where both teachers and students dynamically create and recreate the online learning environment.

A critical element of how we frame in situations is dependent on earlier experiences and how we relate these experiences to the activity at hand (Goffmann, 1986). Thus, the teachers’ constitution of a given course activity is fundamental for what is possible to learn. Framing includes the disposal of resources and tools for the students to engage in (Lantz-Andersson, 2009). Thus, visualisation methods and techniques were introduced to explore how they framed the students’ participation and relation to the content matter. According to Goffmann (1986), it is essential to study activities from participants’ perspectives to understand how they *frame* situations. Thus, the emphasis in the analysis of the empirical data was students’ reflective utterances and evaluations.

4. Analysis of the game course

The analysis is an introspective review of the joint inquiry processes that unfolded during the game course. Based on the initial introduction of the game course, the students were presented to the main task of developing a *game for change* that they should design through iterative activities during the 12-week course. During the 12-week course, five different game theoretical themes were discussed in synchronic online meetings to support the students’ asynchronous group work. As mentioned, the course was initially framed by openly asking: ‘*Games for change!?! Let’s explore the possibilities of using games and play for change!*’ The expected learning outcome was for the students to develop a game informed by game theory and refined through game test and peer feedback. After the initial phase, the students were grouped into two-four persons based on common interests, and they began developing their games. Throughout the game course, five groups developed different game designs related to the overall topic of *games for change*.

As teachers and facilitators of the online learning environment (Newman, 2005; Qvist-Sørensen and Bastrup, 2020), the teaching of different activities was structured as follows:

- Online meetings: lectures, video instructions, presentations and feedback sessions
- Reflexive exercises
- Students' self-directed design processes and learning in groups

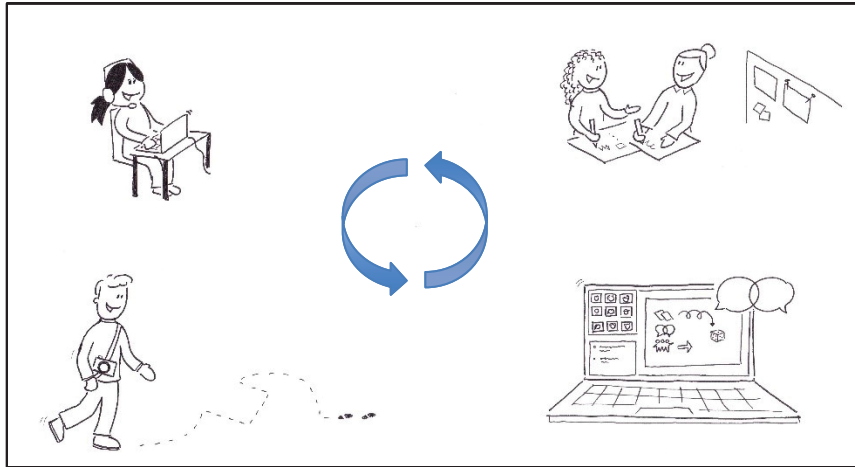


Figure 1: Presentation of the different PBL activities; reflexive exercises, students' group learning and online meetings, etc. (Hautopp, 2019)

The following analysis is organised in relation to the different PBL activities in the course, and the relation between the activities is emphasised. For each activity, examples of students' and teachers' strategies when using visualisations and video productions during the course are discussed.

As we work iteratively with researching educational design, the inquiry process involves producing demonstrable design and changes at the local level and reflecting on the use in other contexts (Barab & Squire, 2004). Thus, the research approach is justified by the way the educational design work in practice by providing a rich description of context, theory and interventions. In the analysis, we aim to give a rich and visual description of empirical examples discussed in relation the educational design and theories.

4.1 Online meetings: lectures, video introductions, presentations and feedback sessions

The course was organised with joint online meetings using the video conference system Adobe Connect. Each meeting focused on a specific theme: 1) *Critical Play - games and activism*, 2) *Understanding games*, 3) *Framing*, 4) *Games in place and space* and 5) *Making an invitation - participation*. Initially, online meetings were planned to last for two hours with 20-30 minute lectures of relevant concepts from the specific theme followed by feedback sessions between the students. In parallel with the development of the students' games, we wanted to make space for more joint inquiry and dialogue in the feedback sessions. Thus, the online meetings were redesigned with more time and focus on feedback sessions in smaller groups, placing the lectures in video introductions for students to view between online meetings. According to McKeachie and Svinicki (2006, p.58), lecturing is best used for summarising and adapting material to the interests of a particular group, initially helping students discover key concepts, principles and ideas within a specific topic. In our case, video introductions were used to relate the themes and theoretical game concepts of the week to the students' work designing games. Concrete examples were included for the students to act upon (Dewey, 1938). Thus, the videos were developed between weekly meetings, adapting to the latest online dialogues and feedback sessions and relating new concepts to the designs and discussions with examples tailored to the students' projects. Simple video recording techniques and tools, e.g. screen recordings (Camtasia and Screencast-o-matic) with a teacher's talking head (Guo, Kim and Rubin, 2014) (see figure 2) or PowerPoint recordings in one-take, were used to retain the tentative and imprecise 'sketchy' feeling in the videos (Ørngreen et al., 2017).

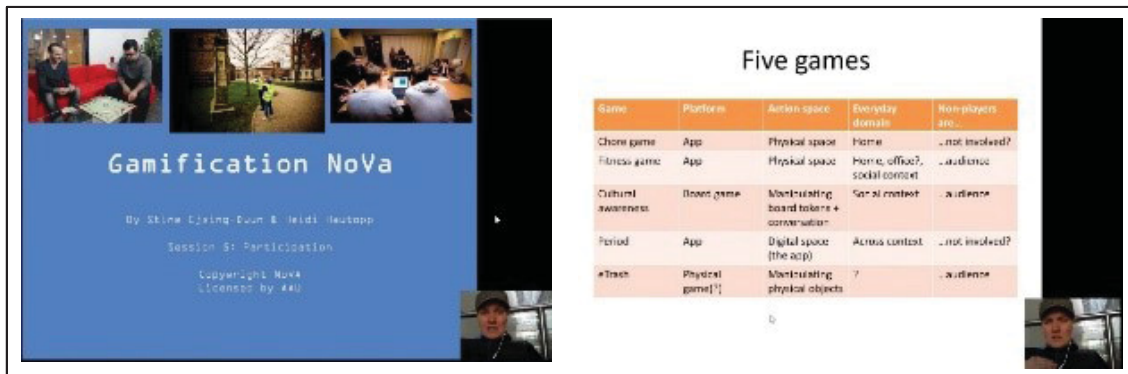


Figure 2: Video instructions with a teacher's talking head in a screen recording with specific feedback on students' game design ideas. The teacher is sitting on a couch and is quite informal

Figure 2 illustrates a video tutorial about the theme 4) *Making an invitation – participation*. The teacher related the topic by asking the groups 'How are you going to invite people to play your game?', specifically relating the question to each of the five groups and their previous game design ideas. The advantage of this approach to video instructions is that the students generally had experiences with the videos as relevant and meaningful in relation to their design work. In their written evaluations, all students expressed appreciation of the video introductions. This is evident in this student's comment: "I really appreciate that there were videos in advance to see and prepare for an upcoming online lesson. It helped much to concentrate on a specific topic (...), and your feedback about our game design processes was also very helpful. I think these preparation videos with examples (!) are great." Thus, for this student, the video provided a focal point, which helped in preparing for the next session. This is supported by another student's comment: "The videos were so helpful! It was great to be able to go into the reading knowing a bit about what the context was rather than grappling to understand it. I appreciated the main points and concepts as well, as I was able to get more from the readings with the videos." In this way, the students used the video introductions to frame the readings and design processes as the feedback provides focus and premises for reading and for the design process.

The disadvantage of this approach to making videos is that it can be time-consuming to produce and render the videos. Moreover, the video introductions cannot be reused for the next semester because specific student projects are mentioned in the videos. In the oral evaluation after the course, some students proposed that the videos should be 5-10 minutes instead of 20 minutes, which could be less time-consuming for teachers.

As a central part of the online meetings, students were asked to give a 5-7 minute visual presentation of their current state of game design. Each stage related to the specific game theme of the week; however, online participation requires technical competences. A student elaborated on the experiences of the online feedback sessions: "Of course, this was also not the first online course, so that made a big difference for me having learned and understood the platform and technologies." Thus, an understanding of the different functions of the online platform, e.g. how to share and comment on the visual representation of design ideas, is essential. Other students also appreciated the feedback sessions as highly relevant to their design processes but mentioned online experiences as a factor in the process: "Giving online presentations and being opponents all in all is good for the design processes and in this course it worked perfectly. Personally, it was a bit hard due to a lack of experience in this kind of online learning environment." These findings point to learning potential for the students in the feedback sessions both in the role of presenter and opponent, and at the same time, it is central to have experience with these activities for students to feel comfortable in online learning environments.

Several students mentioned the benefits of feedback for their design processes: "Giving presentations was essential! That way one had to formulate thoughts into a brief space of slides and then somehow share what one was passionate about." Another group acted as opponents to the presentation, giving feedback on the game design using the theories presented for the week. In this way, the students used visualisations to frame the understanding of their game design in relation to specific topics and theoretical perspectives. A student commented on the role of an opponent: "I value peer review. It's good to learn how to communicate both compliments and critical points." We argue that the use of digital tools for quick processing and the elaboration of visual results in a PowerPoint presentation (Pohl, 2019) made the students' game designs explicit and applicable for joint inquiry in the feedback sessions.

4.2 Reflexive exercises

To encourage students to activate relevant prior knowledge of games and art (Goffmann, 1986; Newmann, 2005) as well as to engage them in new game experiences, we structured reflexive exercises between the online meetings for students to act as gamers as well as game designers (Levinsen and Sørensen, 2018). The reflexive exercises targeted the different themes of the online meetings and required the students to take an auto-ethnographic approach with a focus on the personal experience of playing the game (Ellis, Bochner and Adams, 2011). Examples of activities are: 1) Present game experiences and post questions for debate in an online forum; 2) Make a video screen recording playing a self-chosen game in relation to game mechanics and definition of games; and 3) Make a dot.walk in relation to the theme *Games in place and space* as an example of a location-based game. As part of the reflexive exercises, the students were asked to write a two-page reflection paper for each online meeting reflecting both the exercise, the game theory and the group work on developing games. The individual exercises were a supplement to the students' group work, and the purpose was for the students to embed the game concepts in relation to different activities. Through these exercises, they strengthened their entrance into the game field.

One reflexive exercise was a dot.walk (Medienkunstnetz, n.d.) for which the purpose is to be guided in a city by simple codes and instructions (turn left 1st street, turn right second street, turn left third street). The walk was set to take 10 minutes, and the students were asked to document their walk by taking five photos to reflect on their experiences and to subsequently adjust the instructions for the game to redesign it. This was reported in a two-page reflection paper. The purpose of the dot.walk was for the students to try a location-based game (Ejsing-Duun, 2011) and to experience how simple rules can produce new actions and playful activities in a well-known area. In this exercise, the game structure is framing a behaviour, and the instructions framed the students' meta-reflections on the framing. The act of taking photos is a framing in itself because the student taking the photo focuses on what is within the frame of the photo, leaving something out.

A central part of PBL is facilitating self-directed learning (Newman, 2005); however, this can be difficult when students are situated across campuses. In the first course in 2016, the presentations of the dot.walk were not specifically framed, making it difficult for students to use their experiences for discussions and as materials for design. To improve this, we made a visual template of a dot.walk created as a PowerPoint recording using sketchy drawings, photos and a voice-over reflecting on their own walk experiences to instruct and to inspire students (see figure 3).

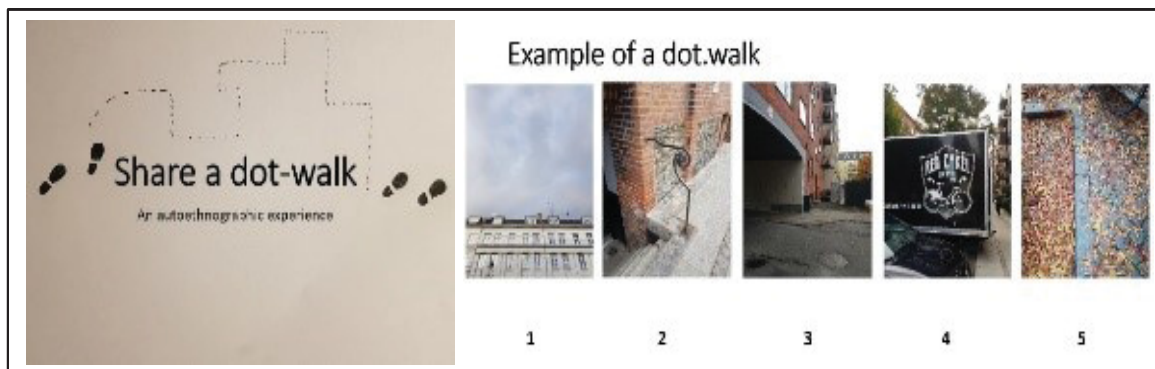


Figure 3: Examples from the teachers' visual template of a dot.walk

This template was intended to frame the exercise so that students could perform it on their own and share it within their groups and during the online meeting. In this exercise, the visualisations provided students with a tangible memory of their walk and made it possible for the group to facilitate a discussion about their experiences.

In addition to taking photos during the dot.walk, some students decided to draw a map of their walks or visualised the route in a Google map (see figure 4). Thus, students used different visual representations to facilitate an understanding of their walks for fellow students and teachers.

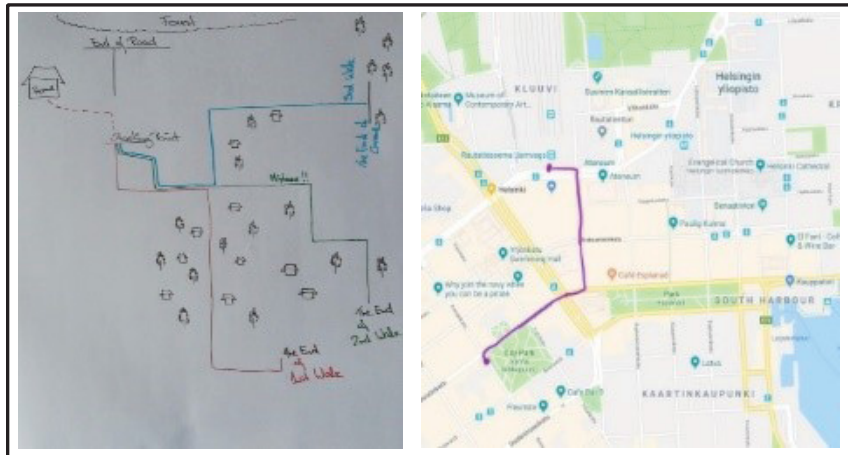


Figure 4: Students' drawings of walks and visualisations of a route in Google maps

The student drawing the map of her walks meta-reflected upon the importance of the 'framing of games' when she almost went to dead-end road in her second dot.walk: *"This experience only emphasises the importance of game design and why the framing of the game is a significant part. As for players, this experience emphasises the importance of following the rules if we want to engage with the game"*. From a pragmatic perspective, this student theoretically reflected upon her own game experiences with location-based game by noting how framing and rules are significant for players' engagement.

In his first dot.walk, another student stumbled upon a rear-view mirror on the roadside (see figure 5a). He described the normal use of these types of mirrors as well as how they could function as a creative and playful way to challenge the game experience: *"This mirror is used for cars to see whether there is traffic but it is a nice feature which can alter or show you another dimension of where you are about to walk."*



Figure 5: Photos from a student's dot.walk: a photo of a rear-view mirror on the roadside (5a) and two photos of 'reflecting things' (5b-c)

On the second dot.walk, he adjusted the codes and instructions inspired by his previous experience: *"New code: Only take photographs in reflecting things. That way, you can create the feeling of another dimension."* (see figure 5b-c). After the second walk, the student reflected upon this way of framing photos focusing on reflecting objects: *"The new code made it much more playful to observe the area. It was also a challenge finding the reflecting objects everywhere, and it brought out the fact that more things than I expected do have a reflection of landscape!"* In this meta-reflection, the student argued based on own experiences that *"making a code or guidelines is good, altering the ordinary is even more important. So, the twist is what makes the walk exciting"*. In addition to the two-page reflection paper, the students also shared their dot.walk experiences scaffolded by the teachers during the next online meeting. Among others, it was discussed that 'altering the ordinary' is a crucial game mechanic when framing critical design (Flanagan, 2013) in games for change.

In these self-directed reflexive exercises, students used visualisations to engage with the topics presented, and a dialogue with their own experiences invited their peers into the dialogue. As such, the visualisations enabled and framed academic discussions and inquiry across space and time.

4.3 Students self-directed design processes and learning in groups

In retrospect, the individual reflection exercises also functioned as shared inquiry spaces for the students to combine their interests in art and photographs to design games. Thus, the exercises also lay a foundation for the students' self-directed learning in groups. For example, a walk in the subway in Stockholm taking photos was used as an inspiration for a *game for change* with a focus on women's periods. In the subway, the students took photographs of graphic artist Liv Strömquist's enlarged visualisations of women having their periods, some of them entitled: "*I'm alright (I'm only bleeding)*." This exhibition has created public debate (Hunt, 2017) and in their presentations, the students used their pictures to make a critical stand in line with the artist regarding taboos related to women's periods. It can be argued that the students used this inspirational walk in the subway to foster ideas of how to question normative assumptions of women's periods through a critical game design (Flanagan, 2013). During their game development, the students made their own visualisations inspired by the originals (see figure 5), which they incorporated as a part of their game design.

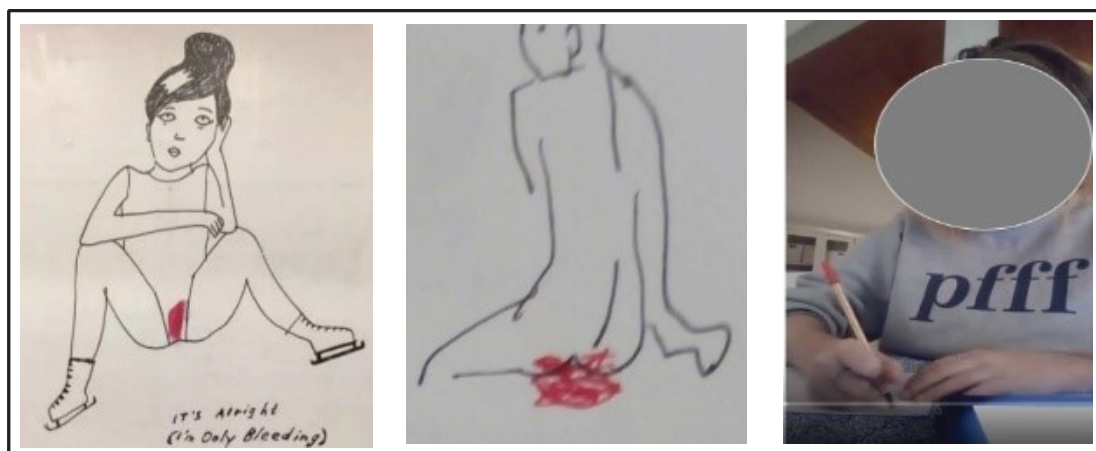


Figure 6: Visualisation by Liv Strömquist, a student visualisation and a play session from video productions

In their final presentation of the 'Period game', the students produced a video showing a player engaging with the game, which was designed as an app that provides scenarios exemplifying issues related to menstruation. This game concept was inspired by Playspent.org, which is a game that one group member played in the first auto-ethnographic exercise of playing a game to reflect upon game mechanics and experiences. The app was created as a paper prototype, and one student acted as the player in the video, discussing her choices (see figure 6) when she encountered challenging choices in the game (Costikyan, 2002). The player assumed the role of a fictive character, a 16-year-old British female from a low socio-economic background. Related to facts that British teenagers sometimes cannot afford menstrual products due to high costs, the character is placed within dilemmas, such as: "*Your period had started this Tuesday morning, but your parents did not have enough money this month for period pads and are too tight in their budget to give you some for the upcoming days. School starts in one hour. What do you do?*" Throughout the game, players must make decisions in relation to economic, health and personal issues related to menstruation. The video production made the struggle in the game visible (Costikyan, 2002), which was used as a reference point for the students to discuss different perspectives of women's periods during the feedback session (Flanagan, 2013; and teaching observations).

Other students were inspired by the different ways to complete the reflexive exercise of making a video recording of a self-chosen game. One student chose to record herself playing a digital game about cultural differences, and she reflected upon how games can focus players' attention on their own stereotyping of other groups. Together with three other students, she formed a group, and they began an inquiry process to explore how a game can foster inviting dialogues and interactions based on cultural issues (Flanagan, 2013; Costikyan, 2002). In the beginning of their design process, the students were keen on making an app as their final game design, but after their second round of peer feedback, they changed their idea. The students wanted to target social aspects of cultural sharing, and the choice of an app as the playground was questioned by fellow students

regarding whether it was the right solution for the purpose. Throughout the course, students were focused on the fact that the game should be playable and in line with their purpose so that it could be tested. This framing was important because they assessed their ideas and adjusted the design during the course. Based on feedback, the students redesigned their initial idea into a board game, which embraced the social aspects of the game to a greater extent. In their final video presentation of their game 'Cultural awareness', the students showed the game play by exemplifying different game situations. The students showed the play situations by starting with a zoom on the specific game card (see figure 7), which invited participants into a dialogue about cultural items and dilemmas (Flanagan, 2013).



Figure 7: Play situations starting with a zoom on specific game cards

Green game cards represented different cultural symbols, and players wrote down their interpretations and afterwards explained their motives for their guesses in plenum. Subsequently, the players negotiated the individual score of one to three points in relation to their answers. In case of disagreement, the presenter of the question has the final word. In a new game situation, one player draws a blue card from the pile and reads aloud: *“Western poet creates his pen name using a Chinese character. Cultural appropriation or inspiration?”* The players then decide for themselves how they will characterise the action of the poet and choose between *cultural appropriation* or *inspiration* while selecting a yellow card representing their choice. Afterwards, players reveal their choices by turning yellow cards, which leads to a conversation about the background of their choices. In their final video productions, the game narrative and endogenous meaning (Costikyan, 2002) of the cultural dilemmas as context-dependent and negotiable became visible in the students’ game structure focusing on dialogues and joint negotiations about scores.

As an overall analytical perspective, the students used visual facilitation techniques as they engaged fellow students and teachers in their game narratives through different visual representations, such as visualisations and video productions, making their game designs relatable and discussable in an online setting.

5. Discussion

The analysis has shown different examples of how teachers and students use visualisations and video productions to facilitate and to create a shared online inquiry space, some students with more game and online experiences than others. Some students expressed that both before and after the game course, they were not particularly passionate about games. Despite the lack of interest in games, several expressed that they could find a personal focus in the course, e.g. a political interest in the game culture or an interest in the exploratory approaches and theory presented during the course: *“The texts were many and very interesting and I was amazed by the text on auto-ethnography. There I saw that the theory was not only about games but also about the research approach of ethnographers exploring a certain field and culture within academia approach.”* The fact that we combined the academic inquiry approaches with visualisations and video productions as methods familiar to the students (Bang, Friis & Gelting, 2015) can be an explanation of the appreciation of the course despite the lack of interest in games. As another student expressed, her understanding of games was wider after the course which she related to her profession as an art teacher: *“In artistic creativity - when designing workshops or learning class, now I could include different approaches (...). Also when thinking about community based art projects, I will definitely remember about games as part of activism”.* This quote exemplifies, how *games for changes* are not just about the specific games, but also about the approaches embedded in the game design when inviting participants to play and to take an active part in critical issues. As this was an exploratory case study of one game course, the student evaluations revolved around the specific course. A long-term

perspective on the implications of combining academic inquiry approaches, visual facilitation techniques, and game theory in higher education, needs further research.

As mentioned, a central point of the game course was for students to take a pragmatic approach (Ejsing-Duun and Skovbjerg, 2018) to explore *games for change* through design based on John Dewey's (1938) concept of *inquiry*. As teachers, we also adopted this explorative approach to develop teaching materials, e.g. visual templates and video instructions based on the dialogue with students from the previous online meeting. Thus, this adaptable way of preparing our teaching had the benefit of students' appreciation of specific weekly feedback in video instructions. On the other hand, when asked about the overall experience of the game course, a student mentioned: "*I wouldn't really change anything. I think that the assignments supported the course and theory and gave the students a good feel of all the different aspects of games. The only thing I would change is the time frames; I would make sure that all the assignments were up weeks before they were due*". An overview of the schedule and all assignments from the beginning of a course could be useful, but it should be up for discussion whether this is doable and suitable when educators have the role of designers of teaching (Sørensen and Levinsen, 2018; Ejsing-Duun and Skovbjerg, 2018).

The analysis has shown examples on how students used visualisations and video productions in their reflective exercises, group work, and to materialize their understanding of course specific themes. The students' visual materials was used in presentations in the online feedback sessions which made game experiences explicit and reference points for joint discussions. Online teaching can be viewed as a social practice where both teachers and students dynamically create and recreate the online learning environment (Goffmann, 1986). In this context, visual facilitation in form of teachers' and students' visualisations, visual templates and video productions was developed as part of the asynchronous course work. Furthermore, in the synchronic online sessions, the students' visual productions were used as representations of group work and game designs driving the feedback and discussion in plenary. Thus, a visual social practice in the inquiry processes was created and recreated throughout the different PBL activities. However, as Blijisje, Hamons and Smith (2019) emphasize, one of the main strategies of visual facilitation is to *draw live* in order to support collective thinking in situ. This strategy of live drawing in plenary should be elaborated in further studies, as potentials for creating more *in situ* drawing sessions could affect the oral feedback discussions, participation and learning. In this perspective, the relation between joint inquiry processes of inventing a game and the act of drawing could be explored as an interaction between student groups and teachers in online settings. This might also call for teachers to frame the online meetings even more student driven (Newman, 2005), making space for students to facilitate the PBL activities and host the online sessions. Thus, the students could be further involved in framing relations between e.g. art and games.

As we discuss analytical results, a limitation of studying own teaching can be our joint roles as both teachers and researchers. In educational design, researchers are not simply observing interactions but are actually "causing" the very same interactions they are making claims about (Barab & Squire, 2004). Therefore, it has been essential to study activities from students' perspectives to understand how they *framed* the teaching situations (Goffmann, 1986). Moreover, in educational design research manifold contexts are conditions, which makes it difficult to replicate others' findings (Hoadley, 2002). In educational design, the goal is therefore not to sterilize naturalistic teaching contexts eliminating all confounding variables, e.g. own involvement, so the generated result is more valid and reliable. Instead, the challenge is to develop flexibly adaptive design interventions and results that remain useful even when applied to new local contexts (Barab & Squire, 2004). By the rich and visual descriptions of PBL activities, student work and reflective evaluations in the analysis, the exploratory case study can function as inspiration for applying similar approaches to new local contexts in higher education.

6. Conclusion

This paper discusses empirical examples of the establishment of shared online spaces for joint design inquiry in the context of games for change across cultural and professional barriers. The study focused on incorporating teachers' and students' use of visual facilitation and representations, e.g. visualisations and video productions, as central parts of creating and framing shared online spaces across the three university campuses. The analysis of PBL activities showed that teachers' video introductions relating theoretical game concepts to the students' group work supported their entrance into the game field as well as their design processes. Thus, the pragmatic abductive approach which starts in own experiences created space for students' more theoretical readings and reflections in relation to the course content of designing games for change. The way to balance feedback-related

video introductions and teachers' time for preparation is identified as a relevant issue for further exploration in online game-based teaching. Students' different strategies of using visualisations and video productions in reflexive exercises and design processes made the game experiences and narratives visible for students across campuses, which enabled further discussions during the feedback sessions and supported the joint inquiry processes. The combination of inquiry approaches, critical game theory and design processes combined with students' visualisations and video productions has interesting connections for bridging gaps between professions, e.g. in art and games. This combination was used to visually facilitate the online joint inquiry space and should be further explored in research studies. For example, the use of live drawing in the online feedback sessions is identified as a relevant focus for further studies in order to explore how these approaches might enhance the joint inquiry processes.

As the aim of the study was to investigate strategies for using visualisations and video productions by both students and teachers to establish a joint online design inquiry, the paper reflects this aim by making the teaching and research process visual through concrete examples in the analysis. Thus, the exploratory case study privilege visual modalities, which are requested in academic practices (see e.g. Mirzoeff, 2002; Bowen and Evans, 2015) and can function as inspiration for applying similar approaches to new local contexts in higher education.

Acknowledgement:

We would like to thank the NoVA master students (2018-2020) for creative and engaging participation in the online game course and evaluation. Likewise, we would like to thank NoVA community for constructive feedback.

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Building Creative Critical Online Learning Communities through Digital Moments

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DOI: 10.34190/JEL.18.5.002

Abstract: This paper is a mixed methods case study measuring student perceptions of a pedagogical strategy called “Digital Moments” (DM) for developing creative interactive online learning communities. The theoretical framework within which this resides is the Fully Online Learning Community (FOLC) model (vanOostveen et al, 2016), based on a foundation of problem-based learning, cognitive and social presence, and learner-centred pedagogies. The article reviews a specific teaching strategy for increasing social presence and student engagement through the use of creative and artistic expression in problem-based learning spaces. Using “Digital Moments” as a way to build inclusion in two synchronous graduate online courses, the author describes how the teaching strategy increased student participation, developed student ownership of learning, and encouraged collaborative processes between participants. This teaching strategy makes a significant contribution to digital pedagogy. Although the growth of online learning is quite substantial, our ability to develop online communities that inspire critical and creative thinking has not kept pace. Traditional teacher-centred learning environments do not meet the needs of students in today’s Fourth Industrial Revolution. As such, the FOLC model provides an online learning community model that removes traditional teacher-learner roles, allows the instructor to act as a facilitator and challenges learners to co-design and co-create the learning process. Within this digital space, collaborative disruption is encouraged, and, in fact necessary for the types of critical and creative thinking to emerge that are central to the FOLC model. Digital Moments, is one example of a pedagogical strategy that enables learners to co-create and own the digital learning space, within a fully online learning community.

Keywords: Critical thinking, creativity, online learning, communities, disruption

1. Introduction

This paper examines a simple yet powerful pedagogical strategy used in graduate online courses to create engaging learning communities. For the purpose of this work, the theoretical foundation is the Fully Online Learning Community (FOLC) model (VanOostveen et al, 2016). FOLC environments facilitate the development of collaborative, disruptive learning spaces within which learners participate in constructive, collaborative discourse that shapes the learning process. (Chapman, Ramondt & Smiley, 2005). This model asks students to actively construct their own learning, rather than passively accept it, which allows students to take ownership for their learning (vanOostveen et al., 2016).

Contemporary digital learning environments have the potential to empower individuals with the confidence, competence, and skills to manage, analyse, and filter information, but also to create, develop and connect new information that collaboratively solves social problems. It is essential in this powerful new learning world that pedagogy is two-fold; we must teach the digital skills to cope and navigate in this world, but we are also bound to nurture the skills that students require to live and work in digital communities (World Economic Forum, 2016).

The author’s goal in designing the Digital Moments (DM) strategy was to replicate the relationship building moments which naturally occur as students enter a face to face class before the structured learning begins. In an effort to do this, each week students met synchronously in Adobe connect. Classes of 20-25 students entered the virtual room to find share pods in which they each uploaded a ‘Digital Moment’. The content of the pod could include a variety of pictures, quotes, colours, links to describe in a single snapshot where the person was at that week. As weeks passed, students began to arrive earlier to class, in advance of start times, and began to look forward to connecting with classmates and sharing their own digital moments with others. As a unique pedagogical strategy, qualities which one might not normally associate with traditional online learning emerged: empathy, humour, risk-taking, compassion and a shared sense of community. This is an arts-based qualitative pedagogical strategy that elicits affect from students/learning community members and thus contributes to building relationships, more frequent and higher quality dialogue and interaction amongst students and between students and their teacher. From a group of individuals learning geographically all over the world evolved a close knit community of learners where the playing field was leveled and the traditional roles of teacher and learner become no longer visible.

2. Theoretical framework

This paper rests on three primary areas of literature, including (a) the Fully Online Learning Community (FOLC) model, (b) Problem-Based Learning, and (c) Arts-Based Qualitative Inquiry and Pedagogy. (VanOostveen et al, 2016; Savin-Baden, 2007; Brearley, 2000). This intersection of these ideas in an online learning situation provides the foundation for our work.

The FOLC is a theoretical and conceptual ideal of a problem-based learning (PBL) environment. The infrastructure of the learning environment is situated on the theoretical basis of the Fully Online Learning Community Model (FOLC) <https://www.youtube.com/watch?v=yk1kVbMfbXE>. In general, the FOLC Model integrates elements of more foundational theories guiding practice in distance and online education, including the Theory of Transactional Distance (TTD) (Moore, 1993), and the Community of Inquiry (CoI) framework (Garrison, Anderson, & Archer, 2010). The CoI framework, in particular, recognizes three presences essential to supporting distance education: Social Presence, Teaching Presence, and Cognitive Presence. As a result, “learning is subsumed by and subordinate to communal belonging” and “critical thinking is best developed through becoming a part of a community that appreciates and values critical thinking (Trninc et al, p. 622). Specifically, the DM strategy is used to increase social presence, thus it can be considered a contributing factor to increased social presence in online learning communities. Further to this, the PBL approach facilitates dialogue and group problem-solving, and the DM technique can be used as a way to develop relationships amongst students. In this way, the affective sharing is a component of effective collaboration, risk-taking, and developing divergent solutions to problems. As students know more about each others’ lives outside of class, they create more opportunities to use the personality characteristics of individuals more effectively in group situations.

Central to the model are four key elements.

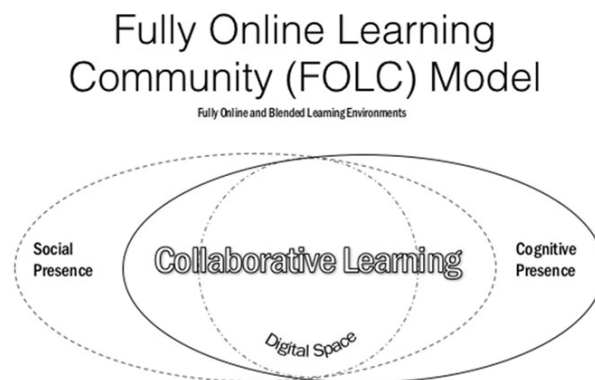


Figure 1: The FOLC Model (Van Oostveen et al, 2016)

First, the community is centred on collaborative work within a variety of digital spaces. In other words, the community exists within class time and space (eg Adobe connect or other web based video conferencing tool), but it also extends to relationships and discussions that occur outside of class time, through the connections that students make by social media, facebook, twitter, Instagram, or other social media tool. Social media posts were not used as data for the purposes of this research, however, students did make reference to using social media outside of class to connect with classmates and develop personal relationships. All course work is designed with collaboration in mind, and disruption and conflict are expected as part of the process. Counterintuitive to traditional teacher-led classes, this model requires community members to be full contributors, active self-directed learners who bring their own lived experience as adults to the digital space. In this way, the online class is co-designed and co-created by students and teachers together, it is a fluid space within which negotiation and teamwork become key.

The second pedagogical foundation for this paper rests is that of Problem Based Learning. We believe that this orientation, towards a learner-centred and problem-centred approach, allows for a social constructivist approach to learning, and provides a model of practices for organizations and institutions to develop and cultivate digital competencies in students or employees. PBL as situated in the FOLC model has several key

features including 1. A focus on complex real-world situations that have no one 'right' answer; 2. Students work in teams to confront the problem, to identify learning gaps, and to develop viable solutions; 3. Students gain new information through self-directed learning; 4. Instructors act as facilitators; 5. Problems lead to the development of problem-solving capabilities (Savin -Baden (2007).

The FOLC model and its emphasis on PBL aligns well with learning outcomes as indicated by several sources, namely the skills and competencies students require for the Fourth Industrial Revolution. There exist common ideals of what 21st century competencies are desired by (international and local) economic and government organizations such as the World Economic Forum (2016), the Conference Board of Canada (2016) and the Ontario Ministry of Training, Colleges and Universities (2016) and e-learning (2015). All of these sources recommend an increased emphasis on skill development in complex problem solving, critical thinking, creativity, and collaboration. These recommendations match a list of best practice principles for online learning, including group collaboration; active learning; active participation; knowledge construction; learner-centred pedagogies; meaning-making discourse; and higher level thinking, analysis, synthesis, and evaluation of real-world problems.

Clearly, one identifying and unique feature is the celebration of disruption. In order to allow for the development of creativity and criticality, is important to strive for learning communities rather than conserving communities.

“Learning communities (such as the science community) aim to expand the collective knowledge of the group. Conserving communities (such as the medieval church in Europe) aim to perpetuate and protect an established system of beliefs. Collins (1998) advocated for shifting school communities from conserving communities towards learning communities, as students not only develop understandings through participation in the knowledge-construction process, but also because they “learn how to learn.” We agree and support a view of critical thinking as a habit developed through communal practice.” (Trninic, 2018, p. 622)

Further, a third series of elements that support this work include arts-based qualitative inquiry and pedagogy (Brearley, 2000) the role of creativity in an academic context Barone (2006), and critical reflective practice (Griffin, 2003). Davis (2012) argues that our pedagogy must change, that it isn't enough to simply add technology on to our already existing practices; we must infuse it throughout, just as it is fully integrated into the daily experiences of individual students and teachers. She reiterates that “teaching with technology is not just about how to use the hardware and the software, but is also very much about people, processes and a range of different interactions” (p. 149).

In relation to the theoretical background and purpose of investigating Digital Moments, this project aims to measure the affective impact that this strategy has on the social presence in the online learning community. Thus, the primary research questions are:

1. What are student perceptions of the impact of the Digital Moments strategy on their learning experiences and
2. How does this practice of weekly sharing of Digital Moments create an engaging creative community.
3. How does the FOLC model facilitate the development of a learning community, within which creative and critical thinking emerge?
4. How does the interdependence of social presence and cognitive presence become stronger through the use of Digital Moments.

3. Rationale for case study methodology

This research was a mixed methods approach using survey data, participant comments, instructor field notes and class recordings in order to discern multiple corroborative sources of data to ascertain the effectiveness of the DM pedagogical strategy. The work consisted of three phases (a) implementing Digital Moments in an online class, (b) using a 7 point Likert style survey to ascertain effectiveness of DM's and (c) data analysis of class recordings, survey data, instructor's field notes and Adobe chat room notes. Merriam (1998) states that there are four major features that characterize a qualitative case study. First, the researcher is interested in understanding the meaning people have constructed. Individual cases in this study focused on the meaning that the subjects have placed on selecting and sharing their weekly Digital Moments. Second, the researcher was the major instrument of data collection and analysis. Third, this qualitative research involved field work, which in this study entailed class recordings and direct/indirect observation. Fourth, this qualitative research used

inductive strategies. In this work, the research applied existing models of online learning using TPACK (Mishra & Koehler, 2006) to the subjects in order to broaden our understanding of how engaging online communities have an impact on learning. Finally, Merriam (1998) believes that the product of a qualitative research study is richly descriptive. This researcher used learners' stories to describe the process of developing meaningful learning and human relationships online.

3.1 Methodology

3.1.1 Phase 1 digital moments implementation

This was a pilot project to implement a new digital teaching strategy, and it occurred over two terms of teaching two graduate online courses entitled "Authentic Assessment" and "Critical and Reflective Practice in Education." The total number of individuals in both courses was 54, the total number surveyed was 47, and 25 students responded. Participants in the implementation phase were 54 graduate students, and the instructor was an Assistant Professor in the Faculty of Education. Classes met once a week for four hours over a twelve week period in the fall/winter terms. Anecdotal reflections from students recorded in Blackboard chat rooms, audio recordings of Adobe classes, and journal notes from the professor were used to provide additional qualitative data.

3.1.2 Phase 2 participants

The total number of students enrolled in the two graduate courses was 54. Of these, a population of 47 students were sent an online survey that asked 12 questions with responses based on a Likert- 7 point scale (where 1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neutral, 5=Somewhat Agree, 6=Agree, and 7=Strongly Agree). Of the 47 students sent the survey, 25 responses were received which indicated a 53% response rate. Gender of participants was noted with a 1 or 2 (Female/Male), with 21 participants identifying as female and 4 identifying as male. Student participants in the study gave informed consent and were given permission to withdraw from the project at any time. Their participation in the research was not related to their academic grades in the class, and the research survey was designed and data collected by a second researcher who was not the course instructor.

3.2 Data analysis

The Likert Scale survey, based on a Likert- 7 point scale where 1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neutral, 5=Somewhat Agree, 6=Agree, and 7=Strongly Agree. The 25 participants answered an online survey to provide responses for each of the 12 questions. Responses for each question were averaged numerically to result in an average score (1-7) for each of the twelve questions. The two open-ended questions relating to benefits and challenges of *Digital Moments* were coded qualitatively and analyzed along with instructor field notes from classes to determine themes, and a word search of the responses was also performed for keywords "community," "social presence" and "connections".

4. Data

The numerical average of responses to each of the 12 questions is indicated here, with 1 being correlated to a Strongly Disagree response and 7 being correlated with a Strongly Agree response. These average scores are reported in Table 1 below.

Table 1: Attitudes toward the use of digital moments (n=25)

Items	Mean (SD)	% Agree ¹	% Disagree ²
I felt Digital Moments were conducted in a respectful way.	6.8 (0.4)	92%	0%
Digital Moments created a greater sense of community for me.	6.6 (0.7)	100%	0%
I felt safe when participating in Digital Moments.	6.6 (0.6)	96%	0%
The expectations of participating in Digital Moments were clear to me.	6.5 (0.8)	96%	0%
Digital Moments improved connections with my peers in class.	6.4 (0.9)	92%	0%
Using Digital Moments is an effective teaching strategy in online learning environments.	6.2 (1.3)	92%	4%
Digital Moments energized me at the start of the class.	5.9 (1.4)	88%	4%
Digital Moments made the class engaging for me.	5.8 (1.5)	84%	8%
Digital Moments supported my overall learning experience.	5.7 (1.4)	88%	8%
Digital Moments increased my motivation in class.	5.2 (1.7)	64%	12%
Digital Moments encouraged me to take risks in my learning.	5.0 (1.5)	72%	12%
Digital Moments improved connections with my peers outside of class.	4.8 (1.8)	52%	20%

¹Includes Somewhat Agree, Agree and Strongly Agree responses

²Includes Somewhat Disagree, Disagree and Strongly Disagree responses

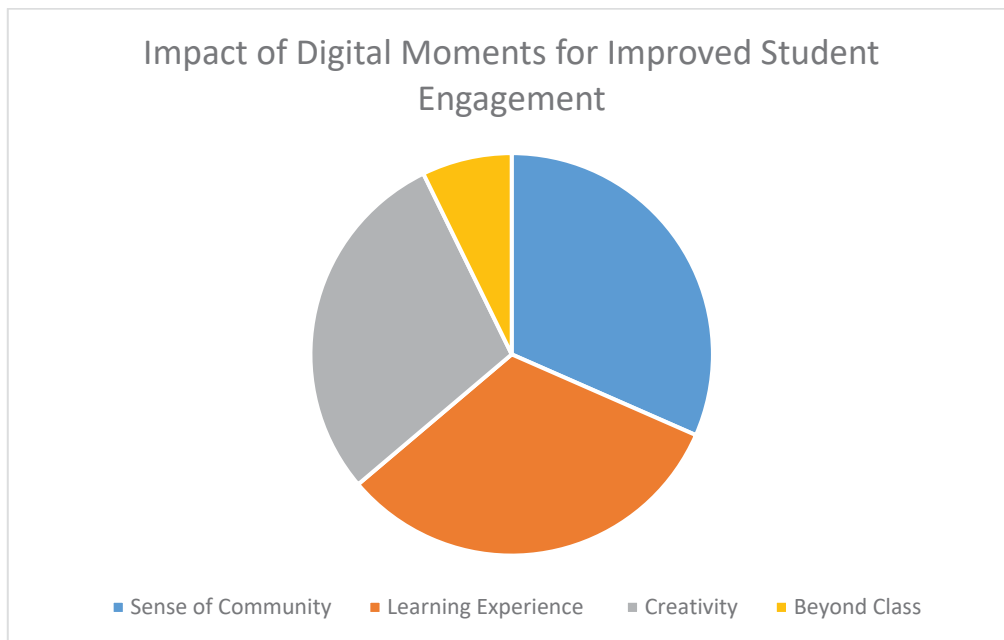


Table 2: Sample student reactions to digital moments (n=19)

It's so emotional
At the beginning I was so nervous and kind of cynical, so I thought "ok here we go" but now I really look forward to finding my own Digital Moment for the week and seeing everyone else's
I loved it!
I never thought I would get to know people online so easily
Doing this every week makes me actually ask myself how I am doing
I like guessing who puts what in their Digital Moment
I just started using this strategy with my own class and they loved it! Grades 5-6 students really opened up and I used it on the smart-board
This is a great way to get students to express how they feel without words
I think it helps to decrease the kind of stereotyping that you can get when you meet people face to face
It's really weird finally meeting classmates face to face and feeling like you already know them super well
When I used it with my own class it really helped me as a teacher to track where the kids were at
It's a safe way to express how you are feeling inside, sometimes I think technology is less personal but this was really personal
I actually shared with my peers, which I usually don't do in face to face settings
I found it interesting that you got to know people's sense of humour, without any real cues like you would get in a f2f environment, like body language
My friends reached out to me on weeks when I was struggling
It levelled the field for me as the teachers did it too, so we could see who they were as people, which made me want to contribute more
Really valuable! Best course I've taken in this degree
One week my Digital Moment was about a family member who had died, but she really had inspired me to go back to school so, it was really good to share it with the group
I am amazed at how well I got to know my colleagues in this class; I've had some awful online experiences and this was a refreshing change

5. Analysis: Overview

This survey data based on responses by 25 of 47 graduate students participating in 2 online courses reports on the results of 12 questions that were numerically rated on a 7-point Likert scale. The questions were each framed positively, and as a result, agreement of a positive impact of Digital Moments would result in a higher score. It is interesting to note that the average of all 12 questions was a score of 5.95/7, indicating that 85% of participants found a positive impact of Digital Moments on creating community.

Researchers triangulated data from multiple sources including survey answers, students comments, class recordings and instructor's field notes.

An analysis of the answers to the additional open-ended survey questions of 1. What were the benefits of using Digital Moments if any? and 2. What were the challenges of using Digital Moments if any? resulted in the following themes being coded and identified:

(a)the impact of developing social relationships in online classes, (b) the role of creativity as an element of an engaging online community, (c) teacher-learner role shifts in online spaces, (d) the de-valuing and re-valuing of types of knowledge representation using creative qualitative pedagogies, and (e) the value of disruption in creative critical thought and (f) the importance of revisiting and reshaping notions of failure as a means of redirection and innovation.

Data resulting from the 12 question survey was reviewed with significant positive results indicating that overall student responses demonstrated a positive impact on community building and the quality of interpersonal relationships in the class. For example, 92 % of participants indicated that the Digital Moments Strategy was conducted respectfully. Qualitative comments also indicated that students had clear expectations about their right to pass, that there was no academic penalty or value for participating in the activity, and they felt safe, and 96% of participants expressed a feeling of safety. It is interesting to note that fully 100 percent of students indicated that a greater sense of community was built through the investment of time up front doing Digital Moments at the beginning of each class. Those participants who were nearing the completion of their degrees, who had the majority of courses completed, spoke clearly about the fact that this was the first course where they had gotten to know classmates. It was evident that while they had been in other courses with the same

individuals, they did not know them well, and in previous courses, the only interaction had been during class time. With no group assignments, students felt that in other courses it was difficult to develop interpersonal relationships. One student remarked that “this was the first time I actually learned more about my colleagues, so I felt more encouraged to speak out in class”. Another participant whose first language was not English, expressed that he felt encouraged to speak more often, due to the fact he knew classmates more intimately and they also knew that he found it challenging to speak up in class.

An interesting comment from a student who was a public school educator, adopted the strategy to use with her own students, and as her school moved to an online setting during the pandemic, she remarked at how effective it had been with elementary age students. Having used the strategy prior to the pandemic, it was a smooth transition for her own students and it became a ubiquitous way to continue building her class community while teaching online. Further to this, another participant who was an administrator in a secondary school remarked that he had used the strategy with faculty who were teaching online for the first time, and it served as a useful icebreaker to maintain relationships between faculty who no longer met face to face. He remarked that this was a low key strategy to make technology and online teaching more accessible and less threatening for educators new to online teaching, and he had better communication with teachers and was able to support them in more meaningful ways as they began online pedagogy, some for the first time.

The relationships between students were enriched, as numerous participants felt they could “reach out to peers better” when struggling with course material, assignments, or with technology. They felt that because the course instructor also participated, the Digital Moments strategy increased the approachability and relatability of the professor. Interpersonal connections, within a professional context were a key component of the class, and professional boundaries were respected. In only one case, a student remarked that on some days they felt it was unnecessary to do Digital Moments, that at times it took up too much class time and “felt too much like a therapy session”. This feedback was important, as one of the challenges of using Digital Moments is to keep it within the context of the learning experience. For example, the students read several conference presentations and proceedings that were previously published about the Digital Moments strategy. In this way, they were provided with some evidence of how it had worked in a previous undergraduate online course taught by the same professor.

Results from the survey data indicated clearly that over 90 % of participants felt that the DM strategy increased the sense of community within the online course. Students remarked that they looked forward to guessing each person’s Digital Moment, and they often reflected during the week prior to class about which image they would share. This may indicate that they have increased reflective time about the cognitive elements of the course, while reflecting on the community building strategy.

Over 80 % of participants indicated that the strategy increased student engagement, while 64% responded that using class time for DMs increased their motivation. While this number is significantly lower, it is important to note that DMs may not have a large impact on student motivation, perhaps because they are already motivated to take a course, or because motivation for an elective course such as this is intrinsic. In addition, one student who self-identified as “not really artsy – I’m more task-oriented” expressed some cynicism about the strategy, and whether it had any value to his learning. This same student stated that he preferred a more traditional format, where the professor uses “top down lecture style teaching – I mean I paid for the course and you deliver it to us”, so the DM strategy did not engage him enough. The digital learning space he experienced in the past, and the one he himself created for his own students as an online teacher, was one where students produced a “right” answer, a “correct” assignment and a “good” grade. Creative learning spaces challenged him, but over the weeks in the course, he began to accept graduate level learning as a process, without a specifically defined end point.

A full 72 percent of students indicated that the strategy enabled them to take more risks in class, and interestingly only 52% of students mentioned connecting outside of class. This may be due to other time demands, as most of the students were working full time as educators or nurses while taking the course in the evenings. Some indicated that they had family commitments, and many shared images of their children and spouses, which gave colleagues a richer picture of the time commitments of each student. This in turn, increased the quality of interpersonal relationships between adults who were experiencing similar life contexts and personal obligations. Students often commented that it was a challenge to manage their time, and that while they enjoyed DMs, they still needed to have clear expectations for assignments and grades in the course, and

that the “end grade” reflected not on the community feeling, but on the assignments and end products they submitted for grading.

Overall, students indicated that the benefits of using DMs as a community building strategy included, but were not limited to, better social relationships, greater interpersonal support in class, more meaningful interactions with colleagues, a more positive course environment, and a greater sense of curiosity about the role of creativity in their learning process. Further benefits were expressed by participants in the ways they felt safe to be assessed and evaluated by the professor, the right to “have a voice” in class, the “sense of ease” between colleagues and the encouragement to “take more risks in my learning and what I discuss with peers”. Further to this, when disruption or disagreement occurred, students indicated that they were using interpersonal skills to disagree respectfully, to negotiate assignment due dates and assignment values, and to request extensions for assignments.

Some of the challenges indicated by students were the length of class time used each day to share, the fact that not all students participated, the voluntary nature of the strategy and the lack of grades attached to the process. They indicated that some types of sharing were “too personal and more like a counselling session”, so maintaining professional boundaries while sharing personal data was a balancing act and an important line to protect.

Clearly, the implementation and acceptance of arts-based and creative assessment tools meant a significant ‘unlearning’ and ‘revaluing’ what it meant to demonstrate one’s knowledge. It became important to unpack how each learner had developed their values about the importance or lack of importance of marks and grades versus the value of the learning process itself. Students began to see how the development of friendships and simple human qualities like trust, caring and compassion were the real foundation for creating meaningful learning experiences. It also helped them to begin to trust themselves; they began to believe there was an authentic self in each learner who could choose which direction to go, define tasks that were personally and professionally relevant, and which were best left for others to tackle.

By using Digital Moments, where there is no “correct” human response, we created the kinds of authentic relationships in the learning community that offer a balance of challenge and support, and we are able to disrupt students’ notions of the importance of learning versus the importance of grades. As Eisner (1997) states, what we count, counts, and students significantly repositioned their views on the importance of grades, rather than the importance of deep learning, creativity and critical thought processes.

6. Conclusion

This research demonstrated through mixed method data collection that both quantitative and qualitative results showed Digital Moments had a positive impact on the quality of the online learning community. More specifically, the Digital Moments strategy was a significant factor in increasing social presence, a key element in the Fully Online Learning Community Model (FOLC).

This paper has discussed in detail how Digital Moments as a pedagogical strategy contributes to the development of meaningful, co-created online learning spaces, and the Fully Online Learning Community model can be effectively used to develop critical and creative online learning environments. By encouraging the interaction of social presence and cognitive presence through the use of Digital Moments, participants indicated that they experienced increased social presence within a PBL -FOLC model, and this had an overall positive effect on the quality of the online learning community. By engaging students in Digital Moments, the author created a safe learning space wherein teacher-learner roles shifted, learning became a student-centred adventure, and multiple learning outcomes became plausible. Learners were supported by pedagogical approaches such as problem-based learning that include, but are not limited to, the use of Digital Moments to create social presence.

It is important to note that DMs do not work for all students, and may not work in all subject areas. The students here were in a Faculty of Education, and it is possible that in areas of study (eg engineering or medicine) that are heavily content-oriented, DMs may not be as positively perceived by students. In addition, the predilection of some instructors to measure knowledge using tests and exams may predispose the instructor to perceive that they cannot “waste time” on affective or creative processes. However, some medical schools are moving towards a greater use of PBL and more group processes in diagnostic dialogue. Thus, student and instructor

willingness to adopt and fully invest in DMs may be more effectively used in courses and programs where process is valued more than product. In addition, the role of “failure” may be perceived differently in merit-based programs or courses where admission to the profession is highly competitive, as such, students may be less willing to take risks or be creative in case it has a deleterious effect on their grades and career outcomes.

Online instructors are tasked with the challenge to develop digital communities with the kind of social capital and presence to engage students, decrease attrition and improve learning outcomes. Badge, Saunders and Cann (2012) acknowledge that students’ online attention is focussed on these other sites with high activity rates, and that “engagement is more than participation, it requires emotion and sense-making as well as activity, these social networks are rapidly moving beyond their original purpose and are inevitably becoming part of the learner experience” (p. 2). While we may be aware of institutional barriers or traditional models of learning, the digital world demands that we adapt and evolve, using creative, socially constructivist and community-based approaches to learning. This research indicates that pedagogical strategies such as Digital Moments can have a significant effect on student engagement, and the concomitant improvement in the quality of the learning community. Although Vetrano attests that “education is tied up so tightly in its own web of red tape and bureaucracy that real learning, the rich and deep learning that needs to be there, often, struggles hard to escape” (2010, p. 77), it is imperative that digital educators begin to explore arts-based strategies to engage and challenge online students. Cousins and Bissar affirm, “What stories can be told about the fast-changing world of higher education, and what can we learn from them? Adapting to new situations, conquering fears and overcoming obstacles are familiar storylines, with particular relevance for university lecturers having to introduce new technologies in their working practices.” (2012, p. 1). This examination of the Digital Moments strategy has been an effective way to address these concerns raised by many higher education professors moving to an online teaching and learning space.

As such, using arts-based strategies such as Digital Moments can create a community of learners who take risks and support one another, thereby coming up with original thoughts and ideas that they may never have come to by taking a traditional “distance education” course where learners often feel isolated or alone. Creative and critical online communities can develop with intentional and purposive design, using collaborative processes to disrupt old ideas, and make room for innovation and new direction. It is entirely possible, and even desirable, that a group of distinct individuals whose learning lenses are geographically and culturally diverse, can evolve into a close-knit community of learners where the playing field is levelled and the traditional roles of teacher and learner become imperceptible. A fully democratic and innovative online class provides a digital space for creative critical thought to emerge. This research provides an examination of the use of Digital Moments through a FOLC, and we argue that is a highly useful pedagogical tool that can be implemented to attain the goal of improved social presence and cognitive presence in creative critical online learning communities.

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Learning Analytics in Flipped Classrooms: A Scoping Review

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DOI: 10.34190/JEL.18.5.003

Abstract: The Flipped Classroom (FC) is an instruction method, where the traditional lecture and homework sessions are inverted. Online material is given to students in order to gain necessary knowledge before class, while class time is devoted to application of this knowledge and reflection. The hypothesis is that there could be deep and creative discussions when teacher and students physically meet, which has known a significant surge of popularity in the past decade. A marked recent trend in the FC is the increased use of Learning Analytics (LA) to support the development of the FC and students' reflexive learning. The aim of this paper is to investigate the literature on applications of LA in FCs, and to determine the best practices and needs for technological development supporting LA in the FC by means of a scoping review. This literature review revealed that there is potential in using LA in the FC, especially as a means to predict students' learning outcome and to support adaptive learning and improvement on the curriculum. However, further long-term studies and development is necessary to encourage self-directed learning in students and to develop the whole of the FC for a more diverse population of students. We anticipate an increased and expanded use of LA to come, with focus on predictive and prescriptive analytics providing more adaptive learning experience. We also anticipate that LA will expand beyond data mining to correlate student performance and online engagement with the aim to include a wider range of possibilities of interventions and adaptation of the learning experience.

Keywords: active learning, flipped classroom, learning analytics, virtual learning environment, educational data mining

1. Introduction

The Flipped Classroom (FC) is possibly one of the most prominent endeavors to overhaul educational practices in recent years. Faced with the need to engage students, and with disaffection from the traditional lecture-based model, educational institutions turned towards active learning to shift "...the focus of learning from passively receiving content information to diligently participating in learning activities" (Frey, 2018). In that regard, the FC, where "...events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa" (Lage, Platt and Treglia, 2000) is a concrete application of the principles of active learning. After a first decade of developments and tests of the model, the FC is undergoing further developments, amongst which the increased use of Learning Analytics (LA) (Fernández, Merino and Kloos, 2018).

1.1 The Flipped Classroom

Interest for the FC however rose sharply in the early 2010s, following its popularization in secondary education in the United States (Bergmann and Sams, 2009). It is now frequent in higher education, as a means to engage an increasingly diverse and flexible population of students (Reidsema et al., 2017). Abeysekera and Dawson (2015) provided a "lowest common denominator" definition, defining the FC as "a set of pedagogical approaches that: (1) move most information-transmission teaching out of class, (2) use class time for learning activities that are active and social, and (3) require students to complete pre- and/or post-class activities to fully benefit from in-class work."

The FC methodology has been frequently reviewed and studied, and interest in the methodology has remained constant in the past decade (Bishop and Verleger, 2013; O'Flaherty and Phillips, 2015; Zainuddin and Halili, 2016). The FC has been recognized as an effective learning approach in various courses: it gives teachers more time for personalized interactions with students, improves students' creative thinking and communication skills, and encourages students' responsibility in their learning (Lin and Hwang, 2018).

1.2 Learning analytics

Based on the most commonly cited definition, "LA is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs." (Siemens and Long, 2011). Figure 1 presents the different steps in the LA process.



Figure 1: The different steps in the LA process

LA aim at providing ways to gather and make sense of educational data, which is generated while educators and learners interact with digital technologies. The goal is to improve the learning experience for learners and teachers, and better adapt courses' design. Although LA is a relatively young field, it might prove crucial in further developments of the FC since it can inform teachers about the learning process of the students, and teachers can in turn use this information to make informed pedagogical decisions (Van Leeuwen, 2018). The method also encourages adaptive learning and self-regulated learning: learners can improve their meta-cognitive abilities with information to reflect on their own learning, and teachers can create a feedback loop between online and classroom phases to assess the progress and needs of students (Klemke, Eradze and Antonaci, 2018).

In a recent study of LA trends based on more than a hundred articles, Leitner, Khalil, and Ebner (2017) anticipated that LA would continue to be a staple of higher education. They argued that in the short term the potential to cater to individual learning outcomes, and personalized feedback and visualization would increase, and that the rise of predictive analysis would mark long-term trends. Although this evolution appears slower than originally stated, these issues remain central to the development of LA.

1.3 Combining the flipped classroom and learning analytics

Although both the FC and LA have both been active fields of study, research in combining them is still rare. According to Fernández, Merino and Kloos (2018), early research focused on the results obtained in the FC, or used specific indicators to obtain useful information for the FC. However, that research did not indicate precisely what the best tools were, or what specific learning activities they could support.

More recently, the potential of using LA in the FC has come to increased focus and attention. For example, Doko and Bexheti (2018) tried to map educational data mining practices with a wide scope, including MOOCs, videos, and the FC. Their study showed an increased number of studies after 2010 in these issues. While their study provided a comprehensive overview of interest in educational data mining, it was constrained by a very wide scope that ended up diluting the specific issue of LA in the FC in an approach where Video-Based Learning (VBL) dominate. As such, this study showed interest for LA in the FC but did not allow a targeted understanding of the processes at work, when we attempt to analyze the use of LA in the FC. Similarly, Lam, Lau, and Chan (2019) recently advocated extended use of LA in the FC while pointing out the limitations of current Learning Management Systems (LMSs) to provide a valuable use of LA in the FC. They argued that LA has the potential both to assess the student's learning process, provide feedback for the student's improvement, and offer data for the teacher's reflection, but that current assessment practices and reliance on LMSs limit the full potential of LA.

This article means therefore to complete the existing literature by examining the potential in combining the FC and LA through a scoping review of the existing literature. We believe that examining previous use of LA in the FC will allow us to determine when LA have been used successfully, and where use of LA is still lacking. There are several advantages to using a scoping review. According to Arksey and O'Malley (2005), it allows researchers to examine the extent, range, and nature of the research activity, to determine the value for undertaking a full systematic review, to summarize and disseminate research findings, and to identify gaps in existing literature. We will therefore research the implementation of LA in the FC, and determine the best practices, the limitations, and ways to improve it.

2. Methodology

For this paper, we have used Arksey and O'Malley's methodology (2005), as expanded by Levac et al. (2010). The scoping review method uses the stages presented in the following sections.

2.1 Stage 1: Identifying the research question

The focus of this research is to explore the key factors in the use LA in the FC. We also want to examine how LA can improve the FC model. To ensure that a substantial range of literature was examined, we followed the following research questions to guide the search:

1. Which type of data and learning analytics algorithms were used in the FC and to what purpose?
2. What were the educational outcomes of using LA in the FC, and which theoretical background were they based upon?
3. What were the main limitations in the use of LA in the FC?

2.2 Stage 2: Identifying relevant studies

Arksey and O'Malley suggest that a wide definition for search terms should be used. Therefore, we opted for a large selection of related terms, which covered various forms of LA. The following research string was thus devised:

("flipped classroom") AND (("learning analytics") OR ("engagement data") OR ("educational data") OR ("activity data") OR ("data mining")). The selection was then restricted to research that specifically used LA in the FC.

The selected databases for this study were Scopus, Proquest, Web of Science, and JSTOR. Only peer-reviewed articles and papers, accessible in English, were selected. The research was carried for the period 2009-2019, a decade, which coincides with the exponential development of the FC.

2.3 Stage 3: Study selection

Using the key search descriptors, we identified an initial selection of 188 articles. Figure 2 presents the selection process and exclusion criteria to the selection.

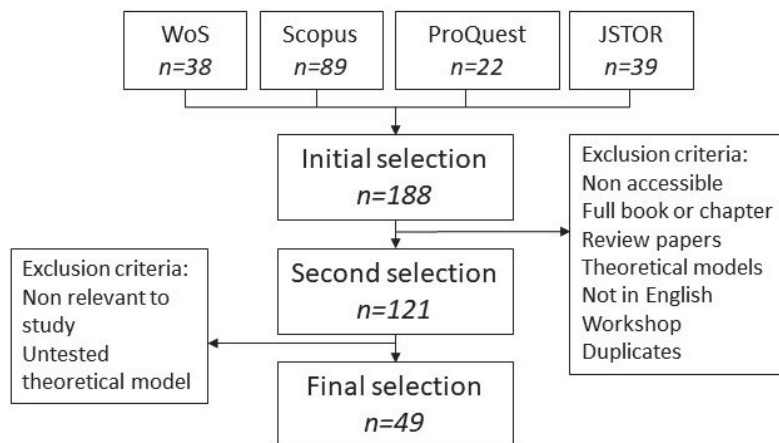


Figure 2: Model for the article selection

The first round of exclusion took out duplicates and formats that did not fit the research, narrowing the selection to 121 articles. From these, a detailed reading of abstracts allowed us to select studies who were actually combining LA as a tool in the FC, and not addressing both methodologies as separate subjects, or in untested theoretical models. From there, we finally ended with a final selection of 49 articles.

2.4 Stage 4: Charting the data

The data extracted from the selection of articles was mapped using the following attributes: Study ID, Database, Paper title, Journal/proceeding, Author, Year, Country of study, LA algorithms, Data extracted, Feedback to students, Position in the FC, Level of class, Subject, Size of class, Control group (if applies), Outcomes, Evaluated variables, Methodology, Evaluation of performance (grade, knowledge test, learning outcomes), Evaluation of students perception (self-reported opinion, interviews, interest, attitudes), Student experience (motivation, stress level, engagement, participation, cognitive load), Theoretical framework, Limitations.

2.5 Stage 5: Collating, summarizing and reporting the results

The final stage of the scoping review summarizes and reports findings.

3. Findings

The publishing information for the studies we selected yielded several observations. A first analysis of the selected studies showed that the issue of LA was a recent subject, who met an increased interest in the second part of the observed decade. Figure 3 represents the distribution of studies by year.

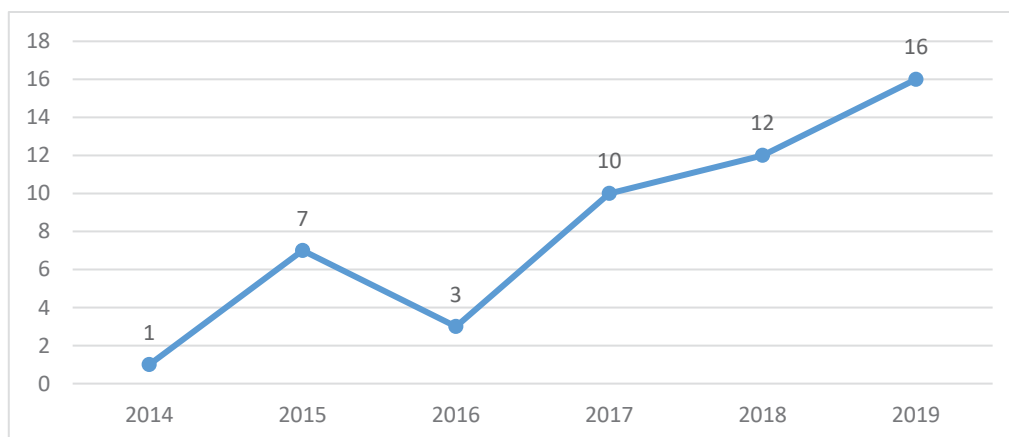


Figure 3: Distribution of studies by year of publication

We can observe that studies on LA have increased in the past three years, with a consolidation of publications after 2017. The geographic distribution of studies, however, appeared more homogenous: 18 countries were represented, nine in Europe, two in South America, four in Asia, as well as the USA and Australia. Only five countries had more than five articles: the USA (nine articles), China including Hong Kong (seven articles), Taiwan (six articles), Australia and Spain (five articles each). The rest presented only one or two studies.

The type of study presented a stark domination of STEM in higher education. Only four studies interested themselves to secondary education, and the other 45 studied classes at university level. Figure 4 presents the distribution of articles by subject. We can observe the domination of STEM related subjects: Computer science (11 articles), Engineering (11 articles), Math (6 articles) and other scientific subjects e.g. physics or biology (7 articles). This data explains these discrepancies: as learning systems that integrate LA are a recent development, early testing was carried in the departments that already had the technical competencies in learning algorithms and machine learning. It will be noted, however, that a greater scope of investigation remains to be explored to adapt LA to wider contexts.

Finally, only one study (Hsu, 2019) specifically investigated LA during the in-class activity time. The rest of the articles were evenly distributed between pre-class preparation (27 articles), and the whole FC with a focus on out-of-class student monitoring (21 articles).

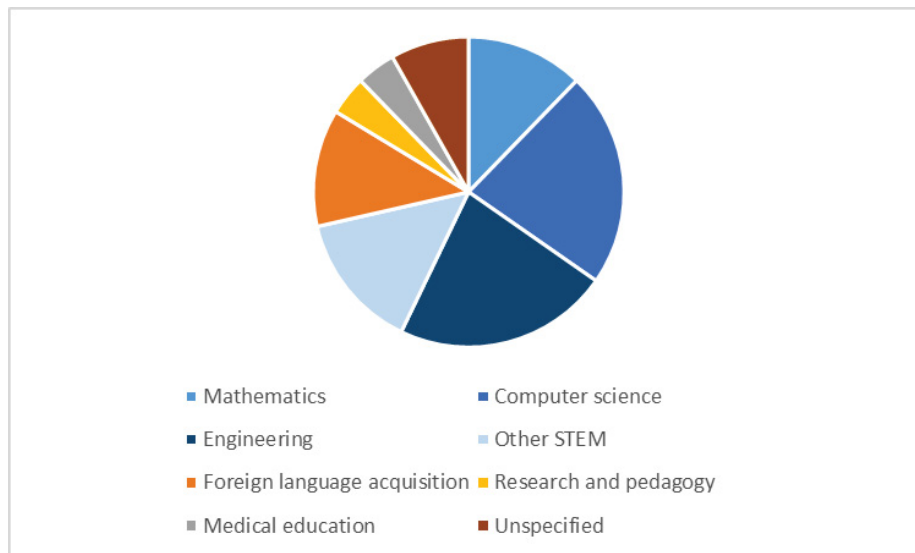


Figure 4: Distribution of studies by subject

3.1 Which type of data and learning algorithms can be used to implement LA in the FC?

To further this analysis, we also observed which model of data extraction, and which learning algorithms were used in the selected studies. Every study tended to use more than a single approach in extracting relevant data, as well as applying different algorithms to the data set. Therefore, the numbers in this section will exceed our initial 49, but will reflect the common denominators in the choices that have prevailed thus far in applying LA. Figure 5 presents the modalities of data extraction.

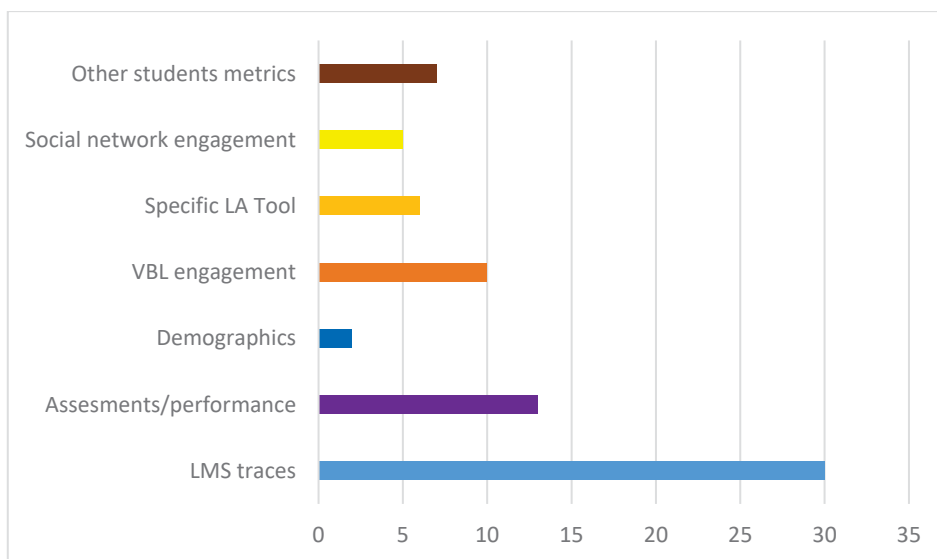


Figure 5: Type of data extraction for LA in the FC studies (by number of studies)

Data mining and exploitation of LMS traces, especially in Moodle, is the main source of data in the articles we reviewed, appearing in 30 articles (e.g. Gelan et al., 2018; Yamada and Hirakawa, 2015; Lin, 2019). LMS traces focus usually on student engagement with the learning platform, and usually cover such basics as time spent on lesson (Matcha et al., 2019; Martínez et al., 2019), completion time of online activities (e.g. Poon et al., 2017; Ayres et al., 2018), and regularity and frequency of engagement with the platform (e.g. Jovanovic et al., 2019).

Stemming from the previous category, we also identified 13 studies that specifically focus on online performance leading to an evaluation or assessment. Metrics such as the completion rate and success rate in the course are taken into account (Kaw, et al. 2019; Yang, Wu and Cao, 2016), as well as summative evaluations (Smallhorn, 2017). A single study integrated peer evaluation (Fernández, Merino and Kloos, 2019).

A significant number of studies focused on the pre-class preparation through engagement with the video lectures, with 10 articles (e.g. Xiao, Pham and Wang, 2015). In these articles, the focus was on data as interactive notetaking (Hecking et al., 2017; Pardo et al., 2015), results from embedded multiple choices questionnaires in the video (e.g. Giannakos, Chorianopoulos and Chrisochoides, 2015), multiple views and unique viewers per video (Gilliland, 2017), or assessment of the video quality by the learners (Giannakos and Chrisochoides, 2014).

Five studies focused on social interactions as a means to engage learners in the learning process, using data such as their comments on the class Facebook page (Lin and Hwang, 2018), the online interactions with peers or teachers (Ji and Han, 2019; Reidsema et al., 2017), or the volume of submissions on the learning system (Isomöttönen and Tirronen, 2017). Another study used specific applications on the students' mobile phones to evaluate work on a BYOD (Bring Your Own Device) configuration, where students were encouraged to use social networks for support (Hsu, 2019).

Some articles focused on other student metrics, such as student self-reported satisfaction in the experience (Lei et al., 2017; Van Leeuwen, 2018), student self-assessment (Corrias and Hong, 2015), or self-regulation in learning (Hwang and Chen, 2019). Two studies investigated the students' adaptive learning pathway in the FC experience (Kaw and al., 2019; Reidsema et al., 2017). One study (Xiao, Pham and Wang, 2015) introduced a rare example of a mobile MOOC, where learning was adapted via implicit cognitive states inference that integrated a tangible video control, and implicit heart rate sensing based on heartbeat waveforms.

Finally, a minority of six articles presented specific data mining, and LA tools that were devised to facilitate that process. For example, Mouri, Uosaki and Ogata (2018) presented an e-book using a ubiquitous learning system called SCROLL, and a specific LA tool, VASCORLL 2.0 (Visualization and Analysis System for COncnecting Relationships of Learning Logs). Redondo et al. (2015) used the plug-in tool ANALYSE to handle their LA. Similarly, Xiao et al. (2015) used their own custom system, AttentiveLearner. Fernández, Merino, and Kloos (2019) used a custom learning platform and LA tool (called GE-L+), and Martínez et al. (2019) the learning engagement tool Socrative. Other examples include specific tools used on students' mobile phones (Hsu, 2019), and an unnamed CLI (Command Line Interface) data extraction tool (Ayres et al., 2018).

While a small majority of studies used only quantitative data as mentioned above, 21 studies used mixed methods and completed their use of LA with qualitative data. Such studies investigated the participants' experience through interviews (e.g. Hui et al., 2018; Kravchenko and Cass, 2017) or focus groups (e.g. Ayres et al, 2018; Kaw et al., 2019), or in-class observation based on the action research methodology (Isomöttönen and Tirronen, 2017). Some studies also investigated the lived experiences of students through self-reported opinion or motivation questionnaires (Marasco et al., 2018; Lau et al., 2018; Lei et al., 2017; Chu, Wang and Wang, 2019). Sun, Lu and Xie (2019) introduced results from Motivated Strategies for Learning Questionnaires (MSLQ), and Hwang and Chen (2019) analysed the content in questionnaires with a Quantitative Content Analysis (QCA) to evaluate the students' experience.

However, although mixed methods are applicable to the observation of the FC experience, the core of the data was quantitative and used to apply LA algorithms. Figure 6 presents the type of algorithm applied in the LA phase. Similarly, most articles used more than one type of algorithm to conduct their study so the results go beyond our original 49 occurrences. We have sorted the use of LA in the following categories: cluster analysis, sequential analysis, predictive analysis, linear regression analysis, data mining, process mining, and other non-classified in the previous categories approaches. This classification relies on the terminology of the studies themselves, while unspecified mentions of LA fell under data mining. The order of importance in which these diverse approaches occurred is the following:

- *Data mining* refers to projection based on participants' engagement in the learning platform, essentially based on LMS traces. These cover essentially log-ins to the platform, number of resources accessed, time spent on resources, number of clicks, number of exercises taken, and completion rates.
- *Cluster analysis* appears to determine profile groups of students based on their achievement rates or level of engagement with the platform. These diagnostics allow determining learner profiles or group dynamics. For example, Sun, Lu, and Xie (2016) managed to identify up to six learning groups using cluster analysis.
- *Predictive statistics* were used to correlate student profiles with student results or pass grade, and try to predict students' success or dropout risk based on their learning profile, and engagement in the FC and online activity (Hui and al., 2018)

- *Sequential analysis* means to analyse patterns of engagement based in time. It focuses on the distribution and frequency of online activities, and its articulation with in-class time and assessments. The minor category *process mining* employs the same data to determine learning strategies in conjunction with cluster analysis. For example, Fincham et al. (2018) used a combination of cluster analysis and sequential analysis to determine which learning patterns were more efficient for students.
- *Linear regression analysis* is used in these studies to establish relations between variables in the data mining process, usually between student level of engagement and their pass rates, or in the case of mixed method studies, with the students' comments and experiences. For example, Hsiao et al. (2018) used multiple linear regression to show that students' online learning behaviour did not have a short-term impact on learning outcome, but did have a significant long-term impact.
- The unclassified category covers models that only appear in two studies or less. However, we can underline that these minority studies offer often more complex statistical models in the form of neural network and Bayesian models, trying to ascertain complex patterns in the learner behaviour (e.g. Nouri, Saqr, and Fors, 2019).

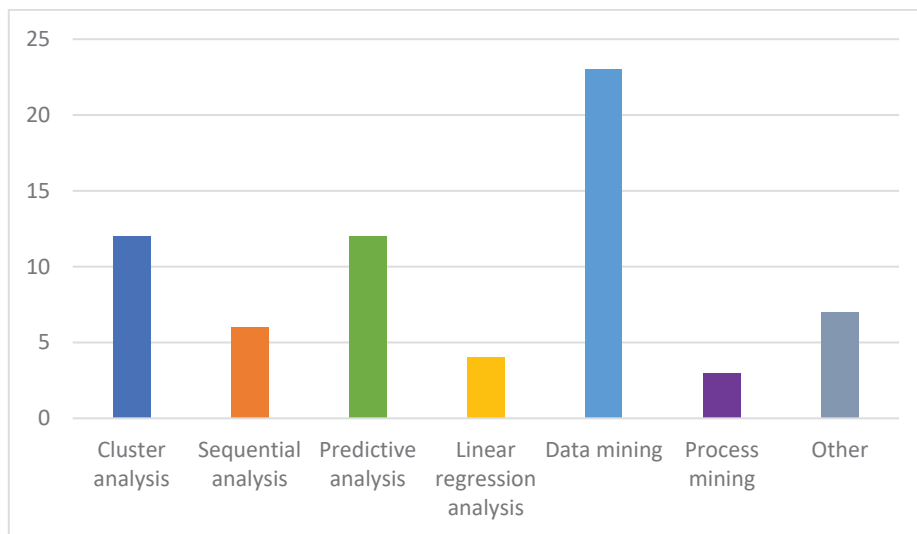


Figure 6: Type of LA (by mention in number of studies)

Therefore, there is a very clear domination in the studies of LMS and VBL traces used for descriptive or diagnostic analytics. However, LA is a quickly expanding field and other forms of cluster and predictive analysis are clearly catching up, while use of original and dedicated LA tools start to encroach in recent studies.

3.2 What were the educational outcomes of using LA in the FC, and which theoretical background were they based upon?

We then looked into what was the basis on which these studies established their conclusion. Where all studies presented LA and the FC, owing to the terms of our initial research, only a smaller part of our study corpus expanded their theoretical backgrounds beyond framing the context. Figure 7 presents a tentative description of the theoretical frame for integration of LA in the FC.

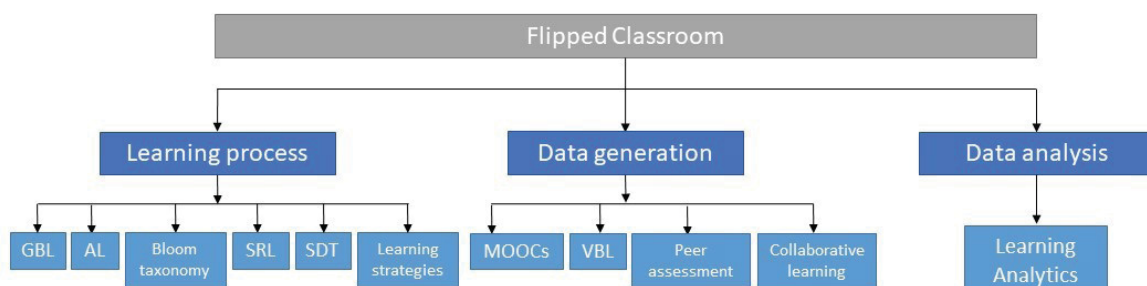


Figure 7: Theoretical framework for the structuration of FC using LA

We have determined that we can sort out the theoretical background for integrating LA in the FC in a three-tier distribution: learning process, data generation, and data analysis. By data generation, we underline the presentation of educational tools that generate data such as MOOCs (e.g Ng and Xie, 2017), VBL (Garrick, 2018) or specific LA tools (e.g Redondo et al., 2015). The dominance of LMS traces in data collection illustrates this focus on online tools for FC management and data collection. A minority of studies also presented the theoretical background behind peer assessment (Lin, 2019) or collaborative learning (Hwang and Chen, 2019) for research that specifically focused on these issues.

Finally, a significant 28 out of 49 articles presented an expanded context that also included educational theories to map the learning experience of the student population, which we map under learning process. Self-Regulated Learning (SRL) takes the greatest share of mentions, with 10 articles represented (e.g. AlJarrah, Thomas, and Shehab, 2018; Silva et al., 2018; Saint et al., 2018; Fincham et al., 2018; Jovanović et al., 2017; Sun, Lu, and Xie, 2016; Pardo et al., 2015). The SRL theory (Pintrich and Garcia, 1994) establishes that students can have better learning outcomes, cognition, and behaviour with planning, monitoring, and regulating strategies, but also that these strategies are not inherent traits but aptitudes that can be trained. Therefore, many studies use this theory as a means to encourage the use of LA in the FC to support students' self-regulation in learning and metacognitive strategies. In that regard, potential for increased benefit for SRL in students appears a strong trend.

In the same vein, four articles reference the notion of learning strategies with the aim to identify specific learning pathways through LA (Fincham et al., 2018; Jovanović et al., 2017, Jovanović et al., 2019; Schwarzenberg, Navon and Pérez-Sanagustín, 2019). Another essential cognitive theory appears in the form of the Self-Determination Theory (SDT), which posits the existence of motivation as a continuum based on a sense of competence, autonomy, and relatedness. This theory, as developed by Deci and Ryan (1985), appears in two articles (Sergis, Sampson, and Pelliccione, 2018; Isomöttönen and Tirronen, 2017). Finally, a smattering of studies reference other educational theories to analyse the efficiency of the FC. These studies reference for example the principle of active learning (Kaw et al., 2019; Hui et al., 2018), Bloom's taxonomy (Hwang and Chen, 2019; Giannakos, Chorianopoulos, and Chrisochoides, 2015), and Game-Based Learning (GBL) (Chu, Wang and Wang, 2019).

Based on the aforementioned elements, we can now question what were the learning outcomes observed by integrating LA in the FC. Most studies, 18 out of 49, focused on the correlation between students' learning performances and online activity, and found positive results correlating the highest grades and pass rates with the most active learning strategies (e.g. Hsiao et al., 2018; Martínez-Muñoz and Pulido, 2015; Smallhorn, 2017; Mouri, Uosaki and Ogata, 2018). Two studies among these especially highlighted the positive impact of students engaging with online feedback on their learning process on higher levels of SRL and better learning outcomes (Matcha et al., 2019; Silva et al., 2018). Some studies succeeded in identifying high performing student groups by correlating their online engagement and assessment performance (Reidsema et al., 2017; Saint, Gašević and Pardo, 2018), and showed that online environments encouraged students' participation in the FC (Hsu, 2019), especially collaborative learning and discussions. Studies, which also investigated the students' perception of the process, found high level of students' satisfaction in the learning experience (Lei et al., 2017; Corrias and Hong, 2015; Smallhorn, 2017), and reduced levels of anxiety in low-performing students (Chu, Wand and Wang, 2019).

The second most represented outcome of these studies, with 16 articles, was the use of LA as a means to improve the learning experience and the FC process. Such studies offered LA to help teachers improve the course (e.g. Van Leeuwen, 2018), to enable adaptive learning by selecting the best material and exercises according to the student's profile (e.g. Xiao, Pham and Wang, 2015), or to select the best learning materials and videos (e.g. Lau et al., 2018; Kravchenko and Cass, 2017). Within this group, some studies focused on the temporality of students' engagement with the learning material to issue recommendations for adaptive learning and improvement of the learning material (e.g. Garrick, 2018; Silva et al. 2018).

Finally, several studies presented positive learning outcomes in the capacity of LA to predict students' success or risk of dropout and monitor interventions, but this approach appears more recent, represented only in the past two years. Five articles presented strategies aligning with these objectives (Hui and al., 2018; Van Leeuwen, 2018; Nouri, Uosaki and Ogata, 2019; Schwarzenberg, Navon and Pérez-Sanagustín, 2019), developing predictive models or supporting teachers' intervention towards students at risk of under-performing.

Therefore, the majority of studies presented positive results and made a compelling argument to the idea that LA support the FC experience and result in better success in the FC, and better monitoring and support of online engagement. Furthermore, these studies showed that using LA in the FC could reinforce the method by providing an adaptive learning framework to students, and encourage SRL. Finally, the potential for the use of predictive statistics was observed, and their capacity to predict success and identify vulnerable students.

3.3 What were the main limitations in the use of LA in the FC?

Although the impact of implementing the FC and the use of LA seemed overwhelmingly positive, this review allowed us to observe several limitations, especially issues connected to students' engagement with the learning material, limited use of feedback and LA on learning strategies, and students' difficulties to adopt the methodology. Twelve articles out of 49 presented similar issues, which we can decompose into the following specific problematics:

- *Quality of engagement*: several studies (e.g. Marasco et al., 2018) underlined that the measures from LA were mostly click-based, and did not evaluate the quality of students' engagement with the learning material.
- *A utilitarian engagement*: two studies (Ayres et al., 2018; Smallhorn, 2017) underline the fact that many students only performed the learning activities before the exam, or if grades were attached to them.
- *Specific difficulties*: some studies underlined the difficulties of students to self-regulate their learning process (Isomöttönen and Tirronen, 2017), or the reluctance of already high-performing students to adopt new learning methodologies (Pardo et al., 2015).

Some studies also underlined negative or non-significant results. For example, one pointed no statistical difference between passing and failing students (Gelan et al., 2018), while another one no correlation between success rate and time spent online (Yang, Wu and Cao, 2016). One had a disappointing pass rate due to lack of quality engagement with the learning materials (Lei et al., 2017), or no effect for the highest performing students (Jovanovic et al., 2017). One study could not find correlation between the use of VBL for capturing lectures and the evaluated results in their students, and had to conclude that their use of VBL did not yield any improvement for them (Williams, Aguilar-Roca and O'Dowd, 2016).

Finally, we observed the fact that only 10 articles presented studies where direct feedback or visualizations were part of the experimental design. Of these studies, one limited access to the analytics information to teachers so that they could intervene (Fernández, Merino, and Kloos, 2019), but the rest provided students direct access to feedback information, or their own learning analytics. Most of these studies allowed students access to their analytics in real time with a review of their engagement and completion successes (Giannakos, Chorianopoulos and Chrisochoides, 2015; Redondo et al., 2015; Hsu, 2019; Kaw et al., 2019; Jovanović et al., 2017). One study provided a learning bulletin at the end of the session (Silva et al., 2018). Two studies used both methods conjoined, giving students both a real-time analytics feedback and a personalized dashboard information, and personalized feedback at the end of the session (Jovanovic et al., 2019; Matcha et al., 2019). These examples show that direct feedback is also a major element in the development of LA, and that there is room to improve its use in the FC and exploit its potential to develop fully adaptive learning.

4. Discussion

4.1 Educational data mining, LA, and educational models

This scoping review shows that there is great potential in using LA in the FC, especially as a means to reinforce the efficiency of the methodology. Improvements in technology allow instant access to a wide range of educational data. However, we observed that, because of its reliance on online educational data, most studies focused on the pre-class preparation, and approached the post-class process only through students' summative assessments and results. There is, therefore, a clear lack of research investigating the in-class process and activities.

Furthermore, to inform and improve educational practice, key researchers have underlined the need for LA to be rooted in research on learning and teaching (Gelan et al., 2018), and our research showed that studies in applying LA to the FC focused so far mostly on the technical aspects and did not articulate their results with in-depth learning theories. In that regard, the most promising angle we observed is the use of SRL theory to analyse and understand patterns in students' behaviour and learning strategies. There is, therefore, an under-

investigated potential in putting more emphasis on SRL, and giving better feedback and access to LA to students with the aim to develop fully adaptive learning.

Finally, if we take into account the most common types of LA, our current study allows us to discuss what the major evolutions in the application of LA in FCs could be through observation of the LA types employed in our 49 studies. Figure 8 presents the four types of LA that serve as a basis for our discussion on the potential future of LA in the FC.

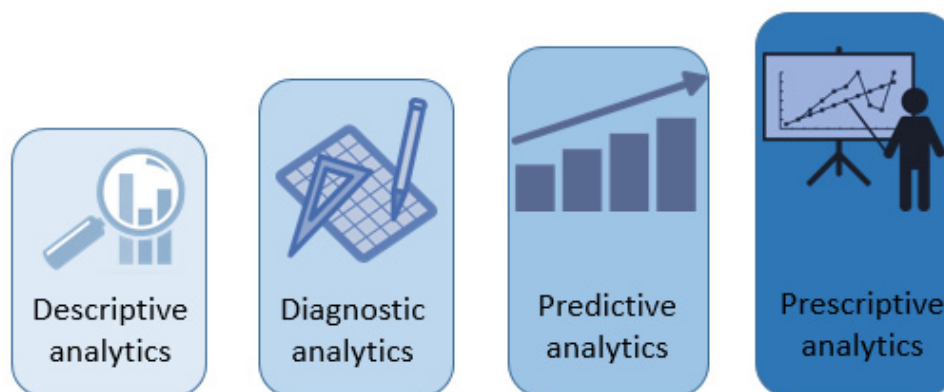


Figure 8: The four types of Learning Analytics

In the reviewed studies, we observed the following applications of LA:

- *Descriptive analytics* ask, “What happened?” As we observed earlier, most studies approached LA in a general descriptive manner based on educational data mining. LA in these many instances relied on the use of LMS traces to monitor students’ engagement with the learning platform, and the measure of their learning performance.
- *Diagnostic analytics* show interest into “Why did it happen?” They intervene in observing students’ patterns of learning and correlating explanation variables to the observations. They are usually used in studies that correlate students’ success and improved learning experiences with experience in the FC and use of LA.
- *Predictive analytics* are one of the huge potential in the FC and raise the issue “What will happen?” Studies with interest in predictive analysis try especially to allow early intervention to adjust the course of a curriculum or anticipate risk of dropout in students.
- *Prescriptive analytics* appear as the last potential expansion, and try to focus on “How can we make it happen?” In our corpus, this was observed through a combination of data mining, cluster analysis or use of neural networks in an attempt to identify specific student groups or learning strategies. This classification work should allow educators in the future to identify and support the best practices. In the future however, more potential is to be found into combining predictive analysis with targeted recommendations and visualizations.

Therefore, we will argue that our scoping review allowed us to present a solid overview of the current state of LA in the FC and to project that the process is bound to undergo further development. We especially anticipate interest in predictive analytics and prescription analytics, resulting in increased use of instant feedback, and user visualizations and targeted recommendations.

4.2 Educational outcomes and limitations

The majority of studies presented positive learning outcomes and the capacity to predict student performance based on their online engagement with the learning materials and with student-teacher or peer-activities. However, our analysis showed that there are still fields that remain underexploited regarding LA in the FC.

Few studies tried to investigate the long-term effects of the FC, and used only students’ results on a given course. Indeed, some groups showed no significant improvement in short-term assessment in the FC, but improved results in long-term assessment (Hsiao et al., 2018). Similarly, few studies investigated the effect on different populations of students. Some only used the video metrics without evaluating individual users’ engagement (e.g. Kravchenko and Cass, 2017), and only two studies presented a different population. Kaw et al. (2019)

investigated students “other than white male” and Ng and Xie (2017) showed that the FC was slightly more efficient with female students. Other studies insisted on the fact that their model affected a limited number of subjects and could not yet be generalized to all students (Chu, Wand and Wang, 2019).

Finally, our research shows that there are still issues that need to be resolved to implement efficiently LA in the FC. For example, click-based data can only measure superficial online engagement and should be completed by either qualitative data from interviews or students’ social interactions. Marasco et al. (2018) even suggested that the whole system of evaluation should evolve to fit the new paradigm.

5. Conclusion

Faced with the necessity to promote and develop active learning, educational institutions have turned massively towards the FC to encourage self-regulated learning in students. As the efficiency of the FC became well established, the potential of improving the FC by using LA seems a logical step forward. By conducting a scoping review, we found that most articles on LA for FCs were published after 2017 describing interventions mainly in STEM fields. Moreover, LMS and VBL traces were broadly used for descriptive or diagnostic analytics, which were also the most common type of analytics employed. Our literature review revealed also that there is potential in using LA in the FC, especially as a means to predict students’ learning outcome and to support adaptive learning and improvement on the curriculum. However, further development and long-term studies are necessary to encourage self-directed learning in students and to develop the whole of the FC (pre-, in- and post-class sessions) for a more diverse population of students. We anticipate an increased and expanded use of LA to come, with focus on predictive analytics and prescription analytics, resulting in increased use of instant feedback, and user visualizations and targeted recommendations. We also anticipate that LA will expand beyond data mining to correlate student performance and online engagement with the aim to include a wider range of possibilities of interventions and adaptation of the learning experience.

Acknowledgements

This research was funded by the FLIP2G project. This project has been funded with the support of the Erasmus+ programme of the European Union. This paper reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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Accelerating the Energy Transition Through Serious Gaming: Testing Effects on Awareness, Knowledge and Efficacy Beliefs

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DOI: 10.34190/JEL.18.5.004

Abstract: To have sustainable societies, we need to accelerate the energy transition towards clean energy solutions, however, awareness and understanding of the process as well as intentions to change behaviors are still limited, especially among young people. An optimal balance considering the point of view from all parties involved is out of sight without a focus on social structures and a dialogue among all parties. In this context, universities have a critical role to play: these institutions build capacity through the development of new knowledge, new understanding and new insights, and can therefore provide effective solutions to complex societal challenges. In search of innovative approaches to reach young people, whose communicative paradigm has become more interactive and participatory, the use of serious gaming in formal education is gaining attention among scholars and practitioners: they can foster skills and abilities, contribute to content development of complex issues by integrating insights from different disciplines, and permit learning experiences that are not possible in real life. In this paper, we introduce “We-Energy Game”, a serious game that address the urgency and complexities in the provision of affordable energy from renewable sources for an entire town. During the game, players negotiate, from their respective roles, which energy source they want to employ and on which location, with the goal to make a village or city energy neutral. Then, we present findings from a pretest and posttest completed by a hundred university students in The Netherlands to analyze the effects of the game on players awareness, understanding and efficacy beliefs. Results reveal positive outcomes on all variables.

Keywords: serious games, education, youth, sustainability, energy transition, effects

1. Introduction

In respond to the complex challenges introduced by the climate emergency, the European Union have set ambitious but urgent goals: to create a transition of the energy system by improving energy efficiency and increasing the share of renewable energy in ways that would be compatible with increasing competitiveness and security of supply, and reducing greenhouse gas emissions by 80–95% by 2050, when compared to 1990 levels (EU, 2018). That means that involvement from all parties is necessary to reach those goals, from local governments to private sector and citizens; their awareness and understanding of the process is needed, however, communication and education efforts is an often-neglected pillar, especially among younger generations whose support is a significant driver in the short, medium and long term. In this context, universities have a critical role to play: these institutions build capacity through the development of new knowledge and insights and can therefore provide effective solutions to complex problems. They also produce a regular supply of highly educated, skilled people who will soon develop and implement solutions to present challenges. In words of Marie Skłodowska Curie: “nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less” (EUA, 2017).

To reach young people, traditional communicative paradigms need to be revised towards new formats that facilitate a natural interaction between the person, the interface, and the environment. In search of innovative strategies, games are gaining attention among researchers and practitioners in higher education institutions, as a tool to raise understanding and encourage action on sustainability and energy transition. Games that are intended to fulfil a purpose, convey ideas and values, and sometimes, to influence the players’ thoughts and actions in real life have received the name of Serious Games (Frasca, 2007). When used in formal education, these games can foster awareness, skills and abilities, contribute to content development, increase motivation and allow experiential learning.

In this paper we introduce “We-Energy Game” as an example, a serious game that address the urgency and complexities in the provision of affordable energy from renewable sources for an entire town. The game has been used among international students in higher education institutions in The Netherlands. In this paper we

also present findings from a pretest and posttest to analyze the effects of the game on players' awareness, knowledge and efficacy beliefs.

2. Games and education

Until not long ago, video games have been linked to negative stereotypes and effects on gamers' physical and mental health. However, when playing takes place during a moderate length of time and the environment is adequate, they can also be seen as a safe activity. Success of classical platforms such as Nintendo, through innovative games like Nintendo Wii Fit or Nintendo DS (e.g. Brain Training) show different methods in which digital games can have a positive impact on youth well-being. In this context, the Serious Games movement has emerged to use gaming technologies for communication, education or training purposes. The term invention has been attributed to Clark C. Abt in 1970, while the popularization has been assigned to the paper *Serious Games: Improving Public Policy through Game-based Learning and Simulation* by Ben Sawyer in 2002; later in 2007, the evidence of an established academic field became a fact with the foundation of The Serious Games Institute at Coventry University (Wilkinson 2016).

One of the reasons of the popularization of these tools are to meet the needs of the "interactive generation" (Aguaded-Gómez, 2011) or "digital natives" (Prensky, 2001). This generation of learners was born after the 1970s and has grown up surrounded by digital technology, entertainment media, social networks and two-way communication processes from a very young age. They usually engage in activities that have the capacity to reward them for effort and perseverance, "and as a result they expect the same level of reward from learning activities" (Felicia, 2009).

While youth shows a growing interest for games, especially digitally, educators are observing a declining motivation for school and difficulties to engage this generation to take part in traditional learning activities (Kemp, 2006). Specially topics like energy can be uninteresting for teenagers, so one solution has been the use entertainment media like games (Reeves et al., 2013), as it was done with birth control information in soap tv or nutrition information in radio dramas. Scholars have found out that games seem to have high intrinsic motivation factors, and this has been the basis for research conducted in the field of (video) games and education. One of the earliest works in the field of intrinsic motivation is attributed to Malone and Lepper (1987): they studied what makes computer games interesting and exciting, establishing a taxonomy of intrinsic motivation.

One of the main scholars in the field of games and education states that some of the learning principles that "good" games can incorporate are (Gee, 2003, 2004, 2005):

1. Identity: learning something requires the learner to play a role and take on a new identity which turns into becoming committed to the "new world" they are immersed.
2. Interaction: the game give reactions, placing feedback in the context of an interactive relationship between the player and the environment.
3. Production: players become producers by co-designing actions and taking decisions in the game.
4. Risk taking: players are encouraged to take risks, explore, and try new things, which the consequences of failure and negative feelings attributed to it.
5. Customization: players can usually, in one way or another, customize a game to fit with their learning styles by, for instance, having different levels of difficulty.
6. Agency: players can feel a real sense of control and ownership over what they are doing.
7. Well-order problems: when players are left free to explore and discover complex problem spaces, they can develop further creativity. Having different levels is a sign of the importance of arranging and organizing problems in the game.
8. Challenge and consolidation: games can offer challenging problems and then let players solve them until they have "automatized" their solutions; the new mastery is consolidated through repetition.
9. "Just in Time" and "On Demand": instead of providing many words like in books, games give verbal or visual information either when players need it or want it.
10. Situated meanings: games situate the meanings of words in terms of the actions, images, and dialogues they relate to.
11. System thinking: games encourage players to think about relationships and connections between causes and consequences.

12. Cross-functional teams: when playing in teams, people are affiliated by their commitment to a common quest. This also makes the experience more fun and memorable.

However, in practice many education practitioners feel confused and lack guidance on how to evaluate quality of serious games that available for free online and on how to implement these games in class. When games are considered for instructional use, many factors must be weighed (Turkay et al., 2014). To bridge this gap, Ouariachi et al. (2019) developed an evaluation tool that presents a definition of quality and a scale of scores for each of the criteria, divided into five different categories (identification, narrative, contents, gameplay, and didactics), then the integration of the five dimensions provides quality scores that allow to determine the quality scenario of games (low quality, medium quality, and high quality). This tool can be used by teachers when deciding if certain serious games fit their needs to be implemented in class.

3. Energy-related serious games

Sustainability or energy literacy can play an important role in promoting political decisions and changes at the individual and collective levels; however, it is not easy or “attractive” to engage the public, especially young people, in these complex issues. Serious games make use of entertainment for educational purposes, facilitating the process in which players cultivate their knowledge and practice their skills in a subconscious way. Today, serious games are one of the growing areas in educational media; its market is expected to grow from 3.2 billion U.S. dollars in 2017, to 8.1 billion in 2022 (Statista, 2018).

Most of studies that map and explore serious games in the field of climate change or sustainability have found that mitigation is the main topic, understood by United Nations as efforts to reduce or prevent emission of greenhouse gases (Katsaliaki & Mustafee, 2014; Ouariachi et al., 2017). Mitigation can be understood as using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behaviour; it can be as complex as a planning a new city or as a simple as improvements to a cook stove design. Concretely, serious games on energy issues have grown and diversified exponentially over the last years but, especially, these types of games have experienced most progress in an online format.

Different web platforms are available to the public and for free that serve as a repository of these types of games, such as Games4Sustainability or Gamepedia, targeting academics, trainers, NGOs, teachers, students, and anyone interested in this topic. Examples of energy related serious games include “Energities”, a game in which the player is faced with the challenge of developing an eco-friendly city dealing with issues such as pollution, energy shortages, and renewable energy. Players place buildings on a grid to grow their city. They need to balance energy sources, cash flow, and the city’s economy, wellbeing, and environment. Another example is “WindMill Game”, a strategy game about building wind farms to create clean energy profitably. Players fulfil a specified energy offset goal as quickly as possible by building turbines smartly, and research locations carefully for the best wind conditions, avoiding upsetting the local citizens by building turbines in undesirable places.

4. Theoretical framework

In the last decade, the interest in researching the potential of games beyond their motivational value for learning has brought an increasing number of papers and conferences proceedings (Turkay et al., 2014). According to Squire (2006), one of the emerging ideas is to think of games as “designed experiences in which participants learn through a grammar of doing and being”. Under the same approach, Gee (2004) considers games as enablers of “situated language and learning”, a view that relates to theories in situated cognition, which suggests that learning is tied to the authentic activity, context, and culture within which knowledge is developed.

The field of game-based learning and serious games in the education sector have also experienced an increasing number of studies related to effectiveness. Scholars have argued that serious games can be an effective tool to increase awareness and knowledge, but also to change people’s attitudes and behaviors. The mechanism through which this process occurs is that “playing a game can lead to a state of flow or immersion where players are extremely concentrated and time passes unnoticed”, which can lead to a higher awareness and understanding of relevant factors involved in the game (e.g. energy saving), and in effect, to a positive change in attitude which can subsequently trigger a change in behavior itself (Soekarjo & van Oostendorp, 2015). Scientists have argued that “experientially derived knowledge” through vivid and concrete information is often

more compelling to influence attitudes than “abstract knowledge” (Aronson, Wilson & Akert, 2013). Regarding awareness, most studies have found positive changes (Van Pelt, 2015). Knowledge has been increased by players in five of the sixty games reviewed after playing them, however, evidence on changes in attitudes and behaviours is still contradictory (Soekarjo and van Oostendorp, 2015).

When addressing the extent to which environmental attitudes can predict environmental behaviors, Ajzen’s Theory of Planned Behavior (1985) postulates that a positive attitude towards a particular behavior in combination with positive subjective norms and a higher degree of perceived control will likely positively influence a person’s intention to perform that behavior, and increase the likelihood that the behavior will be performed. In relation to perceived control, a crucial concept is self-efficacy. According to Bandura’s Social Cognitive Theory (1986a), perceived self-efficacy is the extent to which people believe that they are capable of doing specific tasks in order to achieve certain goals. Two common sources of self-efficacy are enactive experience (learning through direct experience) and observational learning (learning through observation of the experiences of others). Playing games can be considered a “mediated” enactive experience because it offers an environment to imitate behaviors and their consequences, and for Bandura (1986b), enactive experience is the more powerful mechanism to raise self-efficacy.

In the field of games, several empirical studies have been carried out examining the relationship between playing games, self-efficacy, and behavioral intentions or actual behavior change. On the one hand, Yang et al. (2016) found out that learners’ behavioral intention was significantly improved after playing a game. Reeves et al. (2013) built a social game about energy use in a virtual home, and in a field test, smart meter data showed a significant decrease in electricity usage when comparing 30-day periods before and after playing. Using health games, Kato et al. (2008) study revealed that after playing a game there was significant increase of cancer-related self-efficacy (significantly greater in game group vs. control group), and significant improvement of treatment adherence. In Peng’s study (2009), self-efficacy and intention to eat healthier were significantly greater at post-test in the experimental group that played the game versus the control group who did not. On the other hand, scholars like Soekarjo and van Oostendorp (2015) suggest that limited empirical evidence is currently available to prove the effectiveness of games in attitude or behavior change: first of all, evidence of successful change in attitude after playing a persuasive game can only be found in five of sixty papers reviewed, and evidence of change in behavior in only three papers. Secondly, using a pretest-posttest design, they tested whether change in attitude was different for people playing the persuasive game EnerCities compared to a control condition where participants read a document with highly similar information, finding out no significant differences.

In order to raise awareness, improve knowledge and enhance self-efficacy beliefs, playing games shall provide an enjoyable experience (Lee, 2000). According to a research conducted by Zhonggen (2019), one of the main reasons for the effectiveness of serious games in education may be related with the impact of these games on learners’ mood: effective serious games try to create a positive mood in order to encourage players’ interest in gameplay, as well as better academic performances. Other studies put emphasizes on learners’ previous attitudes as the main factor. In a research carried out by Sinatra et al. (2012), persuasive materials were used with students to change their attitudes as well as influence their willingness to change regarding global climate issues, finding out that students who have more favorable attitudes toward the idea of human-induced climate change are more likely to report a willingness to act. The study by Bell et al. (2016) reveals that adolescents who already actively engaged in reducing energy reported a significant increase in energy-saving behaviors as a consequence of participation in an online intervention based on implementation intentions, whereas those who were not already saving energy did not.

5. Case study: We-Energy Game

The We-Energy Game (developed at EnTranCe the Centre of Expertise Energy in Hanze University of Applied Sciences in Groningen, The Netherlands, under the project “From A to Sustainability”) is a serious game aiming to create understanding on the urgency and the challenges in the provision of affordable energy from renewable sources for an entire town or city. The game can be played on board or on screen by a minimum of five players who take the roles of:

- Production: a project leader who needs to produce a certain amount of energy
- People: the citizens of the area where the game is played
- Planet: how green/clean is the energy production

- Profit: how much profit is made by the different projects
- Balance: how easy to work with is the energy source for the network-operator

The exact calculations and effects of the different options are based upon scientific research and the latest insights. While playing, players negotiate from their respective roles which energy source they want to employ and on which location. Once agreement is reached, they place the icon that represents that energy source on the map and they check the consequences for each of the roles (production, people, planet, profit and balance).

Through playing the game, they will realize that without collaborating with the others, they will not be able to achieve their ultimate goal of creating a sustainable energy mix for their town or city. In the process, players also realize that there are many available solutions to reach an optimal balance, and that sustainability is not just a technical issue, but a social one as well. For example, even though there is great support for solar panels, the sun does not always shine, so other resources are needed; wind provides a lot of energy, but can also encounter protest by local residents; biomass could be a good solution, but its yields are less and its environmental footprint is greater.

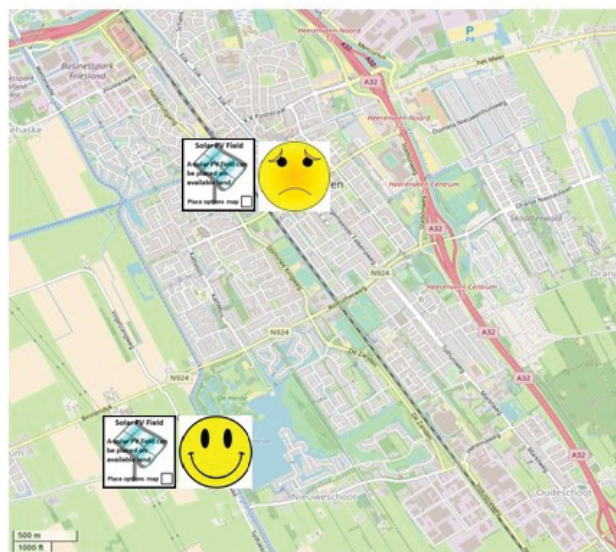


Figure 1: One of the location representations of We-Energy Game

The image above (Figure 1) is an example of locations represented in We-Energy Game, using real data based on own research and an open street map. In the Netherlands, population ranges from 500–5000 inhabitants in a village to 10,000–50,000 inhabitants in a populated area, like a city. The game uses four levels of difficulty by making use of four different maps in The Netherlands, allowing players to experience the challenges of making different towns with different populations sizes and urban structures energy neutral: Diever (goal: 25 points), Meppel (50 points), Assen (75 points), Emmen (100 points). The scores are also based on realistic effects of each variable and refer to the amount of energy, emissions, and impact. The game finishes when all roles reach the total score for the selected town, maintaining a positive balance. Therefore, the educational objective is to create understanding on the urgency and complexities once they are familiar with game mechanics in order to understand that the larger the locations are, the more challenging to achieve common goals and keep all roles satisfied are, and that the need of collaboration from all stakeholders is crucial to reach the goals. Additionally, although not the primary focus, the game hopes to influence positively on players' intentions to change behaviours on a later stage.

5.1 Implementation of the game in class

The We-Energy Game has been played by a variety of groups, such as energy cooperative members, business, municipality representatives and politicians, but also students. The game is suitable to be implemented in class for several reasons: on the one hand, it covers a variety of key competences and abilities. They can be integrated into 21st century skills—learning and innovation skills (critical thinking and problem solving), digital literacy skills, and career and life skills (adaptability, social interaction, accountability). On the other hand, the game is characterized to be interdisciplinary, which means that it can be used simultaneously for different disciplines, such as social studies or environmental studies, and to allow group work in class.

The game has been implemented with students in higher education institutions, such as Hanze University of Applied Sciences. Students were Dutch and international and they belong to different disciplines: marketing, international communication, engineering, etc. The game session is facilitated by an expert on energy transition together with a teacher from the respective class. Before starting, students are introduced to the game goals and rules, then they are split into groups of five. The length of the gameplay is about 30 minutes when playing two different maps, and therefore two different levels. After playing the game, there is a debriefing session where information is shared and examined.

5.2 Analysis of the effects

5.2.1 Methodology

In search of evaluating the effects of the game on students, we conducted a pilot study using a pretest-posttest design research. Participants' awareness, understanding and efficacy beliefs are assessed by using a survey before playing the game and after playing the game, including as main questions (Table 1): how informed and what degree of urgency to act do they feel about the energy transition; how much do they believe energy transition is a social, economic or technical issue; how much do they agree that there are many available solutions to reach an optimal sustainable energy mix in their region; and how can they contribute, by themselves or with the community, to a sustainable energy transition in their region. Respondents are asked to rate those statements on a four-point and five-point Likert scale ranging from respectively 'not at all' to 'a lot'. They are also asked in an open question about the fun factor and learning points.

Table 1: Operationalizations of the variables in the study

Variable	Indicator	Measurement
Awareness	Information	Four-point Likert scale
	Urgency	Five-point Likert scale
Knowledge	Technical issue	Five-point Likert scale
	Economic issue	Five-point Likert scale
	Social issue	Five-point Likert scale
	Optimal mix for my region	Five-point Likert scale
Efficacy	Self-efficacy	Five-point Likert scale
	Collective-efficacy	Five-point Likert scale
Fun factor New learning aspects		Open question

Content validity of the instrument used is determined by a selection of dimensions explored by other authors on aspects of awareness, knowledge and efficacy beliefs. Items were compiled from similar previous studies and were based on topics present in the game. The researchers used Google Forms to compose and send the surveys online. The data was later transferred to the software SPSS Statistics in order to conduct statistical analysis such as t-test to compare scores pretest and posttest. We translated the students' names into numbers to guarantee their anonymity.

We also conducted a group discussion with a smaller group of students to understand their opinion about the game and to get more qualitative data about their interaction with the game. The discussion, facilitated by researchers just after playing the game, was aimed to be a collective exchange of ideas to share their opinions about the game and their main take-away. The sample of this study is composed by 101 bachelor (Dutch and international: German, Lithuanian, Czech, Azerbaijani, Bulgarian, British, Mexica, Chinese, Turkish, Ukrainian), who finished pre- and post-test, with a mean age of 20.4 years (18-25 years, 67,6% female), at Hanze University of Applied Sciences.

5.2.2 Findings

From the survey, results reveal an increase in urgency and being informed about energy transition: after playing, majority of students feel more the urgency to take action ($t(100)= 45,3$; $p < .001$; see Figure 2) and significantly more informed about the energy transition ($t(100)= 44,3$; $p < .001$).

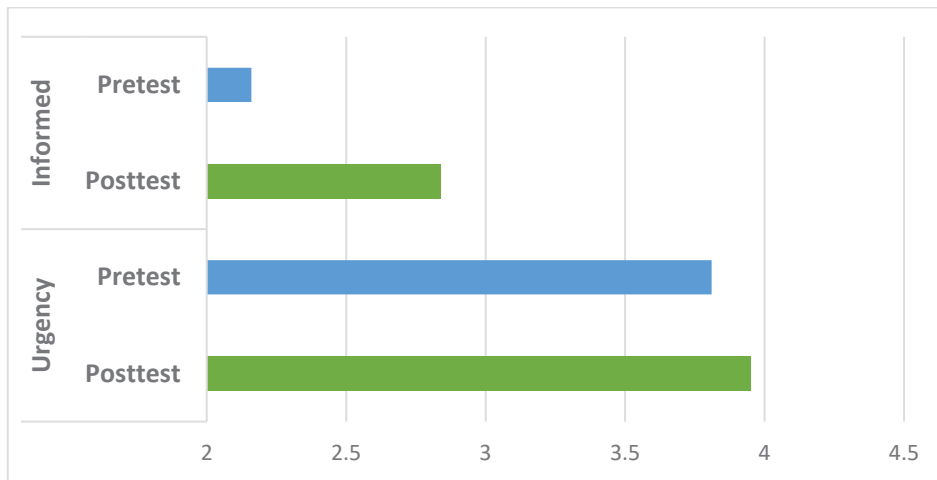


Figure 2: results on being informed and the urgency of the energy transition

When asked whether the students think the energy transition is a technical, economic or social issue and the extend to which they feel that their own region can find an optimal sustainable energy mix, we found in the posttest significant increases in both indicators (Table 2).

Table 2: one sample t-test statistics on whether the energy transition is a technical, economic or social issue, including the need to find an optimal regional optimal mix

Variable	t-value	degrees of freedom (df)	p
Technical issue	40,5	101	<.001
Economic issue	53,2	101	<.001
Social issue	44,8	101	<.001
Optimal regional	40,4	101	<.001

The means on the issues and the optimal regional mix are displayed in Figure 3:

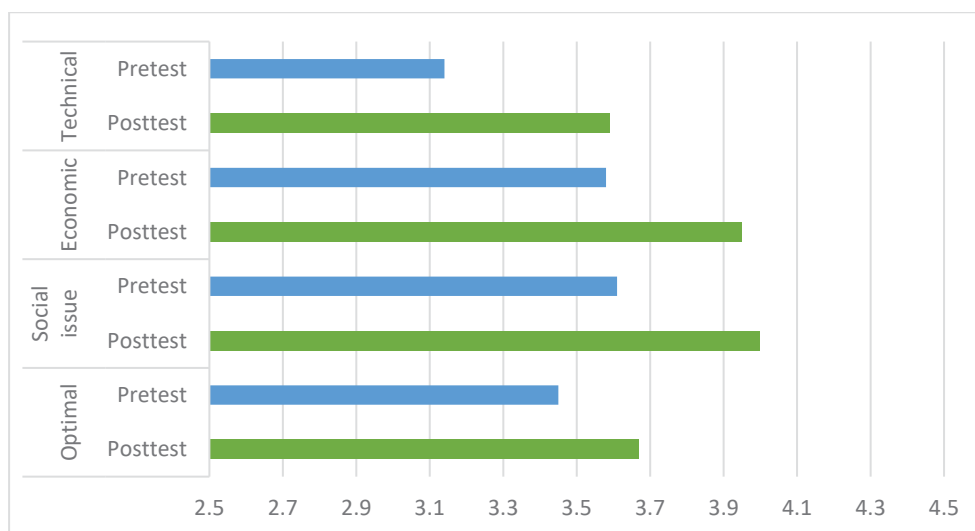


Figure 3: mean scores on the pre- and posttest on the social

The contribution individual students feel they can make (self-efficacy) was also significantly higher in the posttest compared to the pretest ($t(101)=34,6$; $p<.001$) as well as the collective efficacy ($t(101)= 35,7$; $p<.001$). The means of self-efficacy and collective efficacy are displayed in Figure 4.

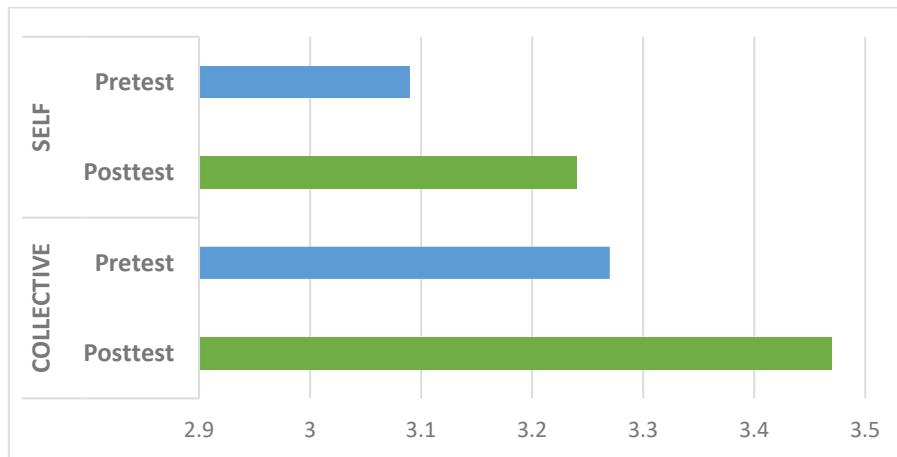


Figure 4: means in the pre- and posttest of self-efficacy and collective efficacy

The group discussion showed us that students perceive the game as fun and that they prefer to have this type of interactive practice rather than a traditional class characterized by a unidirectional transmission of information. After playing the game the students indicated an increase of the suitability of games for educational purposes ($t(100)= 41.0; p<.001$) and they indicated that their interest in the energy transition increased as well ($t(100)= 39.0; p<.001$). The means of these two variables are presented in Figure 5.

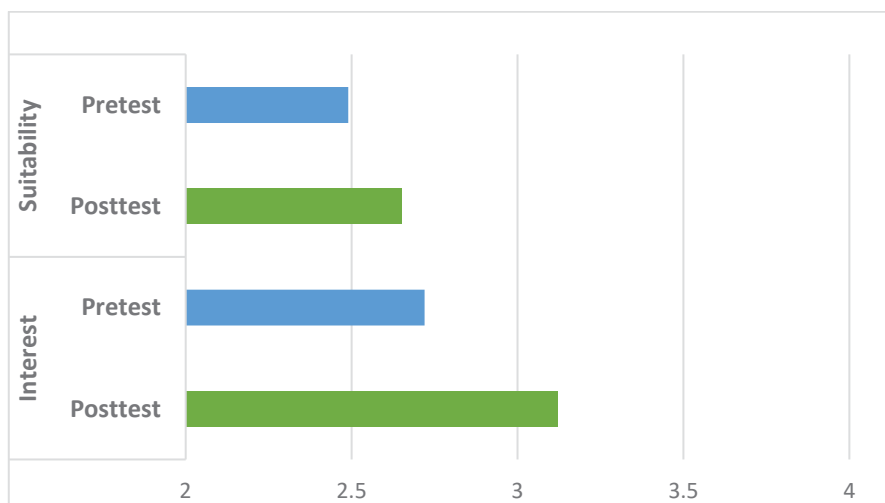


Figure 5: mean scores in pre- and posttest on the suitability of games for educational purposes and the interest in the energy transition before and after playing the game

However, the discussion also shows how educational games have still a long way to go to achieve the high levels of engagement of commercial games which present impressive graphics, more challenges and different types of interactive mechanics. The following table (Table 3) provides some examples of answers to the question was the game fun:

Table 3: Opinions about the fun factor of the game

Yes, because you had to be strategic Yes, because we were in control Yes, helping each other Yes, it was interactive and presented in a more fun way Yes, nice team work, more fun than teaching style Yes, because of the people I played it with Yes, it's nice to try and get everybody to go as far as you can. it has strategy and creative thinking Yes, it was interesting and something different and we had to work like a team Yes, because we all had to work together and because it was Groningen and we recognized the parks Yes, it was really fun and interesting at the same time. It was exciting to get an insight in the problematic situation and to see what it actually means for the different parties Yes, because we got to understand how to balance the different resources and roles that are needed to achieve an arguable sustainable environment	No, just initially. After I started playing I started thinking about what can become priority to achieve our goal. Then I was thinking is it really hard to make such decisions No, too much calculation No, there was no competition 50/50 Fun for once No, too much calculating and moving stuff around No, it was very long
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To the question ‘what are your main learning points after playing the game’, some of the answers are (Table 4):

Table 4: Opinions about the learning points of the game

People hate wind turbines It is hard to work together and achieve the goals Not every renewable energy is good for the environment It's quite hard to please every stakeholder There are different ways to get energy It's difficult in a big city to improve solar fields You win faster if you work together How many options there were and why we still don't have completely sustainable cities We should care less about making money for energy The hectares it takes to build a corn field just for biomass or to build a solar panel field The problem of space The fact that it's harder for cities to get all their energy from (natural) sources -> this is easier in small villages Teamwork for sustainability
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6. Discussion and conclusions

Using the We-Energy Game as a case study, this paper offers insights into the opportunities and challenges of using serious games in formal education, concretely in higher education institutions. The game has significantly contributed to raising awareness and understanding on the urgency and complexities of energy transition in an interactive, innovative and attractive way for young people. In accordance with other studies, serious games have potential in raising awareness and knowledge on complex issues -enhancing cognitive abilities, affect, and pleasant mood-, however, it remains to be seen to what extent these types of tools have also an impact on attitudes and behaviours. If we look at efficacy beliefs, considered here as a crucial antecedent of people intentions to change behaviours, in this case we observe that both self-efficacy and collective efficacy experience an increase after playing the game. Findings also reveal that the feeling of collective efficacy seems slightly higher than self-efficacy in the posttest. This might be related with the fact that the game encourages teamwork and dialogue among players to reach the goals. Through playing the game, they realize that without collaborating with the others, they will not be able to achieve their ultimate goal of creating a sustainable energy mix for their town or city. It is important to add that the game is developed for politicians and policy workers, and that students needed to jump in a situation that they normally would not so much have interest in. The results show that the game is excellent in raising awareness and raising the urgency of the Energy Transition. In addition, this research is considered a pilot study with a small sample of students, so we encourage researchers to further

explore this field and conduct more empirical studies to test the effectiveness of this serious game or any other in improving awareness, knowledge and/or efficacy beliefs with larger samples of players.

What seems clearer is that most students perceive the game as a fun activity and usually prefer this type of interactive practices rather than traditional teaching methods. Several scholars have studied what are the possible factors of enjoyment. Ryan, Rigby and Przybylski (2006) use Self-Determination Theory (SDT) as a theoretical framework to explain that enjoying a behavior depends on the individuals' experience of autonomy, relatedness and competence. Crutzen, van 't Riet and Short (2016) suggest narrative transportation (being away from the physical world and entering into the imaginary world presented in a story), relevance (self-identification with characters), and competence. For Klimt (2003), competence is a key factor too. He states that in order to offer enjoyable experiences, the game should balance challenge and mastery in a careful way: "players should be able to achieve goals and perceive themselves as successful, but at the same time feel curiosity that is generated from the uncertainty of whether they will be able to cope with challenges as they arise". This analysis coincides with Csikszentmihalyi's (1990) flow theory, which postulates that most positive experiences result from mastering tasks that are not too easy and not too difficult.

In order to explore the impact of serious games on learning, different implications must be taken into account for educators and facilitators. From our experience, feedback, interaction among players, and debriefing. Zhonggen (2019), for instance, coincides in these three factors and adds backstory-production, realism, artificial intelligence-adaptivity in order to achieve success in learning. Other authors include the perceived usefulness of the game, ease of use, and goal clarity as indicators of satisfaction and effectiveness in use of serious games: when learners clearly predict the goals and ease of use, they tend to focus on the contents and enjoy themselves (Wang et al., 2017).

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Factors Predicting Integration of E-Learning by Preservice Science Teachers: Structural Model Development and Testing

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DOI: 10.34190/JEL.18.5.005

Abstract: This study investigated the possible factors that predict e-learning integration into the teaching and learning of science subjects among preservice science teachers. A unified e-learning integration model was developed in which factors such as attitude, intention, skill and flow experience served as precursors of e-learning integration. This was done to help close the gap that no previous studies have developed a structural model to statistically explain the interactions among the most influential factors in various technology integration models. The survey method was used to gather data from 100 preservice science teachers and partial least square structural equation modelling technique was applied for structural path analysis and testing of the developed model. Results revealed a good model fit and hypotheses formulated in this study were faithfully supported. The results also revealed that all factors investigated were found to be significant predictors of e-learning integration with skill standing out as the most significant and strongest factor that predicts the integration of e-learning by preservice science teachers.

Keywords: E-learning Integration, Least Square, Planned Behaviour, Preservice Teachers, Structural Model, Technology Adoption

1. Introduction

The ever-growing and emergent roles of information communication technology (ICT) such as e-learning in education system across the world has increased the expectations and curiosity of teachers to seamlessly integrate technology for quality and innovative teaching, learning and assessment in the schools (Sadaf, 2013; Saltan and Arslan, 2017). Against this background, many governments across the nations of the world have invested heavily and made considerable capital investments through several initiatives to provide a variety of interventions to help teachers integrate e-learning into teacher education programmes and schools (Ziphorah, 2014; Adu Gyamfi, 2016). Despite these investments, the uptake of e-learning integration by teachers in South Africa schools is still very low, especially in teaching and learning of mathematics and science subjects, where e-learning tools can be used for concretizing scientific abstract concepts (Howie and Bignaut, 2009; Mofokeng and Mji, 2010; Stols, et al., 2015; Umugiraneza, Bansilal and North, 2018). For this important reason, Jita (2016) and Adu Gyamfi (2016) expressed concern that for effective e-learning integration to take place in schools, a solid foundation must be laid properly at the level of preservice teachers who are expected to be part of the innovation change process in schools.

Thus far, literature has generally revealed that despite several inherent benefits of e-learning, preservice teachers are not integrating it during their teaching practices in schools (Al-Ruz and Kawsaneh 2011; Ziphorah, 2014; Prasojo, et al., 2018). The reason behind their inability to integrate e-learning could depend on factors that predict integration behaviour of preservice teachers (Tezci, 2011; Bozkurt, 2016; Olugbara, et al., 2019). However, there has been a paucity of research investigating factors that influence e-learning integration by preservice science teachers in many developing countries of the world (Jita, 2018). Many researchers such as Ajzen (1991), Knezek, et al., (2000), Lee (2010) and Teo (2011) have developed an integrated model to help in explaining technology integration. However, no previous studies have developed a model to explain the interactions among the most influential factors in various technology integration models to compete with one another for predicting e-learning integration. The overarching aim of this study is to propose and test a model to predict e-learning integration by preservice science teachers. The factors contained in this model were the most influential factors in the preceding technology integration models that predict technology. However, these factors have been coherently agglutinated for the first time into a unified structural model to uncover the salient factors that would best predict the integration of e-learning by preservice science teachers.

The remainder of this current paper is succinctly articulated as follows. Section 2 discusses the related literature that are of immediate relevance to the current study. Section 3 presents the theoretical foundation that has

guided the development of the proposed structural model and the research hypotheses. Section 4 presents the study methods, highlighting data collection and analysis. The details of the results are presented in Section 5. In section 6, discussions of results are presented and discussion on the implication, limitation, and conclusion of the paper is advanced in section 7.

2. Literature Review

2.1 Integration of E-Learning by Preservice Teachers

Teaching in the 21st century entails that teachers integrate e-learning technologies into teaching and learning (Batane and Ngwako, 2017). Therefore, it becomes imperative for preservice teachers who are generally regarded as digital natives to integrate e-learning technologies in their teaching, learning and assessment process. Several studies have established that preservice teachers are not integrating e-learning in the delivery of their lessons because of several underlying factors that influence them to integrate or not to integrate e-learning in schools (Al-Ruz and Khasawneh, 2011; Batane and Ngwako, 2017; Prasojo, et al., 2018). For example, Agyei and Voogt (2011) explored the potential of will, skill, tool (WST) model to predict Information Communication Technology (ICT) integration of preservice science and mathematics teachers at the University of Cape Coast. The study reported low level of ICT integration into lessons by preservice teachers because of their low ICT skill and access levels of ICT. In a similar attempt, Sedega, et al., (2018) conducted a study to explore the perceptions of preservice teachers on factors affecting their integration of ICT in teaching and learning of Mathematics. The study revealed that preservice teachers did not integrate technology in their lesson because of limited skill to do so.

However, having skill does not guarantee that preservice teachers will always integrate technology, there are some other essential factors that needs to be considered. A number of researchers have pointed out that the attitude of preservice teachers can play a significant role among the factors that affect the successful integration of technology in the classroom (Adu Gyamfi, 2017; Teo, 2009). Knezek, Christensen and Fluke (2003) tested the WST model with high school teachers and argued that at the highest stage of technology integration by teachers in the classroom, attitude to push forward influence ICT integration over ICT skills. The authors were of the view that ICT integration involves a set of well-defined stages, which requires that a teacher must first develop positive attitude rather than acquisition of ICT skills. In addition, Adu Gyamfi (2017) found that preservice teachers who showed positive attitude towards ICT felt more comfortable using ICT, and more intrinsically motivated to integrate it into their teaching. Another study by Teo (2009) among Singapore preservice teachers concluded that negative attitude towards ICT was a deterrent to integrating e-learning by the preservice teachers in the learning environment.

However, Gotkas, Yildirim and Yildirim (2009) disputed this claim arguing that having a positive attitude towards ICT is not sufficient by itself to achieve effective and meaningful integration of ICT into classroom environment. Other important factors such as motivation, skill, intention, access and leadership support do play a pivotal role. In the same vein, Morales (2007) when testing the WST model to predict ICT integration argued that attitude of teachers to use technology are pointless if it is not supported by the necessary skills to use the technology. That is, attitude must be agglutinated with skills for technology integration to be effective. Moreover, technology integration by preservice teachers can be influenced by other factors, such as intention (Teo and Lee, 2010; Teo and Tan, 2012). This avowal is well supported by theory of planned behaviour (TPB). Teo and Tan (2012) applied TPB to explain the intention of 293 preservice teachers to use technology at a teacher training institute in Singapore. The results explained 51% of the variance in intention of the preservice teachers to use technology. The one apparent limitation of this study is that the authors did not investigate whether the preservice teacher translate their intentions to actual integration. Sadaf (2013) investigated factors that influence the integration of Web 2.0 technologies by preservice teachers during their student teaching experiences. Results of the study revealed a significant positive relationship between intentions and the actual integration of Web 2.0. The results further revealed that some preservice teachers were unable to integrate Web 2.0 because of limited access to technology resources such as connectivity, suitable platform and lack of support from teachers who were not accepting new technologies.

Therefore, intention may not directly translate to the actual integration of e-learning (Olugbara, et al., 2019). Guillén-Gámez, Lugones and Mayorga-Fernández (2019) asserted that willingness and motivation are key elements for preservice teachers to succeed in integrating ICT in the classroom. Batane and Ngwako (2017) studied the problem associated with the integration of technology by 52 preservice teachers during teaching

practice. The study results indicated that the majority of the participants did not integrate technology in the delivery of their lessons, even though they had enough skills to do so. They were not motivated to integrate technology because there was lack of adequate resources in the classrooms and integrating technology was not part of the assessment for them to pass teaching practice examination which was their ultimate goal. The review of previous studies indicates the significance of searching for factors that might best predict e-learning integration by preservice teachers. A common understanding of these factors have been established, that is factors that predict integration of e-learning by preservice teachers have not been agreed upon.

2.2 Preparing Preservice Teachers for E-Learning Integration

Having established the need to understand factors that predict the integration of e-learning in the classroom by preservice teachers. The concern of teacher education institutions should focus on measures of how to prepare preservice teachers for technology integration to make innovate use of technology in a classroom which have been seen as part of the development of teacher education programme. There are many views on what the preparation of preservice teachers should include to increase the possibility of e-learning integration in classrooms. Prasojo, et al., (2018) suggested that technology related training can play a crucial role in preparing preservice teachers for integrating e-learning. Guillén-Gámez, Lugones and Mayorga-Fernández (2019) also suggested that teacher education institutions should focus on the training of preservice teachers based on motivation and ensuring that they see the real benefit of using ICT to cause innovation in teaching and improve the quality of education (Olugbara, et al., 2019). The literature has shown that even when teachers are adequately trained to integrate technology, it is still not a guarantee that they would integrate technology (Batane and Ngwako, 2017; Nkula and Krauss, 2014; Sadeck and Cronjé, 2017). On this basis, Ndlovu and Lawrence (2012) explained that the fact that teachers struggle to innovatively use the skills they acquired from the trainings in their lessons to improve learning is an evidence that the training does not adequately prepare the teachers to integrate ICT pedagogically. On the other hand, Nkula and Krauss (2014) argued that even though some teachers have received training on ICT integration, they may still not integrate, because they are not inclined to do so. Consequently, they are resilient to change their old pedagogies, and this may also be associated with their individual factors such as personal preference and attitude to ICT integration, which are not easily resolved.

Moreover, preparing preservice teachers to effectively integrate technology in the classroom is an arduous task that is confronting teacher education institutions (Liu, 2016). Therefore, teacher education institutions have a substantial role to play in preparing preservice teachers to integrate technology into curriculum. To address this challenge, scholars such Tondeur, et al., 2016; Batane and Ngwako, 2017; Ndlovu and Lawrence, 2012) have revealed that teacher education institutions need to develop a systematic and effective strategies. This should include learning technology by design, using teacher educators as role models and scaffolding authentic technology experiences with the available tools. This will assist preservice teachers to develop skills to help them circumvent the challenges of integrating ICT in their teaching processes. Modern preservice teachers are expected to be leaders of technology application in the curriculum upon their graduation from the universities. They should be able to demonstrate to seasoned contemporaries the new trends in technology for them to gain the necessary expertise (Ward and Overall, 2013). By doing so, newly qualified teachers may not be re-trained in the basic technology skills and integration of e-learning technologies into the curriculum. Thus, to implement effective strategies that can prepare preservice teachers to integrate e-learning tools into the curriculum, it is important to understand the factors that best predict their integration of e-learning and tailor the strategies towards the best factors.

3. Theoretical Framework

Many researchers have developed and validated various technology adoption theories and models to understand the predictors of e-learning integration. The model proposed in this study was justified by the extant, eminent and robust theories of the Will, Skill, Tool (WST) of ICT integration (Knezek, et al., 2000), Theory of Planned Behaviour (TPB; Ajzen, 1991), and the Flow Theory (FT; Csikszentmihalyi, 1975). The WST was proposed by Knezek, et al, (2000) to predict the level of ICT integration by teachers to influence academic performance. The model postulates that Will (computer attitude) of the teacher, Skill (ICT competence), and Tools (access to ICT tools) are key elements for a teacher to effectively integrate ICT into classroom practice. The WST model has been used extensively to comprehensively explain the level of teachers and preservice teachers ICT integration into classroom practice (Morales, 2007; Agyei and Voogt, 2011; Knezek, Christensen and Fluke, 2003; Knezek and Christensen, 2016). The TPB was proposed by Ajzen, (1991) as a theory that predicts deliberate behaviour,

which can be deliberate and planned. TPB postulates that intentions of individuals are the proximal determinants of their behaviours, with intention as a concept to capture the motivation of an individual to perform a given behaviour (Ajzen, 1991). The stronger the intention of an individual to engage in a behaviour, the more likely the individual would perform that behaviour. The TPB was applied in an educational setting to examine the intentions of preservice teachers to integrate technology (Teo and Lee, 2010; Teo and Tan, 2012). The flow theory was proposed by Csikszentmihalyi (1975) as a better way to understand intrinsic motivation. Flow theory posits that the flow experience occurs when people engage and immerse themselves in specific activities (Csikszentmihalyi, 1997). When people are in the flow state, they become totally immersed in their activities to the point of losing an awareness of time and critical matter, unable to recognize changes in their environments that nothing else seems to matter besides what they are doing (Lee, 2010). Some researchers have extensively applied flow theory to explain intentions of teachers and students and the usage of e-learning (Liao, 2006; Lee, 2010; Rodriguez-Ardura and Meseguer-Artola, 2017; Kim and Jang, 2015).

3.1 Research model and hypotheses

The research question investigated in this paper deals with the factors that best predict integration of e-learning by preservice science teachers. The proposed model in this study combines the most influential factors reported in the literature to predict technology integration under a single framework to realize a new validated structural model. These influential factors have hitherto not been coherently integrated into a unified structural model to compete with one another to predict e-learning integration. Hence, it is possible that, when these influential factors are combined, they collectively provide a broader understanding of the factors that best predict the integration of e-learning for science education.

3.1.1 Attitude

Attitude is defined as positive or negative feelings of someone about using technology to accomplish a given task (Teo and Tan, 2012). The successful integration of e-learning largely depends on the attitudes of teachers who eventually determine how these tools will be used in the classrooms (Afshari, et al., 2009). The attitude and integration relationship in WST suggests that at the highest stage of technology integration by teachers, attitude to push forward was the best predictor. Thus, the willingness of teachers to integrate technology leads to higher stages of classroom ICT integration, which in turn leads to greater student achievement. This relationship has been empirically tested using WST by prior study (Knezek, Christensen and Fluke, 2003). Moreover, according to TPB, attitude predicts behavioural intention of teachers, which in turn influences their actual behaviour. Prior research which applied TPB has demonstrated that attitude is a significant predictor of intention of preservice teachers to integrate e-learning (Teo and Lee, 2010; Teo and Tan, 2012). The following hypotheses were therefore proposed in this study:

H₁: Attitude will be a significant predictor of e-learning integration by preservice science teachers.

H₂: Attitude will be a significant predictor of intention of preservice science teachers to integrate e-learning.

3.1.2 Intention

Intention is the exact decision of a person to behave in a certain way and it guides a motivation to perform behaviour in terms of direction and intensity (Sheeran, 2002). The factor of intention is the most prominent predictor of behaviour in TPB. This argument is supported by Tarhini, Hone and Liu, (2013) who considered intention to be an immediate antecedent of usage behaviour. It gives an indication about the readiness of an individual to perform a specific behaviour. In regard of the relationship between intention and behaviour, researchers have applied TPB to predict intention of preservice teacher to integrate technology in the classroom (Teo and Lee, 2010; Teo and Tan, 2012; Olugbara, et al., 2019). Therefore, the following hypothesis was therefore proposed in this study:

H₃: Intention will be a significant predictor of e-learning integration by preservice science teachers.

3.1.3 Skill

Technology skill is defined as the ability of a teacher to use a wide range of varying ICT applications to perform various education tasks (Tondeur, Valcke and Van Braak, 2008). The ICT skill of teachers is a major predictor of ICT integration and lack of it has been reported as inhibitors of ICT integration into teaching practices (Morales, 2007; Mofokeng and Mji, 2010; Agyei and Voogt, 2011). The close link between skill and integration in WST model posits that technology skills of teachers influenced them to integrate ICT in teaching and learning processes. This close link is empirically supported by prior studies that applied WST model to predict the level of ICT integration by teachers and preservice teachers (Morales, 2007; Agyei and Voogt, 2011). Knezek and

Christensen (2016) have extended the WST model by including pedagogy factor to predict technology integration among teachers. The result indicated that pedagogy was the strongest predictor of technology integration with an R^2 of 33 % followed by skill with an R^2 of 28%. The results indicated that skill contributed significantly to technology integration. Moreover, Anderson, Groulx and Manibger (2011) found that technology skills of preservice teachers predicted their intention to integrate e-learning frequently in their classrooms. Bordbar (2010) and Babic (2012) discovered that the majority of teachers who showed negative or neutral attitudes towards the integration of ICT into teaching and learning processes lacked the knowledge and skills that would allow them to integrate e-learning in their classrooms. Hence, the following hypotheses were proposed in this study:

H₄: Skill will be a significant predictor of e-learning integration by preservice science teachers.

H₅: Skill will be a significant predictor of intention of preservice science teachers to integrate e-learning.

H₆: Skill will be a significant predictor of attitude of preservice science teachers to integrate e-learning.

3.1.4 Flow experience

Flow experience is defined as “the holistic experience that people feel when they act with total involvement” (Csikszentmihalyi, 1997). People experience flow when they are completely engrossed in an activity to the point of losing sense of time and unable to recognize changes in their immediate environments. Flow experience is an intrinsic motivation that can stimulate users to perform an activity with inner joy (Lee, 2010). Most researchers have measured flow experience with two variables, which are concentration and enjoyment. Concentration refers to the degree to which the attention of a person focuses on an activity (Trevino and Webster, 1992). Enjoyment refers to the degree to which ICT usage being perceived to be pleasant, irrespective of the consequences that may arise (Davis, Bagozzi and Warshaw, 1992; Liao, 2006). When preservice teachers use e-learning, they may experience flow, as most e-learning tools provide interactive functions such as chat rooms, discussion forum, virtual gaming and entertainment services that may capture their interest and help them to enjoy and concentrate on their learning (Lee, 2010).

Evidences from the literature supports the application of flow experience in explaining e-learning integration, intention, skills and attitude amongst students (Rodriguez-Ardura and Meseguer-Artola, 2017; Lee, 2010; Ro, Guo and Klein, 2018; Liao, 2006). For example, Rodriguez-Ardura and Meseguer-Artola (2017) investigated the effects of flow in an e-learning environment among 29,723 university undergraduate and graduate students. The results indicated that flow states influence effective continuance usage of e-learning by students and enhance their academic performance. Kim and Jang (2015) indicated that perceived enjoyment was the strongest predictor of integration of Web 2.0 tools by preservice teachers into their teaching and learning processes. Lee (2010) applied the flow theory among 363 students in a Web-based learning service to predict continuance intention of students to use e-learning. The results revealed that flow experience through concentration was a significant predictor of intention of students to use the e-learning service. Mirroring similar outcomes, Teo and Noyes (2011) showed that perceived enjoyment was a significant predictor of intention of preservice teachers to integrate e-learning. The study of Ro, Guo and Klein (2018) examined the effect of flow experience on 315 undergraduate students learning performance. The results revealed that continuous engagement of students in the flow activity developed their skills better in using e-learning, which enhanced their learning performance. Liao (2006) applied flow theory to examine the cause and effect of flow experience on the attitude of 253 undergraduate students to use e-learning systems. The results indicated that students experienced flow and developed positive attitudes towards integrating the e-learning in their module. The following hypotheses were therefore proposed in this study:

H₇: Flow experience will be a significant predictor of e-learning integration by preservice science teachers.

H₈: Flow experience will be a significant predictor of intention of preservice science teachers to integrate e-learning.

H₉: Flow experience will be a significant predictor of skill of preservice science teachers to integrate e-learning.

H₁₀: Flow experience will be a significant predictor of attitude of preservice science teachers to integrate e-learning.

3.1.5 E-Learning Integration

E-learning integration refers to innovative way of using diverse electronic tools to improve teaching, learning and assessment (Olugbara, 2018). From the literature, effective integration of e-learning in the classrooms is determined by the attitude of a teacher toward e-learning and the technology skill of the teacher (Knezek, Christensen and Fluke, 2003; Morales, 2007). How skilful teachers are with technology tools would determine their abilities to integrate it in the classroom. In addition, e-learning integration was found to be predicted by behavioural intention in TPB (Ajzen, 1991). The stronger the intention to perform behaviour, the more likely the behaviour is to be performed. Moreover, Rodriguez-Ardura and Meseguer-Artola (2017) indicated that flow experience influence effective usage of e-learning by preservice teachers. The research hypotheses constitute the proposed e-learning integration model of this study as graphically illustrated in Figure 1.

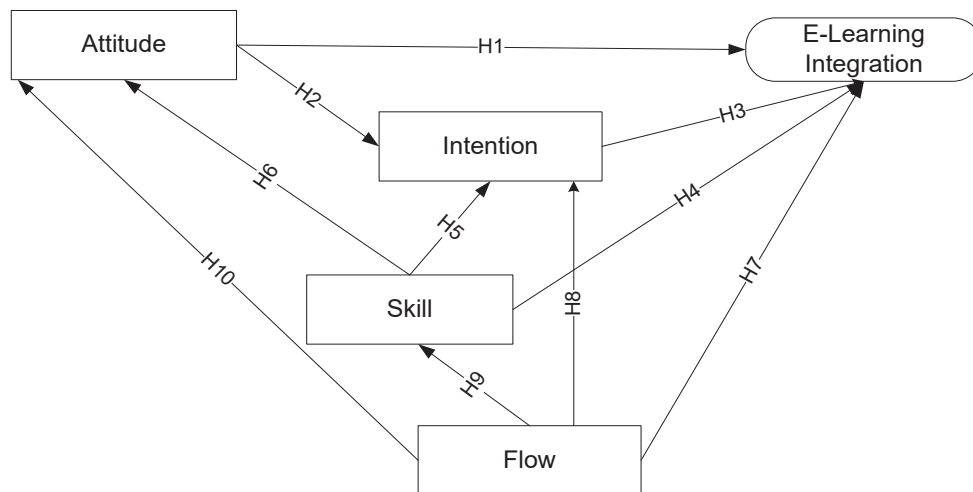


Figure 1: Proposed E-learning Integration Model

4. Methods

4.1 Data collection

The survey instrument with two sections was used to collect data for this study (Olugbara, 2018). The first section had questions about the demographic profile of the participants, while the second section focused on measuring the model factors. These factors are *attitude, intention, skills, flow experience and integration*. The scale items for the model were adapted from previous studies (Sadaf, Newby and Ertmer, 2012; Sadaf, 2013; Lee, 2010; Liao and Lu, 2008; Liao, 2006) with slight modifications to fit the specific context of e-learning integration. In addition, each conceptual item corresponding to these factors was measured on a five-point Likert-scale ranging from “strongly agree” (5) to “strongly disagree” (1). One hundred preservice science education students were conveniently and purposively selected from the fourth year batch at the participating University in South Africa to provide answers to the administered survey. These preservice science teachers were selected for this study because they were involved in formal e-learning classes in their different modules and they had recently completed their teaching practice in the high schools, thus, they were expected to provide in-depth information about the study being investigated. Although, first, second and third year preservice science education teachers were also involved in formal e-learning classes in their different modules, they have not been in teaching practice during the data collection process of this study.

4.2 Data analysis

The partial least square (PLS) structural equation modelling (SEM) (PLS-SEM) was used to examine the proposed model. It is a statistical tool widely used for structural model development and testing in the education domain (Kalema, Olugbara and Kekwaletswe, 2011; Teo, 2011; Lee, 2010; Olugbara, et al., 2019). SEM allows factors to act as both independent and dependent factor in the model and interact with each other directly or indirectly to predict e-learning integration (Teo, 2011). Data analysis in this study comprised two stages. The first stage examined the descriptive statistics of the measurement items and assessed the psychometric reliability and validity properties of the measurement model. The second stage assessed the structural model through the hypothesis testing with a view to ascertaining the strength of relationships among the model factors. The PLS-

SEM technique was used to develop the path analysis that quantifies the relationships among multiple factors. The PLS-SEM was chosen because it is a variance-based (VB-SEM) that does not require neither a large sample size because it works well on a minimal sample size of 30-100 nor a specific assumption on the data distribution or missing data as it is distribution-free (Chin, 1998; Hair, Ringle and Sarstedt, 2011; Peng and Lai, 2012; Fan et al., 2016; Joseph and Olugbara, 2018). Moreover, the 10-times rule method for PLS path modelling requires the sample size be equal to the larger of either (Henseler, Ringle and Sinkovics, 2009; Goodhue, Lewis and Thompson, 2012; Mohammad and Nazila 2015):

1. Ten times the number of indicators of the scale with the largest number of indicators or
2. Ten times the largest number of independent factors used to determine a dependent factor in the inner path model. Thus, the sample size of 100 preservice science teachers used in this study meets these requirements.

5. Results

The study results are presented in this section, under the various sub-headings, which are demographic profile, e-learning usage, descriptive statistics, measurement model and structural model.

5.1 Demographic Profile

The research sample of this study consisted of 54 (54%) female and 46 (46%) male preservice science teachers. The majority (72%) of the preservice science teachers (PSSTs) fell in the 21-25 year age range, which fitted the general age profile of undergraduate students at the institution and South African universities. By and large, 20% of them fell under the 26-30 age group while 8% were 31-35 years of age.

5.2 E-learning usage

The 39% of the PSSTs indicated that they used e-learning in their science modules several times each week, 26% used it several times a day, 20% at least once in a week and 15% once in a day. In addition, 30% indicated that they spent 1-2 hours of using e-learning each week, 28% spent 3-4 hours each week, 13% spent 7-8 hours each week, 12% spent 5-6 hours each week, 11% spent 11-12 hours each week and 6% spent 9-10 hours each week. The result indicated that the majority of the PSSTs were technology savvy. They represented 15 major study areas in their studies in mathematics and life science having the greatest number. In addition, they came from various subject combinations offered in the Department of Mathematics, Science and Technology Education (MSTE).

5.3 Descriptive statistics

The mean (M), standard deviations (SD), coefficient of variation (CoV), skewness (SK), and kurtosis (K) values of all the 16 items were computed as shown in Table 1. The mean values fell above the midpoint of 3.0 ranging from 3.54 to 4.63. The SDs ranged from 0.50 to 1.00, indicating an overall positive response to the factors that were measured in this study and a fairly narrow spread around the mean. The CoV measure expressed on a percentile scale was used to combine the mean and standard deviation for better decision making because the measure is bounded between 0 and 100. It is a ratio of standard deviation to mean to measure the degree of relative variability of items with less emphasis on dimensionality (Olugbara, et al, 2019). All items achieved low CoV below 50% to indicate that all items have low dispersion from their respective means. The ATT1 and INTE2 have the lowest and highest dispersions respectively. The values of the SK and K for the items were between -1.51 and -0.05, and -0.83 and 3.49, respectively. These values were within the recommended cutoffs of 3.0 and 8.0 for skewness and kurtosis, respectively, indicating univariate normality in the data for the purpose of structural equation (Kline, 2010).

Table 1: Factor, item, item description, mean, standard deviation, coefficient of variation, skewness and kurtosis of items

Factor	Item	Item description	M	SD	CoV	SK	K
Attitude	ATT1	I believe it is a good practice to use e-learning for teaching and learning	4.63	0.51	10.93	-0.79	-0.83
	ATT2	I like the idea of using e-learning to prepare teaching and learning materials	4.35	0.77	17.70	-1.51	3.49
Intention	INT1	I intend to use e-learning for teaching and learning	3.75	0.91	24.37	-0.45	-0.14
	INT2	I plan to use e-learning for teaching and learning	4.11	0.68	16.55	-0.53	0.66

Factor	Item	Item description	M	SD	CoV	SK	K
	INT3	I hope to frequently use e-learning for teaching and learning	4.05	0.66	16.22	-0.05	-0.64
Skill	SKL1	I am knowledgeable about e-learning	3.98	0.86	21.72	-0.73	0.56
	SKL2	I know how to use e-learning for teaching and learning.	4.02	0.85	21.22	-0.94	1.14
	SKL3	I know how to operate e-learning functions	3.75	0.90	24.08	-0.66	0.16
	SKL4	I have the necessary skills to use e-learning for teaching and learning.	3.73	0.95	25.52	-1.01	1.17
Flow	FLW1	I enjoy using e-learning as a teaching and learning assisted tools.	4.17	0.78	18.68	-0.70	0.12
	FLW2	I find it interesting when I use e-learning for teaching and learning.	4.15	0.78	18.87	-0.66	0.02
	FLW3	I find the use of e-learning pleasurable.	3.93	0.84	21.48	-0.28	-0.72
	FLW4	I focus attention on learning when I use e-learning.	3.86	0.85	22.10	-0.42	-0.35
Integration	INTE1	I use e-learning frequently for learning.	4.15	0.50	12.05	-0.20	3.28
	INTE2	I use e-learning frequently for assessment.	3.61	1.00	27.81	-0.49	-0.37
	INTE3	I use e-learning frequently to collaborate.	3.54	0.92	25.85	-0.57	0.05

5.4 Measurement Model Testing

The PLS-SEM implementation in the WarpPLS 4.0 software (Kock, 2013) was applied to assess the study measurement in reflective mode. Confirmatory factor analysis was employed to determine the extent to which the reliability and validity values met the standardized criteria. The model reliability was assessed using item reliability and internal consistency reliability. The item reliability was assessed using the item loadings, wherein all the loadings were above the threshold value of 0.70 (Chin, 1998), ranged from 0.712 to 0.879 and were significant at $p < 0.001$ level. The internal consistency reliability of each factor was assessed using the composite reliability instead of Cronbach alpha because of the propensity of Cronbach alpha to underestimate reliability (Chin, 1998; Henseler, Ringle and Sinkovics, 2009). The composite reliabilities ranged from 0.757 to 0.879 as reported in Table 2, which exceeded the recommended threshold value of 0.70 (Kock, 2015).

Table 2: Internal consistency reliability (loading) and Composite Reliability (CR)

Factor	Item	Loading	p-Value	CR
Attitude	ATT1	0.848	<0.001	0.837
	ATT2	0.849	<0.001	
Intention	INT1	0.746	<0.001	0.838
	INT2	0.875	<0.001	
	INT3	0.763	<0.001	
Skill	SKL1	0.745	<0.001	0.879
	SKL2	0.852	<0.001	
	SKL3	0.739	<0.001	
	SKL4	0.866	<0.001	
Flow	FLW1	0.879	<0.001	0.878
	FLW2	0.848	<0.001	
	FLW3	0.763	<0.001	
	FLW4	0.712	<0.001	
Integration	INTE1	0.744	<0.001	0.757
	INTE2	0.735	<0.001	
	INTE3	0.743	<0.001	

The model validity was assessed using the convergent validity and discriminant validity (Urbach and Ahlemann, 2010; Kock, 2015). Convergent validity was measured by the average variance extracted (AVE) test on the factors, which should equal or exceed the recommended threshold value 0.50 (Henseler, Ringle and Sinkovics, 2009). The AVE values for the model factors had an acceptable level of convergent validity that ranged from 0.511 to 0.720 as reported in Table3. Discriminant validity was assessed using the criterion proposed by Fornell and Larcker's (1981), which compares the square root of AVE with the correlation of latent factors. As shown in Table 3, bolder elements represent the square roots of the AVEs, which are greater in all cases than off-diagonal elements in the corresponding rows and columns. Hence, the results showed that discriminant validity was established.

Table 3: Convergent validity (AVE) and Discriminant validity (Fornell-Larker), square roots of the AVE shown on the diagonal and off-diagonal represent the correlations

Factors	AVE	Attitude	Intention	Skill	Flow	Integration
Attitude	0.720	0.848				
Intention	0.635	0.349	0.797			
Skill	0.645	0.317	0.383	0.803		
Flow	0.645	0.431	0.518	0.582	0.803	
Integration	0.511	0.342	0.447	0.505	0.478	0.715

5.5 Structural model Testing

The structural model was assessed by the coefficient of determination (R^2), significance and relevance of the path coefficients, effect sizes (f^2), predictive relevance (Q^2) and Goodness of Fit (GoF) (Urbach and Ahlemann, 2010; Navimipour and Soltani, 2016). The research model explained 44% of the variance in e-learning integration. More specifically, with an R^2 of 0.44 for INTE, four factors (ATT, INT, SKL and FLW) explain 44% of the variance in INTE as shown in Fig. 2. The model had a moderate explanatory power to predict e-learning integration. In addition, there are some interactive effects among attitude, intention, skills and flow experience on integration. With an R^2 of 0.32 for INT, three factors (ATT, SKL and FLW) explain 32 % of the variance in INT. With an R^2 of 0.21 for ATT, two factors (FLW and SKL) explain 21 % of the variance in ATT. Finally, with an R^2 of 0.36 for SKL, FLW explains 36% of the variance in SKL.

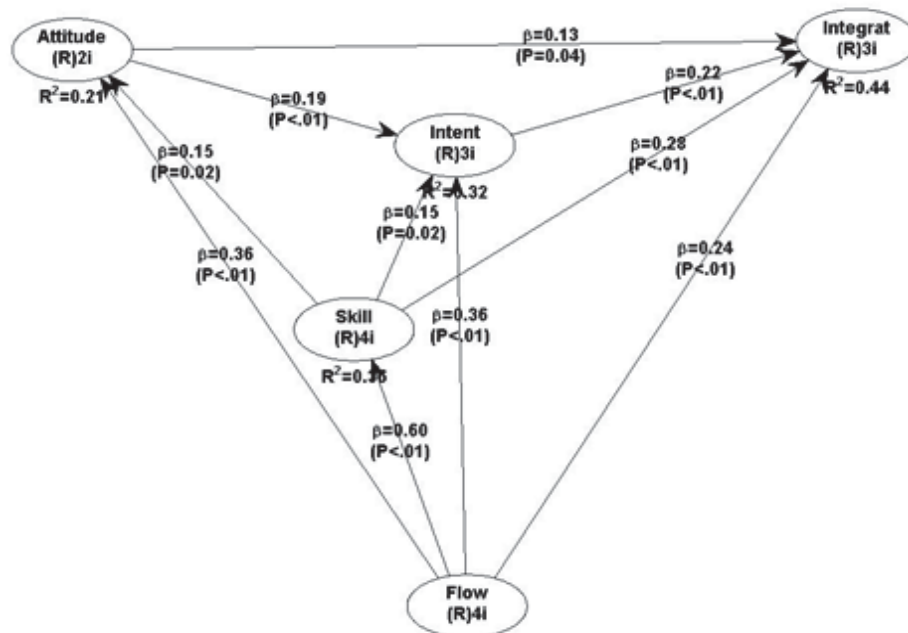


Figure 2: The Hypothesized Structural Results

The results of the structural model showed that all paths were statistically significant and all the research hypotheses were supported as shown in Fig 2 and Table 4. The effect size (f^2) of path links between exogenous and endogenous variables ranged from 0.05 to 0.36, representing small, medium and large effect sizes as shown in Table 4. The Stone-Geisser Q^2 predictive relevance value for the endogenous factors are greater than zero as recommended by Hair, et al., (2014), demonstrating that the model has adequate predictive relevance as shown in Table 5).

Table 4: Summary of hypothesis testing

Hypothesis	Path	Path coefficient (β)	Significance (p -Value)	Effect size (f^2)	Inference	Validation
H ₁	Attitude → Integration	0.13	0.04*	0.05	Small effect size	Yes
H ₂	Attitude → Intention	0.19	0.007**	0.07	Small to medium	Yes
H ₃	Intention → Integration	0.22	0.002**	0.11	Small to medium	Yes
H ₄	Skill → Integration	0.28	0.001**	0.15	Medium effect size	Yes
H ₅	Skill → Intention	0.15	0.024*	0.06	Small effect size	Yes
H ₆	Skill → Attitude	0.15	0.024*	0.05	Small effect size	Yes
H ₇	Flow → Integration	0.24	0.001**	0.13	Small to medium	Yes
H ₈	Flow → Intention	0.36	0.001**	0.19	Medium to large	Yes
H ₉	Flow → Skill	0.60	0.001**	0.36	Large effect size	Yes
H ₁₀	Flow → Attitude	0.36	0.001**	0.16	Medium to large	Yes

Path significance: * $p < 0.05$, ** $p < 0.01$

Table 5: Predictive relevance of the model

Factors	Q Square
Attitude	23
Intention	33
Skill	37
Integration	45

The overall predictive power of the model assessed through the Goodness of Fit (GoF) was 0.46, which exceeds the cutoff value of 0.36 for large GoF. The model has a good fit and quality indices (APC, 0.268; ARS, 0.330; AARS, 0.313; AVIF, 1.433; AFVIF, 1.591; G_oF, 0.457; and RSCR, 1.000), all of which showed the compatibility between the data and the model (Kock, 2015).

6. Discussion

The study aims to develop and test a structural model to predict the integration of e-learning by preservice science teachers. The overall explanatory power of our proposed model had an R² of 44% for e-learning integration, R² of 36% for skill, R² of 32% for intention, and R² of 21% for attitude. The result suggests that the model is capable of explaining a moderate proportion of variation of e-learning integration by preservice science teachers. Many perceptive results were summarised from the research model, and these are presented below.

6.1 Factors of e-Learning Integration by Preservice Science Teachers

The results of this study revealed that skill is the strongest predictor of e-learning integration, followed by flow experience, intention, and attitude. The relationship between skill and integration has previously been validated among practicing teachers (Knezek and Christensen, 2016). However, the predictive power of skill with an R² of 36% and path coefficient of ($\beta = 0.28, p < 0.01$) in our model is higher than the predictive power of skill with an R² of 34% and path coefficient ($\beta = 0.26, p = p < 0.01$) (Knezek and Christensen, 2016). This result confirms the fact that preservice teachers are likely to accept e-learning integration better than the practising teachers because preservice science teachers were mostly familiarised with using e-learning in their modules (Prasojo, et al., 2018; Batane and Ngwako, 2017).

The flow experience is the second predictor of e-learning integration with path coefficient ($\beta = 0.24, p < 0.01$). Flow experience came second because the result shows that the relationship between flow and integration is stronger through skill as a strong mediator because path coefficient between flow and skill gave the highest

value of ($\beta=0.60, p<0.01$). Hence, the indirect relationship between flow and integration is stronger than the direct relationship between flow and integration. This result is consistent with previous study (Ro, Guo and Klein, 2018) which showed that the continuous engagement of undergraduate students in the flow activity developed their skills in using e-learning, which enhanced their learning performance.

The study results also revealed that intention was the third predictor of e-learning integration with path coefficient ($\beta = 0.22, p < 0.01$), which is inconsistent with other studies that applied TPB where it was shown that intention is the immediate predictor of integration of technology by preservice teacher (Teo and Lee, 2010; Teo, and Tan, 2012).

The study results revealed that attitude was the fourth predictor of e-learning integration with path coefficient ($\beta = 0.13, p < 0.05$). This result contradicts previous studies which tested the WST model to predict technology integration by teachers (Knezek, Christensen and Fluke, 2003), which found that attitude was the strongest predictor of integration of technology by teachers.

The study results also revealed that flow experience predict intention with a path coefficient ($\beta=0.36, p<0.01$) than attitude with a path coefficient ($\beta=0.19, p<0.01$). This result is contrary to prior studies that applied TPB (Teo and Lee, 2010; Teo and Tan, 2012), which found that the attitude of preservice teacher was the immediate predictor of their intention to integrate e-learning.

The interactive effect among the factors showed that the relationship between flow and attitude with a path coefficient ($\beta=0.36, p<0.01$) is stronger through skill with a path coefficient ($\beta=0.60, p<0.01$) between flow and skill. Hence, the indirect relationship between flow and attitude is stronger than the direct relationship between flow and attitude.

7. Study Implication, Limitation and Conclusion

7.1 Implication for Education

The results of this study provide evidence that the skill of preservice science teachers was the strongest predictor of e-learning integration. Accordingly, teacher education institutions should take note of this factor and restructure their programmes in the ways that will promote e-learning integration by preservice teachers by strengthening their skills base. Thus, the focus of teacher education institutions in preparing preservice teachers to effectively integrate e-learning in their classrooms should be on improving the skills of preservice teachers to integrate e-learning to support student learning. In this regard, teacher education institutions can provide adequate and ample opportunities for preservice teachers to practise using supportive tools for e-learning in developing actual lesson plans that integrate e-learning, micro-teach those lessons in teacher education modules, and reflect on their experiences. This might help to improve and consolidate their skills towards the integration of e-learning in the classrooms.

The study results showed the significant role of flow experience in the model. It is therefore advised that teacher education institutions should invest on high-quality e-learning interactive tools that can intrinsically motivate their students to promote self-directed learning to ensure successful integration of e-learning into the curriculum.

7.2 Limitation

This study had some limitations that should be pointed out in this paper. First, the nature of the study sample was confined to fourth year preservice science teachers at one public university in South Africa. Additionally, data were collected from one hundred preservice science teachers that constituted a small sample size. Although, many researchers as clarified in section 4.2 agreed that small sample sizes of 30-100 are sufficient for WarpPLS technique, a bigger research sample could have yielded better results. Therefore, the results of this study cannot be generalised to the whole population of preservice science teachers in South Africa Universities. Second, the study data were collected at a specific point in time (cross-sectional study), whereas a longer term (longitudinal study) could have given a clearer picture of how the relationships among factors change over time which could have yielded improved results. Third, the data were collected through self-report measures. Although, self-report measure is often judged in the literature as the most cost-effective and valid means of collecting personal and accurate information about people (Demetriou, Ozer and Essau, 2015), it may have led to the phenomenon of 'common method variance'. This is a situation where the relationships between model

factors are inflated as well as 'social desirability', whereby respondents provided favourable responses opposed to what they really believe or think.

7.3 Conclusion and future research

This study is the first to the best of our knowledge to develop and validate a model that agglutinates the most influential factors in technology integration models for predicting e-learning integration by preservice science teachers. The results of this study has demonstrated that the proposed model has a good fit to the data and supported the research hypotheses. Skill is a key factor to predict e-learning integration by preservice science teachers contrary to intention as suggested in the literature by theory of planned behaviour. This study has added significant value to the small number of studies that have so far examined factors that predict e-learning integration in the classroom. Thus, the study has revealed the order of strength among these predictors of e-learning integration for teaching and learning of science subjects. Moreover, the results of this study will provide some insights for the management of e-learning in the universities and educational technology practitioners to have proper understanding of factors that predict e-learning integration before investing huge amount of money in the development of technology.

Future research may conduct longitudinal study to examine how the relationships among the factors identified in this study change over time. This could allow for tracking preservice science teachers into the first year of their teaching in schools to provide a clearer assessment of how they integrate e-learning during their beginning year of teaching in school, and beyond. Moreover, it would benefit future research to conduct meta-analysis of these factors to discover hidden evidence. In addition, the research model designed in this study may be subjected to further validation to include large sample of preservice science teachers from other universities in the country to strengthen the generalization capability of the model. Finally, future research could test the research model between preservice and in-service teachers to establish the degree to which differences may occur in predicting e-learning integration among the two groups. The results of such study would inform policy makers, teacher educators, and other education officials in their planning, designing and implementing better e-learning curricula in schools.

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Engagement with and Participation in Online role play Collaborative Arguments: A Sociocultural Perspective

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DOI: 10.34190/JEL.18.5.006

Abstract: Digitally mediated role plays indicate potential for collaboration, social exchange of information and knowledge as well as motivation for learning beyond classroom time. These elements are critical for ESL learners' development of language and argumentative writing practices. The aim of this research project was to investigate how students' engagement with and participation in online role play collaborative arguments shaped their literacy practices, and influenced their beliefs and thinking regarding particular societal issue. This qualitative research project based on a larger ethnographic case study and tools of action research investigated students' interactions and experiences before, during and after the online role play. The study involved 20 ESL pre-service students at one university in Uganda and was conducted in both the real and online spaces. The real space involved face-to-face sessions aimed at building students' confidence in using blogs for online role play. While the online space involved non-participant observations to gain understanding of the social dynamics of students' engagement in online role play, and the opportunities for students to engage in literacy practices related to online argumentative compositions. The study findings indicated that engagement in online role play using blog platform provided a rich environment for learners to exercise their creativity, orchestrate multiple ways of meaning-making and build tactical relations for purposes of collective action. Furthermore, the use of online role play collaborative arguments facilitated a shift from "ascribed" to "achieved" identities where students did not only become aware that they were dealing with issues larger than individual perspectives, associated with school, family, culture and the legal system, but also that there need for them to take part in the civic action.

Keywords: Online role play; participation; literacy practices; discourses; student engagement; collaborative arguments; pre-service students

1. Introduction

Students' ability to form arguments aimed at convincing others about the validity of their position is one of the important literacy practices. However, this does not only involve formulating convincing arguments, providing supporting evidence and challenging weaknesses in an opponent's argument. It "also ultimately involves convincing others to agree that problems are worth addressing leading to change through collaborative actions" (Beach and Doerr-Stevens 2011, pp.185). The traditional argumentative writing pedagogies in many educational contexts often focus on competitive approaches that reify individualistic perspectives of arguments, rather than collaborative ones. This implies that educators have to rethink their teaching and learning approaches "well beyond the traditional argumentative models" (Kong et al., 2014, pp 71). Supporting students to engage in online role play collaborative arguments is a promising alternative.

Thomas (2007, p.2) defines online role play as an "asynchronous text-based world" as it exists as a non-physical realm that relies on written character dialogues, and descriptions of physical traits, actions and behaviours (Haynes-Moore, 2015). Role play activities encourage participants to step into someone else's shoes and also facilitate exploration of issues or behaviours within new contexts (Russell and Shepherd, 2010). For role plays to take place, participants adopt different roles through which they express varying viewpoints regarding an issue, for purposes of convincing an audience. Being online, participants are afforded a shared space to deliberate on the various positions presented in order to arrive at a common understanding.

Research has proved the potential for online role plays in language learning to expand opportunities for communicative competencies, especially argument-related ones (Beach and Doerr-Stevens, 2013; Haynes-Moore, 2015; Azman and Dollsaid, 2018). In contexts where English is used a medium of communication, it is generally assumed that learners are naturally able to 'pick up' the language skills, especially the argumentative writing skills. This belief tends to confine many ESL educators to a top-down transmission model of argumentation where learners are modelled to formulate arguments and provide supporting evidence to

convince their educators who are the primary audience. However, such models have proved habitually disengaging to the learners and lack context for collaborative communication needed for effective arguments (Beach and Doerr-Stevens, 2011). However, adopting digitally-supported online role plays can be one way to assist learners to develop social skills, leading to a better understanding of practices related to argumentation. According to Kongmee et al., (2011) online role plays affords players a space to interact and exchange information geared towards achieving meaningful goals.

In the current study, a blog-mediated role play was introduced in English as Second Language (ESL) methods class at one university in Uganda with third year, pre-service students as participants. The aim was to understand those specific literacy practices pre-service students exhibit during online role play engagement. That is, how do those literacy practices look like when digital tools are used, what are their properties and how those enacted practices contribute to students' learning and thinking abilities. This would be beneficial for educators, (especially in technologically emerging pedagogical contexts) looking for ways to incorporate literacies associated with use of digital tools into students' writing activities that are creating opportunities for mediating creativity and agency within the sociocultural realm of language learning. This would also help to reduce the monologic nature of argumentative writing that is characteristic of autonomous-based classrooms, by providing space for students to experiment with new ways of meaning-making. Since this was the first time students were using the blog platform for online role plays, they were exposed to several "scaffold learning activities" so as to "gain explicit information" (New London Group, 1996, p. 86) pertaining to digitally-mediated role plays. The activities included; creating blog entries, building online role play personas, crafting on-screen arguments and manipulation of visual resources. Thus, the project sought to answer two questions; first, what literacy practices do ESL pre-service students engaged in online role play collaborative arguments enact? Secondly, how do the literacy practices enacted through engagement in online role play influence ESL pre-service students' argumentative thinking and civic action?

2. Background

Research indicates that using digital tools for online role-plays and debates has potential to transform the teaching and learning of argumentative writing. Kongmee et al. (2011, pp.1) argue that online role plays "require players not only to complete a variety of tasks and develop their characters individually, but also to participate in teams or guilds to accomplish specific missions". Online role plays perform an important role in creating simulated spaces that "allow for students to take an active role and learn by doing, which is a principal tenet of social cognitive theory" (Bryant 2006, p.3). Additionally, digitally mediated online role plays present "relaxed, accessible, friendly and comfortable environment that promote collaboration, social exchange of knowledge which increase students' motivation and engagement for learning outside normal classroom hours (Thalluli and Penman 2015, p. 455).

Engagement in an online role plays requires that learners are adequately prepared to respond to the demands of working with online tools, while at the same time pay attention to in-game dynamics such as; interacting online, setting of goals, exchanging of ideas, and consolidating role play positions to achieve the set goals. Kongmee et al., (2011, p.1) posit that the online game genre facilitates social constructivist approaches to learning where students engage in open dialogues and collaborative construction of knowledge. In addition, this genre provides enhanced opportunities for collective intelligence, problem solving, strategic thinking, imaginative and interpretive play (Thalluli and Penman (2015) and also affords multiple audiences that provide richer contexts for exchange of ideas, perspective-taking and collegial support (Wodzichi, Schwammlien and Moskaliuk 2012).

The past two decades have indicated a steady increase of empirical studies to demonstrate that the 'participatory', 'collaborative' and distributed' affordances associated with digital technologies have potential to support ESL/EFL learners' development of literacy skills, as opposed to the 'individuated' and 'author-centric' affordances of the traditional print-based pedagogies (Lankshear and Knobel, 2006; Beach and Doerr-Stevens 2009; 2011; 2013; Gee 2012; Zhang and Kaufman, 2015; Hong et al., 2016; Zhang, 2017; Azman and Dollsaid 2018). However, many of the studies were conducted in contexts with relatively higher uptake of adoption and use of digital technologies for academic purposes as compared to many African contexts, Uganda inclusive, where uptake is still emerging (Early and Tembe, 2010; Veletsianos, 2010; Gachago, et al., 2013). There was need for similar research to be conducted in the emergent contexts in order to contribute to the global digital literacy debates. Veletsianos (2010) and Gachago et al. (2013) suggest that digital innovations ought to be considered

as ‘placed resources’, implying that any technology when adopted, takes on new contextual meanings and influences varying literacy practices, particularly in socially distinctive African contexts. Premised on the ‘ideological’ tenet that ‘text’ is not only print-based, but also a manipulation of other semiotic resources, as well as insights from the sociocultural theoretical frame (Vygotsky, 1978; Street, 1994) which consider literacy as a social practice that must be understood within the realm of the larger social, cultural and historical processes. The study aimed to understand how engagement in blog-mediated role play fosters ESL pre-service students’ enactment of literacy practices and contributed to their argumentative thinking and motivation for civic action. Thus, this research makes a case that literacy is promoted or constrained depending on the conditioned learners are subjected to and these can be best understood through literacy as a social practice that considers learners’ multiliteracies as they negotiate meanings across sites of learning.

3. Literature review

3.1 Traditional argumentative writing versus collaborative argumentative writing

The traditional view to argumentative writing positions students to demonstrate knowledge primarily for their teachers. Beach and Doerr-Stevens (2011: 166) argue that students do not necessarily formulate arguments to convince their peers or wider audiences. Instead, “they make claims and provide justifications for those claims without consideration for potential audiences’ counter-arguments”. Such argumentative practices often occur in a “rhetorical vacuum”- often removed from students’ use of arguments in everyday conversations in which they are more likely to employ counter-claims and rebuttals leading to addressing their everyday life problems (Beach and Doerr-Stevens 2009). On the other hand, collaborative arguments entail creation of authentic rhetorical contexts with multiple audiences in which participants exchange ideas, weigh the merits of competing positions, refute arguments and move towards some recommended synthesis (Beach and Doerr-Stevens 2011). This illuminates the importance of having an audience larger than just the teacher to motivate students to engage in argumentative practices. Midgette, Haria and MacArthur (2008) confirm that students are more likely to engage in counter-arguments and rebuttals if they have a specific purpose and audience for their written arguments.

Secondly, with traditional argumentative writing practices, students have limited conviction about the stances they adopt for their arguments which often leads to information telling. Besides, these practices encourage confrontational approaches that reify individualistic perspectives mainly aimed at defeating opponents or winning debates (Beach and Doerr-Stevens, 2009). In contrast, collaborative argumentative learning environments foster students to respect their opponents as potential sources of useful information. Collaborative arguments also involve embracing tentative or exploratory positions regarding “passing theories”- hunches, opinions, or hypotheses that need further testing (Beach and Doerr-Stevens, 2009). By adopting these “passing theories”, students learn to accommodate differing opinions and counter-arguments from their peers for purposes of obtaining “constructive controversy”- a process of exploring alternative perspectives on a problem with an intention of collaboratively generating a solution to that problem (Johnson and Johnson, 2009). Research has proved the potential of digitally-mediated role plays to transform traditional argumentative writing practices into collaborative ones (Peterson, 2016; Azman and Dollsaid, 2018). Given the increasing popularity of online games for academic purposes, the current study examined to examine how participation in blog-mediated role play fostered students’ engagement in literacy and argumentative thinking practices.

3.2 Using digital platforms for online role play collaborative arguments

Using blogs or social networking platforms for online collaborative arguments provides opportunities for engagement in “mass interpersonal persuasion” Oinas-Kukkonen et al. (2008, pp. 26) where students learn to persuade both the familiar and non-familiar audiences for purposes of problem-solving. This practice is referred to as “rhetoric of significance and transformation” (Beach and Doerr-Stevens, 2009, pp 460), whereby students are motivated to debate and gather evidence to disprove a policy or status quo if it directly affects them.

Additionally, digitally-mediated online role plays provide students with ample time and space to engage in argumentative thinking. Contrary to the superficial, in-class role plays and debates, online role plays create opportunities for ongoing conversations, where students post their stances, and reflect on them for purposes of building a common understanding. The time and space affordances of digitally-mediated role play arguments are critical in fostering argumentative practices. This is because reflecting on the various view points, identifying contradictions, revising positions and building consensus regarding an issue requires time, which is never available in the face-to-face role plays. Moreover, many students in today’s classrooms belong to the net-

generation (Prensky, 2001, pp 1) whose livelihood depends on digital technology for socialization, entertainment and information. Implying that there is need to adopt pedagogies that are consistent with contemporary learners' interests and needs (Najjemba, Cronje and Kafui, 2018).

3.3 The sociocultural theoretical conceptions on literacy

The sociocultural theoretical conceptions of literacy consider literacy as a social practice which is related to historical, sociocultural and political contexts (New London Group, 1994). People engage with literacy depending on the purpose, the medium and the audience for the particular communicative event. According to Gee (1994, pp.vii) language "always comes fully attached to 'other stuff'; to social relations, cultural models, power and politics, perspectives on experience, values and attitudes, as well as things and places in the world." Thus, literacy as component of language reflects all this "other stuff" (Perry 2012, pp.52). This suggests that making arguments as a literacy practice anchors within the larger contextual frames of institutional influences, cultural beliefs and attitudes. It is through the interface with the social context that contextually dependent meanings are shaped (Perry 2012). Therefore, social contexts are critical in shaping argumentative practices during online role plays engagements.

For purpose of this paper, literacy is viewed as a socially situated practice that is conceptualized as "a concrete human activity that involves what people do with literacy, the associations they have with it, how they construct its value and the ideologies that surround it." (Baynham and Prinsloo 2009). It can be inferred that what is regarded as literacy will depend on the purpose it intends to serve, discourses the people involved in, the social, cultural and political influencing those discourses. As such, literacy as social practice is based on the assumption that how we value and use literacy depends on the broader social and cultural meanings, values and representations (Barton and Hamilton, 1998). Therefore, from this perspective, the study aimed to address two research questions;

1. What literacy practices do pre-service students engaged in online role play collaborative arguments enact?
2. How do the literacy practices enacted through engagement in online role play influence pre-service students' argumentative thinking and civic action?

4. Research methods

This interventional study was conducted with 20 ESL pre-service students in one university in Uganda. It employed tools of action research to investigate students' literacy practices, experiences and argumentative skills through their participation and engagement in digitally-mediated role play. Interviews and workshops were conducted to establish students' skills of digitally-mediated role plays and knowledge about collaborative arguments, in order to provide the necessary overt instruction (NLG, 1996, p.86) for effective participation in the role play debate. Additionally, a virtual ethnographic approach was applied to understand students' routine in the assigned roles, the in-game social dynamics, and the social, cultural beliefs, and values assimilated in building role play positions.

The blog was chosen because it is a tool that was specifically designed for writing purposes and its affordances such as embedding of images within texts would support 'textual hybridity' needed to create an 'on-screen visual character' and produce layers of information that make meaning-making a process of navigation and choice (Jewitt, 2009). Moreover, the conversations and interactions afforded by the blog tool could easily mediate online role play collaborative arguments focussed on in the current study. Thus, a fictitious virtual high school "Sparkle High School" was created, in which students were invited to adopt different roles to debate upon a unanimously agreed upon topic. The blog home page contained instructions on how the role play was to be conducted out, as shown in figure1.


SPARKLE HIGH SCHOOL

In this virtual high school, 'Sparkle High School', you will play roles of some of the selected characters to research, discuss and debate about the schools' mobile phone policy and access to students' personal information. In your roles you are required to post a comment explaining the position you are taking on the issue and also give supporting evidence. Thereafter, other characters will come in to post comments on whether they agree or disagree with your position.

Home

THURSDAY, 26 APRIL 2018

Mr.Amanya Wycliff



Hello, I am Amanya Wycliff, the Head teacher Sparkle High School. Our school has kept a wonderful reputation in terms of discipline and academic excellence. I would not want it to be ruined because of a couple of students' bad behavior. At Sparkle High School, we take the safety and well being of our students seriously. I believe that as the school administration, we have a moral obligation to intervene when students misbehave. The recent scandal involving our students drinking alcohol, smocking Shisha, indulging in Casual sex, is rather unfortunate and I

BLOG ARCHIVE

- ▼ 2018 (16)
 - May (1)
 - ▼ April (15)
 - Mr.Amanya Wycliff
 - Joy Teka
 - Conie Were
 - Laura Kaye
 - Anita Bakka
 - Mrs Yogi Ayendale
 - Langa Lagu
 - Ella Ialoyo
 - Willy Gadama
 - Frank Mavido
 - Trudy Bandana

Figure 1: Blog home page containing a Virtual high school

4.1 Action research method (workshops and interviews)

As earlier stated, action research involving workshops and brief interviews were initially conducted to establish participants' knowledge and skills of online role plays, and to provide the necessary support to boost their performance in the online role play. During the interviews, it was established that participants were more familiar with using the blog platform for personal reflective writing purposes as opposed to online role play collaborative arguments. The students were also more exposed to face-to-face role plays and print-based argumentative texts than blog-mediated role play collaborative arguments. As such, the initial workshops (the first and second one) were conducted to boost students' confidence in using the blog platform for online role play. Moreover, online role play collaborative arguments require students to take up different roles and formulate arguments on a topic which they share on the blog platform in form of blog entries. It is these postings that are either challenged or affirmed by other role players leading to a continuous process of meaning-making and knowledge building. In order to give adequate support and tackle any challenges that would arise during the course of the study, workshops were organised on a weekly basis. In these workshops, demos of how to sign into the blog platform, create blog entries, and upload them were conducted. Similarly, discussions of making good arguments, counter-arguments, claims and rebuttals were held.

In the subsequent workshop, students were requested to select a topic that they would like to debate upon in their online role play, citing reasons why they wished to engage with those particular topics. Participants took several hours debating upon various topics, but did not reach a consensus as to which topic they should focus on. Finally, one of the participants suggested a topic regarding mobile technology restrictions in schools to which majority of the participants agreed to focus on. The students cited many instances in which they thought such policies should not continue to apply in schools. Thereafter, the students adopted different roles, ranging from school headmaster, counsellors, teachers, parents, students' representatives, lawyers, child rights activists, religious leaders, among others.

In the fourth and fifth workshops, participants were requested to conduct research and critique the existing mobile phone policies in high school, citing evidence in which these policies did or did not address issues of school discipline, children's safety and well-being. Students were encouraged to read the constitution and policy documents regarding the use of technology among young people and share their findings in the workshop discussions. Additionally, students composed argumentative texts with varying positions and stances on the issue. Some participants wrote the texts using the conventional pen and paper tools, while others used their laptops and desktop computers available in the computer laboratory where workshops were held. Thereafter, students shared their drafts with peers and educator for feedback, and continued to make revisions to their

drafts basing on the feedback offered. The final workshop was devoted to making final touches to the students' texts and to ensure that the semiotic resources employed were well orchestrated to serve the intended purposes.

A virtual ethnographic approach was used to understand students' online role play activities and literacy practices as they unfolded on the blog platform. According to Misuishi (2006) online ethnographic approach allows for use of an extensive range of data collection tools including observation, note-taking and interactive communication through texts. As such students' reflective journal responses were analysed and group interviews conducted with the students at the end of the role play to understand their experiences of participating in online role play.

5. Findings and discussion

This study aimed to examine the literacy practices pre-service students in an ESL Methods class enacted through their engagement in online role play collaborative arguments and also to establish how the literacy practices enacted by students' participation in online role play contributed to shaping their argumentative thinking and civic action. Data showed that blog-mediated role play not only provide a rich environment for students to enact a range of literacy practices ranging from building credible role play personas, adopting competing discourses, building strategic relationships, but also created a space for broadening their argumentative thinking and engagement in civic action.

5.1 Building of credible role play personas

Data revealed that pre-service students used their prior knowledge of social media engagement; building profiles and uploading images to create what Beach and Doerr-Stevens (2013) refer to as "rhetorical persona who serves to achieve own rhetorical goals of convincing others to adopt their positions". For example, in figure 1, a student who created the role of the school head teacher named as Amany Wycliff (pseudonym), embedded an image of a well-dressed, neatly kept man with an imposing personality. This served to project a symbol of authority and a strict disciplinarian expected to instil discipline among students, through controlling their activities within the school. Through employing this image, the student is able to project an image of a non-compromising character in executing his duties as school administrator. Rogers et al., (2010) posit that meanings are not just words combined with images. Rather, word-meanings are modified in the context of image-meanings, thus opening up a wider space for meaning-making.

The student further aligns the image of a strict, non-compromising leader to the position he undertakes which served not only to build ethos but also create credibility of the character. His assertion "I believe as the school administration, we have a moral authority to intervene when students misbehave....." positions him as a person who has high stakes in controlling students' activities, which therefore allows him to defend the action taken. He further explains that uncontrolled phone use during school time and other distractions such as alcohol and substance abuse, as was discovered during execution of the school policies, are forbidden activities regardless of where they take place. The school has the mandate to guard against any destructive behaviour among the students in order to promote what they refer to as "valued learning". The school's belief in 'valued learning' largely involves a school environment that is free from distractions that may divert children's attention from learning. While this position aroused a lot of controversy among other role players, it depicts the school administrator as the voice of the institutional ideologies regarding discipline and preservation of school values.

These findings closely align with the notion of 'figured worlds as socially and culturally constructed sites' (Holland et al., 1998). The student who created this persona continuously re-aligned the character's actions and intentions within lived-world hierarchies and power structures of the 'figured world'. According to Holland et al., (1998, p.52) 'figured worlds' are socially and culturally constructed sites in which particular actors continuously perform and realign their identities in an improvised response to others and in response to the social relationships within the figured world. It was evident that students had learnt the socially recognized ways of using words and other semiotic codes (e.g. images), combined with ways of "thinking, feeling, believing and acting" (Gee, 2005), to qualify their characters as members of particular social groups and also build ethos aimed at convincing audiences to identify with their cause. Such literacy practices not only strengthened students' on-screen visual arguments, but also helped students to shift from what Gee (2005, pp.111-112) describes as "ascribed" identities – superficial identities within the role play to "achieved" identities- those identities within

lived-world spaces of the school or community. Similarly, students adopted competing discourses to challenge identities and positions projected above.

5.2 Using competing discourses to challenge other role play persona positions

Analysis was based on the sociocultural theoretical perspective which focuses on the “ideological” as opposed to the “autonomous” view of literacy (Street, 1994; Gee, 2005). The ideological view considers literacy practices from the perspective of cultural and power structures in society, while the autonomous view considers literacy in terms of universal cognitive or technical skills that can be learned independently of the specific contexts or cultural frameworks (Street, 1994). In this context, data revealed that engagement in online role play collaborative arguments fostered students’ use of competing discourses basing on professional, administrative, legal, family and ideological ways of knowing and thinking (Gee, 2005) to challenge each other’s positions. Students exhibited awareness of the rules, and beliefs operating in the different systems such as the law, school, family and technology. The student who played the role of a head teacher built his position basing on the discourse of school management and protectionism to frame his position based in the power to protect the school image and ensure children’s well-being. While this discourse garnered support from a several characters including; Joy Tekka, the school counsellor, Connie Were, the concerned parent, and Laura Kaye, the school nurse, it also provoked a lot of controversy among other characters especially, Willy Gadama, the single parent, Cissy Loyoka, the legal representative and Yogi Ayendale, the Child Rights Activist (Character names are pseudonyms and the competing discourses can be accessed on <http://ele3101collaborativewriting.blogspot.com/2018/04/>).

On the contrary, Cissy Loyoka, the legal representative used a legal discourse to challenge the school management position. He explains that the school’s policy which restricts students from using their mobile devices during school time and subsequent retributive acts such as confiscating student’s phones and searching through their social media pages for incriminating information, is not only a violation students’ privacy, but also a deprivation of students’ constitutional freedoms to enjoy technology. He adds that basing on an ‘illegally’ obtained video recording (of children drinking alcohol and abusing substances) - an event that happened outside the school premises, to dismiss students, puts the school in a volatile and contestable position. He states;

While the school management may feel justified to get rid of the unruly students as guided by the school regulations. This case can turn out to be much more complicated due to the fact that the basis of the expulsion was focused on what the students did outside the school premises. While it might be clearly stipulated in the school regulations that phones are forbidden, but these rules do not protect the teacher who intrudes on the learners’ online space and interactions with others.

The student who crafted this character was aware of the beliefs and rules governing the legal system which he used to build a valid legal interpretation of school administrators’ actions. By identifying a weak spot in the policy, not only indicated the student’s critical thinking abilities, but also it reflected a real-life court scenario that could be used by lawyers in real-life courtrooms. Moreover, discourse like that illuminates an allegiance to a legal system, (directly opposed to a school system), whose values are purposely geared towards upholding the children’s legal rights.

The school counsellor, on the other hand, uses a psycho-social discourse to defend the actions of the school administrators. She argues that children in the adolescence phase experience serious behavioural challenges which render them incapable of making proper judgement about their life. Therefore, this calls for adults to guide and control their behaviour, even if it means over-stepping boundaries, as the case was with the school administrators searching through the students’ private’ social media pages. “Otherwise, how else would the administrators know that the children were engaged in self-destructive behaviour...?” The discourses of protectionism and control adopted by the school head teacher, and all other like-minded roles reflect an allegiance to school system with an ideological belief that to achieve ‘value in learning’, there must be strict control of students’ activities and provision of a distraction-free and safe school environment for all.

The single parent (Gadama) also challenged the school policy and the belief in ‘valued learning’ using a family discourse. He highlights inconsistencies in the school’s banning of children’s use of mobile devices during school time, while at the same time insisting on their belief in ‘valued learning’ and student’s ‘well-being’. He argued that being a single parent, who is always away on business trips; he ensures the well-being of his children through constant calls via technology-enabled devices. He then wonders how the school expects him to fulfil his parental obligations with the ban on mobile phones;

How does the school expect me to fulfil my parental obligation – which by the way is part of ensuring the well-being of my children- when my children are not allowed to carry their phones or mobile devices at school? Does the school think that by cutting off my children’s communication is ensuring children’s well- being?”

Gadama’s argument is that banning the use of mobile phones during school hours cannot guarantee students’ well-being or learning, because it creates unnecessary inconveniences and anxieties which may hinder children’s well-being and learning, for that matter. Thus, student uses family and the dynamics of contemporary society discourse to make valid arguments as to why the status quo phones policies can no longer work. The legal representative, on the other hand, uses the legal discourse to portray the flaws in the same policies.

By voicing these competing discourses, the students (behind these characters), engaged in what Kamberelis (2001, p.120) referred to as ‘hybrid discourse practice’. The practice involves illustrating the competing agendas associated with larger complex institutional forces related the legal, school, family and technology-oriented systems, which according to Engestrom (2005) create tensions and contradictions suggesting a need for change in the status quo. By experimenting with the various discourses associated with the different systems, students became aware that they were not simply dealing with individual perspectives, but with larger societal issues (Beach and Doerr-Stevens, 2013, p.193), which positioned them to find ways, such as collaborative building of coalitions in order to arrive at possible solutions.

5.3 Strategic online interactions and coalition building

Previous research indicated that students’ blog and social media interactions have limited educational value, except fostering social relationships (Hew 2011; Wise, Skues and Williams 2011; Hew and Cheung, 2012). However, current study revealed that students were using knowledge of their interactions on these platforms, such as, exchange views and opinions about current events or personal lives and drawing on each other’s ideas to build arguments, to build alliances for purposes of boosting their positions and enacting civic action. Beach and Doerr-Stevens (2013, p.188) supports this view that “students’ interactions on blogs and social media platforms involve more than simply social interactions. Students can and do use the writings on these sites to engage in argumentative thinking”. For example, through the ‘comment’ function students engaged in asynchronous conversations in which they exchanged ideas and planned strategies intended to build a common understanding on why mobile phone policies were no longer applicable. For example some students planned to use story-telling as one of the strategies to get their message across.

The student who created Ella Laloyo (teenage girl who got pregnant while still in school) and Langa Lagu (a teenager boy who dropped out of school due of drug addiction) through the narrative technique delivered a message that adolescence challenges require a different handling approach as opposed to the dismissal policies in schools (narratives can be accessed at <http://ele3101collaborativewriting.blogspot.com/2018/04/>). Through narratives students told real life stories of adolescents to serve as testimony that adolescence challenges are real. In both narratives, students highlighted peer pressure and the ‘desire to belong’ as the major causes of teenage burdens. Laloyo explains that growing up as an orphan, she was a very lonely child who felt the need to be accepted by her friends at school. However, the peers she chose as her friends were of questionable character. Similarly, Langa says “I was a grade A student, always on top of my class. I had big dreams for my future. But all these came crashing down when I joined the wrong crowd.... My friends and I always hang out and partied most of the nights. I was introduced to women and alcohol”

The two extracts highlight the misguided social life that teenagers always want to lead, involving ‘hanging out’ ‘drinking’ ‘sexual encounters’ ‘and ‘drugs’. While this paints a typical teenage culture, it also reflects associated behavioural challenges. It also highlights the vulnerability of this age group that makes them fall ‘prey’ to the wrong crowd. Layolo being an orphan, she lacked both material support and parental guidance. As such she was drawn to rich spoilt friends as coping mechanism. Langa on the other hand, simply made the wrong choice of friends. The narratives are used as discursive devices to highlight the burdens of teenage-hood and to draw attention to the need for understanding and not cruelty as the school policy dictates. The children that were dismissed from school could have similar underlying challenges.

Through the students’ narratives, the consequences of teenagers’ bad choices are reflected. Langa dropped out of school and took to mugging and pick-pocketing on city streets to sustain his drug addiction problem. While Laloyo became pregnant with a baby whose father (a fellow teenager) not only denied any responsibility, but

also suggested an abortion. The image of a sorrowful young girl, with a baby trying to console her (see figure 2) was a carefully selected semiotic resource to add visual weight to the framed vulnerable position of teenagers, especially the teenage girls, and also to create a sentimental mood; thereby, drawing attention to the complexities and contradictions of teenage hood. In as much as teenagers struggle to break from adult control, they are reflected as vulnerable and bad choice-makers, suggesting the need for adult guidance.

Similarly, the image of a baby wiping tears off her mother's face (see figure 2) creates a lighter mood, a sense of relief, and symbolically represents hope and a new beginning for teenagers (especially girls). It indicates that in spite of the many mistakes committed, teenagers are capable of fixing their own mistakes and becoming better people. Laloyo's words indicate she had learnt her lesson "In spite of the difficulties I went through, Trina my baby girl gives me the greatest joy. She grew up into an intelligent, loving and caring little soul who always made me smile. I am glad I did not abort her." This suggests a repositioning of teenagers, who after a phase of suffering, they are pulled back into reality to make better life choices.



Hello, my name is Ella Laloyo, a student at Sparkle High School. I would like to share with you my high school experiences regarding substance use. Probably you will be able to agree with me that there is nothing good that can come out of using drugs them .I happened to make some bad choices while I was in my third year (S.3) at high school. Growing up as an orphan, I was a very lonely child who felt the need to be accepted by my friends at school. The road through high school was very difficult for me. Apart from

Figure 2: Images supporting students' arguments (Images obtained from <https://www.google.com/imghp?hl=en>).

In this context, students' literacy practice of appropriating semiotic resources with the textual narratives, created what Rogers et al. (2010) describe as a triple cultural narrative about teenage hood which involve behaviour commonly associated with the adolescents (drinking and partying), its causes (e.g. peer pressure) and consequences (drug addiction and teenage pregnancy) which serves to position teenage-hood as complex and contradictory phase. Conclusively, blog-mediated role play collaborative arguments provided students with opportunities to appropriate context-dependent knowledge and activate literacy practices aimed at building convincing positions and arguments for purposes of causing change in the status quo.

The second research question "how did the literacy practices enacted through engagement in online role play influence pre-service students' argumentative thinking and civic action?" required students to step out of their role play persona and do critical reflection on the roles they considered to elicit more agency in terms of framing ethical positions. Students also considered how the conflicting perspectives and discourses influenced their thinking and desire for civic action. Evidence from the study indicated that navigating through the conflicting positions, beliefs and perspectives projected during online role play broadened students' understanding of the contradicting views and increased their motivation to advocate for change in the school's phone policies.

5.4 Motivation for engagement to cause change

Evidence revealed that students were particularly motivated to engage in the online role play, because they wanted to cause change in those school policies that they considered 'repressive' and no longer applicable in the current times. The students perceived an online role play as an opportunity to "let out what they always felt

about these mobile phone school restrictions” and also they wanted “to create something that could be of use to the school children”. According to Beach and Doerr-Stevens (2009, p.466) students are more likely to engage in argumentative thinking if they perceive an issue or problem being addressed to be a ‘big deal for them’. The fact that pre-service students could not freely use their mobile devices during their high school days was a ‘big deal’ for them. As such, students were motivated to invest their time and effort in formulating argumentative texts citing moral, personal or ethical reasons for why the mobile phone restrictions are no longer applicable in schools today.

Most notably, was the high self-motivation and efficacy participants exhibited in producing the argumentative texts on the blog platform. While the initial stages proved overwhelming for students, they remained consistent in producing texts, while at the same time actively participated in exchanging views regarding the policy through the ‘comment’ function on the blog platform. Subsequently, a total of 434 comments were generated for the four months period, with the role of the legal representative, attracting the highest number of comments (57 comments), followed by the child rights activist with 54 comments and the school principal with 53 comments respectively (see <http://ele3101collaborativewriting.blogspot.com/2018/04/>). In many of the comments, students weighed the validity of specific positions presented by various role play characters. As such, interacting with an online community who share similar values and beliefs, provides participants with the ‘I’m not alone’ feeling which serves to build a “group’s shared, collective belief that embolden collective action in social settings” (Beach and Doerr-Stevens 2011, p.177). Through these conversations, students unanimously agreed that blocking children from using their mobile devices during school time lacked consistency with the school’s ideology of ‘valued learning’. In their position paper, students wrote;

We perceive ‘valued learning’ in schools as providing a supportive environment for learning, as empowering children to make their own decisions and allowing them to learn from their own mistakes. But this can’t happen when schools are blocking access to digitalized learning or when children are threatened with dismissals.

Thus, the affordances of the blog-mediated role play provided students with an opportunity to engage in an online community conversation resulting into building a common understanding regarding the need for those policies to be revised. Beach and Doerr-Stevens, (2013) confirms that online engagements through blogs and social media platforms foster spaces for people to collaboratively posit, test out, and revise alternative position within a larger community for purposes of broadening students’ understanding of issues and for enacting change in the status quo systems.

5.5 Broader understanding of the conflicting positions

Data indicated that participation in blog-mediated role play fostered engagement in conflicting positions and viewpoints which broadened their awareness regarding larger societal issues related to family, institutional cultures, and the legal system, as opposed to just the individual perspectives. In one of the student’s reflection on how the varying positions in online role play changed her thinking, she replied;

I began the role play with a totally different perspective. I fully supported the school’s position to dismiss children who violated school policies. I always felt that rules must be respected, no matter what. However, my interaction with other roles especially the lawyer and his legal interpretation of the school’s position, sort of opened my mind to a new way of thinking. I sort of realized that change in these policies is inevitable.

The student’s views suggest an engagement in what Johnson and Johnson (2009) described as ‘collaborative constructive controversy’ which involves recognizing the validity of opposing perspectives, leading to self-interrogation of one’s perspective, and creating a willingness for an individual to accommodate and work with alternative perspectives.

6. Conclusion and implications

The study illuminated several implications that could be relevant for further research. First, the study confirmed that participation in digitally-mediated online role play provided space for students to enact varying literacy practices, which fostered students’ critical understandings of the issue and a desire to enact change. However, participation in this online role play was restricted to a small group of students, without any external online audiences such as real-life experts and school policy makers. It would be interesting for researchers to explore how the existence of external audiences would enrich students’ online role play engagements. That is, would

the presence of real-life persons provoke deeper insights among students and increase “pedagogical authenticity”? (Scheider and Evans, 2008, p.4)

Secondly, the study proved that students especially in print-based pedagogical contexts, who are often assumed to lack ‘autonomous’ literacy skills, were capable of enacting multiple literacy practices, and re-create meanings across sites of engagement in the role play. The students orchestrated multiple modes (e.g. textual and visual modes), and framed positions linked to “cultural and power structures in society” (Street, 1994, p.433), thereby engaging in “hybrid discourse practice”. These practices reflected students as “literate creators” of new models of literacy which include “sophisticated visual literacies and evidence of mixing, mashing and collaging of discursive forms” (Rogers et al., 2010). Researchers, especially in the field of new literacies would explore further the potential of other ubiquitous digital tools to support the development of the novel skills associated with effective argumentative practices mediated through online pedagogical practices as opposed to the conventional print-based pedagogies. However, as Beach and Doerr-Stevens (2013) argue that practitioners who wish to develop such novel skills need to adequately prepare learners for the complexities involved.

In addition, the current study focused on a small group of ESL pre-service students who were about to complete their English Language teacher training course at university. These students exhibited a range of well-developed digital and non-digital competencies related to argumentative writing. In addition, the majority were proficient online users who easily transferred knowledge of their social media engagements to creating credible role play characters and building strategic relationships on the blog platform. However, the study did not consider students who often experience difficulties with argumentative writing, or those with limited digital skills. As such, further investigation is needed to explore possibilities of using other online platforms to provide struggling students with opportunities for digital writing, specifically focusing the social constructivist spaces that promote open dialogue and collaborative knowledge construction (Whittaker, Howarth and Lymn, 2014) in order for students to work through their difficulties. As Thalluli and Penman (2014, p. 462), observe that “the dynamic written format afforded by online tools allows for both real time and delayed responses which is beneficial for shy, reticent or ESL students who find it hard to contribute in real time face to face activities such as tutorials”. In addition, the current study proved that if adequately supported, students have the ability to enact a range of digital and non-digital literacy practices to develop authorship especially in the area of argumentative writing which is challenging for most students. It is also clear that the support given to students for their online role play engagements needs to be clear and timely as was provided via weekly workshops and other supports during the course of this study.

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Effects of Video Discussion Posts on Social Presence and Course Satisfaction

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DOI: 10.34190/JEL.18.5.007

Abstract: Video is a rich medium that conveys more social cues than text. Use of video in an online discussion forum therefore has the potential to increase social presence in online learning environments. This experimental study compared a group using video for a portion of the required discussion posts to a group using only text in an online undergraduate course. While there was a correlation between perceived social presence and satisfaction with the course, there were no significant differences in perceived social presence or course satisfaction between the two groups. Open-ended comments revealed a mix of positive and negative reactions to the use of video. This study highlights the need for continuing research on the use of video in online discussion forums to assess the benefits of video relative to its possible negative effect on “anytime, anywhere” flexibility.

Keywords: Video Discussion Posts, Student Perceptions, Social Presence, Course Satisfaction, Online Learning

1. Introduction

Asynchronous online discussions are popular activities in both formal and informal online learning environments since they offer interactivity with flexibility for students and teachers to communicate any time or anywhere (Kent, Laslo, and Rafaeli, 2016). One study showed that students engaged in discussion for an online course perceived a significantly higher level of social presence compared with students in the same course but with no discussion activities (Cho and Tobias, 2016). The risk of reliance on asynchronous discussion is that students can feel isolated if they perceive insufficient levels of interaction (Hung and Chou, 2015; Lee and Choi, 2010) and therefore be less satisfied with the course (Bolliger and Martindale, 2004). One way to address this problem of isolation is to foster social presence in the online classroom.

1.1 Social presence

Social presence is a component of the *Community of Inquiry* (CoI) framework (Garrison, Anderson, and Archer, 2000, 2010), which explains how critical thinking and learning can occur in asynchronous discussion forums. In these environments, learners are thought to experience three different types of presence. *Cognitive presence* is the “extent to which the participants...are able to construct meaning through sustained communication” (Garrison, Anderson, and Archer, 2000, p. 89). *Social presence* is the ability of participants to project their identities as real people and to perceive the other participants as real people (as opposed to disembodied text on the screen). Social presence supports cognitive presence by enabling learners to engage in meaningful dialogue centered on the course content. *Teaching presence* is the design and facilitation of the learning experience. While course design is primarily the role of the instructor, the facilitation aspect of teaching presence can be shared between instructor and learners.

Social presence in online learning is important for at least two reasons. First, it supports learners’ subjective level of satisfaction and perceived learning in a course. Richardson, Maeda, Lv, and Caskurlu (2017) performed a meta-analysis over 25 studies that investigated the relationship between social presence and either perceived learning or satisfaction in higher education online courses. They found that students’ perceived level of social presence was a significant predictor of perceived learning in the course moderated by the course length, discipline area, and course audience, and that perceived learning was also positively correlated with students’ course satisfaction. Swan and Shih (2005) surveyed 51 graduate students in an online course, and found that “students who perceived high social presence in the online discussions also believed they learned more from it than did students perceiving low social presence” (p. 127). These students also attributed some of their learning to exposure to multiple perspective as they read their classmates’ contributions.

A second, and arguably more important, reason that social presence is important in online learning environments is that it supports cognitive presence and is therefore an important first step in promoting critical thinking, and ultimately, learning. Garrison, Cleveland-Innes and Fung (2010) used structural equation modeling to explore the relationships between the three types of presence, and found that teaching presence had a direct relationship with both social and cognitive presence, but also that social presence acted as “a mediating variable between teaching and cognitive presence” (p. 35). This finding confirmed previous findings by Shea and Bidjerano (2009), who found that participants’ comfort level with the online discussions, an element of social presence, correlated with cognitive presence. Although both of these studies identified teaching presence as the strongest predictor of cognitive presence, social presence nevertheless had an important mediating role.

In face-to-face environments, “a key aspect of establishing social presence...is visual cues” (Garrison, Anderson, and Archer, 2000, p. 95), but participants in text-based online environments need to find other ways of achieving social presence. Swan (2002), for example, found that students in asynchronous online discussions used immediacy behaviors such as including emoticons in posts, disclosing personal information, and addressing classmates by name. Walther (1992) suggested that speakers might use explicit verbal cues when nonverbal communication was not possible, such as typing “I agree” when listeners know the speaker cannot see them nod their heads.

1.2 Video as a Learning Media

With the increased availability of easy-to-use software for creating video, however, some level of non-verbal communication can be added back into the online learning environment, even in asynchronous courses. Compared to text, video discussion is a richer medium that can engage students, promote social presence, and provide new ways for online interaction (Kinskey, Miller, Hauck, and Manderfeld, 2018). Daft and Lengel (1986) defined media richness as “the ability of information to change understanding within a time interval” (p. 560). They explain further by saying

Communication transactions that can overcome different frames of reference or clarify ambiguous issues to change understanding in a timely manner are considered rich. Communications that require a long time to enable understanding or that cannot overcome different perspectives are lower in richness (p. 560)

Differences in media richness are due to “the medium's capacity for immediate feedback, the number of cues and channels utilized, personalization, and language variety” (p. 560). Written communication is therefore lower in media richness than face-to-face communication, but video, which uses both visual and auditory channels, could fall in between text and face-to-face communication. Rich media are better suited to facilitating communication when tasks are *equivocal*, meaning they have “multiple and possibly conflicting interpretations of the available information (Dennis and Kinney, 1998, p. 257). The video format also provides students more opportunities to communicate, as students found it was not easy to express themselves fully in a purely written format (Arend, 2009). In an educational setting, the use of rich media has been shown to be beneficial students’ learning experience (Oregon, McCoy, and Carmon-Johnson, 2018; Saunders and Hutt, 2015).

1.3 Video, Social Presence, and Course Satisfaction

Research on the use of rich media in asynchronous online courses includes exploration of the use of audio and video by students and by instructors. Research on instructor use of rich media has focused on the use of audio or video files for delivering instructor feedback. For example, Ice, Curtis, Phillips, and Wells (2007) explored student course satisfaction and perceived learning with text versus audio feedback from the instructor. They found that students preferred the audio feedback, saying it enhanced their sense of community and perceptions that the instructor cared about them. Borup, West, and Thomas (2015) also compared the use of video versus text for providing instructor feedback on student projects. They found that both students and instructors preferred text feedback because they found it more efficient. However, students perceived the video feedback as more supportive, while instructors felt their style when giving feedback via video was more “conversational” (p. 178). These studies show the potential of rich media to create a sense of social presence from the instructor.

Some studies have also found rich media to be valuable for student-to-student online communication. Borup, West, and Graham (2012) studied three classrooms where video (hosted on YouTube or Voicethread) was used for communication, though only one of the three used the video for communication between students. Qualitative data showed that students felt the rich media enhanced instructor social presence and, to a lesser

degree, student social presence. Hew and Cheung (2012) compared the use of audio files to text for online discussion in a blended university course. While they found no significant differences in the quantity or quality of posts between the two conditions, data from open-ended questions revealed that students appreciated the opportunity to hear their classmates’ vocal inflection and thought the audio posts enhanced community and the sense of interacting with real people. These studies suggest that rich media can enhance social presence between students.

While these studies demonstrate the promise of video discussion posts to promote social presence, there is a need for further studies to confirm these early findings and provide quantitative data to complement these primarily qualitative studies. This study used a quantitative measure of perceived social presence to compare the use of video versus text for discussion posts in a fully-online asynchronous undergraduate course, named Applications of Media and Technology. Because meaningful interactions can help to combat isolation and have a significant influence on social presence, academic performance (Joksimović, et al., 2015), and satisfaction in online courses (Bolliger and Martindale, 2004), this study also measured students’ course satisfaction.

The course satisfaction measure was based on a questionnaire created by Lee, et al. (2011), who explored the relationship between course satisfaction and the support students received from peers as well as from instructors. The following three hypotheses were tested:

- H1. Perceived social presence will have a positive correlation with course satisfaction.
- H2. Students who use video for a portion of their required discussion board posts will report higher social presence than students who use only text-based discussion posts.
- H3. Students who use video for a portion of their required discussion board posts will report higher course satisfaction than students who use only text-based discussion posts.

In addition, the researchers sought to explore students’ qualitative perceptions of the use of video for asynchronous online discussion.

2. Methods

2.1 Participants

Participants in this study were undergraduate students at a public university in the Midwest enrolled in a fully online course on applications of media and technology. Demographic information about the participants can be found in Table 1.

Table 1: Participants Demographics

	Total (N=57)	Text Group (N=28)	Video Group (N=29)
Age	25.67 (8.54)	24.21 (6.16)	27.07 (10.25)
Gender	49.1% F 50.9% M	46.4% F 53.6% M	51.7% F 48.3% M
Class	1.8% Freshmen 22.8% Sophomore 38.6% Junior 35.1% Senior	3.6% Freshmen 17.9% Sophomore 39.3% Junior 35.7% Senior	27.6% Sophomore 37.9% Junior 34.5% Senior
Previous Online Experience	10.5% First-timer 15.8% Second-timer 73.7% Third-time or more	7.1% First-timer 17.9% Second-timer 75% Third-time or more	13.8% First-timer 13.8% Second-timer 72.4% Third-time or more

2.2 Context

The course was offered by the College of Education but was targeted towards students pursuing careers outside the K-12 classroom. The course introduced a variety of digital technology tools, such as asynchronous and synchronous communication software, multimedia production tools, and social media, then asked students to develop basic skills in using the tools. Before each Sunday, students were required to post discussions regarding the media or tools that were being introduced during the week. Students were also required to post links to their completed projects as well as their reflections on using the tool and the usefulness of the tool in their future careers.

The course was taught by the first author, who at the time was a Ph.D. student in an educational technology program, and supervised by the second author, a faculty member in the same program. Data was collected over four semesters, with no major changes to the course structure or content overall.

2.3 Materials

Students who consented to participate in the study completed an online questionnaire asking about their perceived social presence and course satisfaction. The social presence portion consisted of 10 questions adapted from Gunawardena and Zittle (1997). The scale in its original form had strong internal consistency of 0.88 (Gunawardena and Zittle, 1997). The original questionnaire was retained to the greatest extent possible, but some items, such as questions about usage and attitude towards computer-mediated communication, were dropped, as they were not directly related to the research questions. The wording of some questions was modified as required to fit the context of the study environment. For example, the question "I felt comfortable introducing myself on GlobalEd" from the original questionnaire was changed to "I felt comfortable introducing myself in this online course" for the current study. The course satisfaction portion of the questionnaire consisted of five questions adapted from Lee, et al. (2011). Both social presence and course satisfaction were measured using a 5-point Likert-type scale, where "1" was strongly disagree and "5" was strongly agree. The questionnaire also included demographic questions and two open-ended questions: "What do you think about having video-posts instead of text-posts to interact on the discussion board?" and "How could this course support your learning better?"

3. Procedure

Data collection took place over four 16-week semesters from fall 2015 to spring 2017. Students enrolled in the course were randomly placed in one of two equal groups (8 - 12 students per group) using the group feature of the Brightspace (D2L) learning management system. The two groups were presented with the same content and assignments, but completed their discussion posts within their groups, with no interactions between the groups. During the first eight weeks of the semester, one group was assigned to complete their weekly discussion posts using text only, while the other group was required to do three of the eight weekly posts by creating a video, hosting it online (e.g., using YouTube), and posting the video link to the discussion board. In order to make sure all students had similar experiences with the course, the assignments were switched at mid-semester, so the original control group was required to complete video posts and the original experimental group reverted to text. At the end of the first eight-week data collection period, all students received an email with a link to the survey, which also contained the consent form. Thus, while all students in the class received the same instruction, only students who consented were included in the research.

Average social presence and course satisfaction scores were calculated for each participant by computing the mean of their responses for each scale, thereby retaining the original five-point scale. The data were explored using descriptive statistics, and the bivariate correlation between social presence and course satisfaction was examined. T-tests were used to test the hypothesized effects of video discussion posts on perceived social presence and course satisfaction. In addition, item-level comparisons within each scale were explored. Responses to the open-ended questions were examined to gain insight into students' opinions of the video posting requirement.

Data were first analyzed to see if they met the assumptions for parametric statistical tests. Shapiro-Wilk tests showed that scores on the social presence and course satisfaction scales were normally distributed in both groups at $\alpha = 0.01$. However, when exploring the data item-by-item, none of the scale items were normally distributed. Therefore, t-tests and Pearson correlation tests were used to explore relationships related to the overall social presence and course satisfaction scales, but non-parametric Mann-Whitney U tests were used to compare the two groups on individual scale items. For between-group comparisons, data from the first half of the semester were analyzed. Paired t-tests were also used to examine any changes in social presence or course satisfaction as the semester progressed.

4. Findings

4.1 Relationship of Social Presence and Course Satisfaction

The Pearson correlation test indicated that social presence had a significant positive relationship with course satisfaction in both the video group, $r_s(28) = .875$, $p < 0.001$, and the text group, $r_s(29) = .727$, $p < 0.001$. Thus, H1 was supported.

Table 2: Social Presence and Course Satisfaction Scores

	Total Sample (N=57)	Text Group (N=28)	Video Group (N=29)
Social Presence Score	3.84 (.65)	3.72 (.68)	3.96 (.61)
Course Satisfaction Score	3.98 (.78)	3.81 (.83)	4.14 (.70)

4.2 Effect of Video Discussion Posts

There was no significant difference in students' social presence and course satisfaction scores between the video group and the text group. Therefore, H2 and H3 were not supported. However, the video group had slightly higher social presence ($M = 3.96$, $SD = 0.62$) and course satisfaction scores ($M = 4.14$, $SD = 0.70$) when compared with the text group. The text group had a mean social presence score of 3.72 ($SD = 0.68$) and a mean course satisfaction score of 3.81 ($SD = 0.83$).

As no significant differences were found in the overall social presence and course satisfaction scores, the researchers explored each item of the questionnaire individually. This analysis showed that two social presence items were significantly different at the .05 alpha level between the two groups. The video group (Mean Rank = 33.45) had a significantly higher score than the text group (Mean Rank = 24.39) on the scale item "the instructor created a feeling of online community", $U = 535.00$, $z = 2.297$, $p = .022$, $r = .30$. In addition, the video group (Mean Rank = 33.97) had a significantly higher score than the text group (Mean Rank = 23.86) on the scale item "the instructor facilitated discussion in the online course", $U = 550.00$, $z = 2.622$, $p = .009$, $r = .35$.

Table 3: Descriptive and Mann-Whitney U Test Statistics of Two Social Presence Items in First Half Semester

	Text Group (N=28)	Video Group (N=29)	Mann-Whitney U	Asymp. Sig. (2-tailed)
The instructor created a feeling of online community.	3.68 (1.06)	4.28 (.65)	535.00	.022
The instructor facilitated discussion in the online course.	3.86 (.71)	4.31 (.66)	550.00	.009

Although the remaining differences were not statistically significant, the video group had slightly higher scores on all scale items as well as the average social presence and average course satisfaction scores, see Table 4 and Table 5.

Table 4: Social Presence Comparison for Two Groups in First Half Semester

	Text (N=28) <i>M (SD)</i>	Video (N=29) <i>M (SD)</i>
Social Presence		
1. Online or web-based learning is an excellent medium for social interaction.	3.46 (1.04)	3.48 (.87)
2. I felt comfortable conversing through this text-based medium.	3.89 (.92)	3.93 (.92)
3. I felt comfortable introducing myself in this online course.	3.86 (1.15)	4.10 (.77)
4. The introduction enables me to form a sense of online community.	3.68 (.98)	3.69 (.93)
5. I felt comfortable participating in online discussions.	3.68 (1.02)	4.03 (.82)
6. The instructor created a feeling of online community.	3.68 (1.06)	4.28 (.65)
7. The instructor facilitated discussions in the online course.	3.86 (.71)	4.31 (.66)
8. I felt comfortable interacting with other participants in the online course.	3.82 (.82)	4.17 (.85)
9. I felt that my point of view was acknowledged by other participants in the online course.	3.75 (.75)	3.79 (.82)
10. I was able to form distinct individual impressions of some online course participants even though we communicated only via a text-based/ (video-based) medium.	3.54 (.92)	3.79 (1.01)
<i>Calculated social presence score</i>	<i>3.72 (.68)</i>	<i>3.96 (.62)</i>

Table 5: Course Satisfaction Comparison for Two Groups in First Half Semester

	Text (N=28) <i>M (SD)</i>	Video (N=29) <i>M (SD)</i>
Course Satisfaction		
1. This course increased my interests in the subject.	3.43 (1.14)	3.72 (.96)
2. I felt I achieved the objectives in this course.	3.93 (.86)	4.28 (.59)
3. I liked the course format (online).	3.86 (.89)	4.10 (1.01)
4. I felt comfortable in this course.	3.89 (.96)	4.24 (.74)
5. I would recommend this course to others.	3.93 (.98)	4.34 (.67)
<i>Calculated course satisfaction score</i>	<i>3.81 (.83)</i>	<i>4.14 (.70)</i>

4.3 Timing of Replies

Timing of replies refers to the length of time between the students' initial post and the first reply received. Those quantitative data were tracked by the learning management system. A difference was observed in the length of time it took students to reply to a video post compared to a text post. It took significantly less time (hours) to receive the first reply after an initial discussion post for the text-only group ($M = 31.63$, $SD = 29.62$) compared to the video group ($M = 42.86$, $SD = 36.15$) conditions; $t(91) = -1.70$, $p = 0.04$.

4.4 Social Presence and Course Satisfaction Trend in Course

In 2016 Spring, 2016 Fall, and 2017 Spring semesters, students were asked to put in a self-generated 4 digit code (e.g. last 4 digit of their phone number) to anonymously match their middle semester survey and end of course survey. Twenty-nine matched records were obtained. A paired-samples t-test was conducted to compare students' average social presence score and average course satisfaction score between the mid-semester and end-of-semester surveys. Results showed that both their social presence and course satisfaction decreased in a way that was not statistically significant.

Table 6: Paired Samples Test for Social Presence and Course Satisfaction score

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Social Presence Score in 1 st survey – 2 nd survey	.414	4.452	.827	-1.280	2.107	.500	28	.621
Course Satisfaction Score in 1 st survey – 2 nd survey	1.000	3.140	.583	-.194	2.194	1.715	28	.097

4.5 Responses to Open-Ended Questions

The authors coded the open-ended question responses into positive, neutral, and negative themes. The unit of analysis was a complete thought, which was generally two to three written sentences. Each unit was assigned one theme only. The researcher first coded the responses separately with an agreement of 81.25% at the code level. After discussion, a second round of coding was performed on the units that failed to reach an agreement in the first round. The final coding reached an agreement of 93.85%. Analysis of 65 open-ended comments revealed a variety of positive and negative opinions about the use of video for discussion posts. After removing the comments that did not reach an agreement between researchers, there are 44.26% positive comments, 42.62% neutral comments, and 13.11% negative comments. Negative comments centered around two areas: the practical difficulties of recording a video, and student discomfort with the medium. The video was perceived by some students as being cumbersome to create and inconsistent with the “any time, any place” nature of online courses. The following comments from students demonstrate this theme:

“I personally don't like it, it is hard for me to find quiet places to sit and video myself.”

“I would much rather have text post just because it can be completed in any environment where as [sic] you need a quiet room and time to do a video.”

“I prefer text posts instead of video posts since videos require a student to be at a quiet place. As a full time student, video posts became hard since I am usually in between classes and out. ”

Other students expressed discomfort with video, saying, “I feel very self-conscious about them” and “I do not like talking to a camera and not seeing who I'm talking to on the other end. It makes me uncomfortable.” Some students, however, described how they overcame their initial discomfort and grew to appreciate the video posts. For example, one participant said, “At first I was very uneasy with the video posts, but after I completed my first one, I thoroughly enjoyed it!”

Positive comments included appreciation of the learning opportunity, and comments consistent with increased social presence. Several students viewed the use of video as another opportunity to develop new skills. One student said, “I don't mind the video of myself. I think getting me out of my comfort zone is the hardest for me. I do not feel comfortable with the new technology, but that is why I am taking this class.” Another said, “I was glad to get to see how to use this technology.” Another student went beyond the technical skill of creating a video and said, “I like it, really teaches you how to work on presenting yourself to others with a brief speech relating to your assignment.” Other comments suggested increased social presence from the use of video. For example, one student said the video “lets me put a face to the names of the other students,” while another said, “I think it's good way to get to know my classmates better.” One student said, “I believe it is a good way to get to know each other and enables me to feel more comfortable with the class.” One student elaborated on the potential of increased presence to improve communication, saying

“video post is better than text posts because it allows people to see your body language and tone. There has been a lot of times throughout life where people misinterpret a text because they take it the way it wasn't meant to be taken because they can't physically see the other person's body language or tone being used.”

5. Discussion

This study revealed a positive correlation between perceived social presence and course satisfaction, which is consistent with previous research (Horzum, 2017; Richardson, et al., 2017). The lack of any significant relationship between the use of rich media, in the form of video posts, and either social presence or course satisfaction was surprising. Although the video group did report higher levels of social presence and course satisfaction, the differences were not significant. It was possible that the small sample size of 57 was not sufficient to reflect a statistically significant impact of the video implementation. In addition, the short duration of the study (eight weeks) could be another reason that the video discussion did not have a large impact on students' perceptions. Finally, the video posts were required for only a portion of the discussion posts. This was a deliberate decision to avoid over-burdening students in a course that already required weekly multimedia or technology-rich projects, but it is possible that the effect would have been greater if video had been required for all discussion posts instead of only a portion of them.

It is also possible that rich media really does not affect students' satisfaction with an online course. The goal of the rich media in this study was to enhance interaction between students, but some studies have found that interaction between students does not relate to satisfaction with the course (Hong, 2002; Sun, et al., 2008).

Yukselturk (2009) stated that different characteristics of learners, which include learners' motivation, previous education, experiences, and online learning readiness, are all important factors of learner's satisfaction. It was possible that students' satisfaction was influenced more strongly by factors not related to their interaction on the discussion board. For example, students may have perceived the requirement of recording and posting a video online to be burdensome (Thompson, Vogler, and Xiu, 2017). The perception that posting a video required extra work could also lead to a decreased course satisfaction. Some students commented on the difficulty of finding a quiet room in which to record the video, which detracted from the flexibility of online learning. In addition, the video post required students to reveal more personal traits, such as gender, appearance, or voice, than would be revealed in a text post. Some students may be uncomfortable revealing this additional information. Moreover, compared to video, it is easier to scan text posts for the main idea and then reply. Viewing a video post would require a quiet environment and a longer time committed to understand the information delivered through video. Cummins, et al. (2016), discovered that video discussions did not lead to a greater sense of community.

Concerning social presence, it is interesting that participants in the video group gave significantly higher ratings for the two scale items ("the instructor created a feeling of online community" and "the instructor facilitated discussion in the online course") associated with the instructor's actions in the course. It is possible that the richer social cues from the video posts gave students the impression that the discussion was more effectively facilitated, even though they did not perceive overall social presence as being higher. Given that formal and informal peer facilitators can contribute teaching presence (Anderson, et al., 2001), this rich interaction with peers through video may have contributed to students' feeling that the instructor was more engaged as well.

Participants' comments revealed mixed feelings about the use of video discussion posts, with positive comments about the richness of interaction and the value of learning to present themselves via video, balanced by concerns about its inherent logistical difficulties. Both creating and watching the video discussion posts required a quiet environment, and therefore detracted from the "any time, any place" nature of the online course. The lack of significant differences in perceived social presence and course satisfaction shown in this study highlights the importance of balancing benefits and risks when integrating technology into the learning environment. While this study was limited by its small sample size and the short duration of video use in the class, continuing research on the benefits of video discussion posts is needed to more effectively understand their relative contribution to online learning.

One area of future study is the influence of group size on social presence. The current study, which had a cumulative sample size of 57 from four semesters, resulted in active group sizes of five to ten for both the text and video discussions. Akcaoglu and Lee (2016) indicated that students perceived a higher level of social presence in terms of sociability and group cohesion when in a small size group of five rather than a whole class.

Further comparisons of small, medium, and large groups would add understanding of how group size affects perceived social presence when using different types of media for interaction.

6. Conclusion

This research explored the social presence and course satisfaction in an undergraduate online course. Results indicated that social presence had a significant positive relationship with course satisfaction in both groups, which is consistent with previous literature. This study revealed that the video group had non-significantly higher social presence and course satisfaction scores than the text group. Further analysis found that the video group students had a significantly higher score on “the instructor created a feeling of online community” and “the instructor facilitated discussion in the online course”. It took students a significantly longer time to receive the first reply after an initial video post compared to an initial text post. Open-ended question comments emphasized the practical difficulties of recording a video and students’ discomfort with the video medium. On the other hand, students do appreciate the extra learning opportunities along with creating a video post and the fact that creating video post could increase their social presence in an online course.

Although the findings from this study were inconclusive with respect to the influence of video discussion posts on perceived social presence, more research is needed to explore the potential of rich media to promote students’ social presence and enhance the development of their learning outcomes (Joksimović, et al., 2015). Results of this study showed that some students are aware of the benefits of video discussion posts both as an opportunity for social connection online and as a way to develop technical and communication skills. At the same time, some students find it burdensome and inconsistent with the advantages of online learning. More research is needed to develop guidelines for the appropriate use of video posts. For example, it is possible that restricting video to lower stakes discussions, such as icebreakers, is sufficient for building social presence, since it can overcome the perceived distance between students and help put a face to a name. Providing guidelines for video length could also be helpful, as this would not only prompt students to present their ideas concisely but also make it easier for classmates to revisit the post (Thompson, Vogler, and Xiu, 2017). Meanwhile, the instructional team members, including the instructor, course designers, and teaching assistants, should be aware of the importance of providing sufficient scaffolding and in-time technical support, especially during students’ first experience creating a video post.

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Editorial for EJEL Volume 18 Issue 5

The current covid-19 pandemic changes so many things in our everyday lives, how we work, how we study and learn. As we are writing this editorial in the midst of the second wave, many learning institutions and organizations turn to the lessons learned from the first lockdown. No doubt much can be learned from this lockdown, from this rapid and grand scale implementation process, and from the many studies that now surface from this period, and that suggest important factors to contemplate. However, it is also clear that a lot of the implemented teaching and e-Learning processes were “emergency setups” that often did not utilize what technology-supported learning can, and where many learning design teachers, participants and students were in an emergency state of mind. Hopefully, we are able to move to a better situation, with the arrival of several vaccines. In a more normalised world, it is likely that many would like to continue the exploration into more sustainable e-Learning processes. Here, it is equally or perhaps even more important to address the profound and rigorous research carried out for years by e-Learning researchers all over the world, in varied contexts and different pedagogical settings.

The Electronic Journal of e-Learning (EJEL) and the 18th European Conference on e-Learning 2019 (ECEL) represent one of the many communities where such knowledge can be found. Both might act as an inspiration now, and for future considerations, when e-Learning can be an explicit choice, and not solely a necessity. The EJEL format allows for open access to the publications. In this volume we represent a little snippet of the best research contributions presented at the ECEL 2019. The articles were collected by invitation, and the research has been further worked on, the articles improved and reviewed again prior to publication. In this EJEL issue we present 4 articles originating from ECEL 2019 contributions. Furthermore, this issue was completed with three additional articles from the regular EJEL editing process. In the following, the articles are introduced briefly.

How can online spaces be established for facilitating students’ joint inquiry activities in higher education? In an exploratory case study, Hautopp and Ejsing-Duun investigate how the use of visual facilitation and representations can create exploratory approaches to game design in online teaching. The course “Games for change” which is a part of the international Nordic Visual Studies and Art Education (NoVA) where students design games that address issues in society constitutes the empirical basis. The didactical design of the course comprises different problem-based learning (PBL) activities combined with teacher presentations of game theory, and exercises through videos and visualisations to support the students’ iterative game design processes. An analysis of the PBL activities showed that teachers’ video instructions relating theoretical game concepts to the students’ actual group work supported the introduction to the game field as well as their design processes. The authors conclude that the combination of inquiry approaches, critical game theory and design processes, combined with students’ visualisations and video productions, provides interesting connections for bridging gaps between cultures and professions, e.g. in art and games.

Barber’s article – the second of this issue – addresses that the ability to develop online communities that inspire critical and creative thinking has not kept pace with digitalisation, and suggests the developing of new approaches to teaching in online environments based on a pedagogical strategy called “Digital Moments”. The pedagogical strategy is a way for developing creative interactive online learning communities based on the Fully Online Learning Community model (FOLC) and a theoretical and conceptual ideal of a problem-based learning (PBL) environment. The main argument of the article is that creative and artistic expression in problem-based learning spaces enhances social presence and student engagement. Based on a case study of “Digital Moments” as a way to build inclusion in two synchronous graduate online courses, the author analyses how the teaching approach increased student participation, developed student ownership of learning, and encouraged collaborative processes between participants.

While Flipped Classroom (FC) approaches and Learning Analytics (LA) have for some time been significant to educational studies they have only recently been studied together. The third article by Algayres and Triantafyllou traces this connection through an extensive literature review based on 49 recent papers on FC and LA in higher education. Drawing on this material they argue that LA and FC can inform each other, as learning analytics can both support the development of FC as a way of learning and predict ways in which it can be used for best practices. LA in FC is, they show, dominated by STEM in higher education and uses a number of methodologies to create data and knowledge about student participation, engagement and self-efficacy. Results from the study

are positive as the authors suggest that LA has great potential for reinforcing the methodology and success of using FC in higher education. However, the review also underlines that there is a lack of in-class and long term research on LA in FC and that data mining may be lacking in depth with regard to determining student performance and learner experience. Currently, predictive and prescriptive analysis is therefore a significant area in which Algayres and Triantafyllou predict that LA will expand to support - for example - instant feedback and more adaptive learning experiences.

Using serious games in higher education is one way in which higher education may engage students in addressing the climate crisis and creating awareness of the challenges involved in developing energy efficiency and renewable energy in sustainable societies. In the fourth article of this issue, Ouariachi and Elving investigate these issues through a study of the *We-Energy Game*, which has been used among international students in higher education institutions in the Netherlands. The game can be played both on board and on screen, and allows students to choose and negotiate the energy sources they want to use in a specific location based on roles given in the game. The study is based on surveys pre- and post-gaming and on group discussions to create qualitative data on gaming. Results from the study show increased awareness among students of the urgency of being informed about energy transition and sustainability as well as ways in which students can make a contribution to these challenges. Using the *We-Energy Game* to create awareness and self-efficacy is therefore both relevant and in line with existing research on serious games; however, the paper also suggests that more research is needed to understand whether games can affect attitudes and behaviours related to the development of sustainable societies.

The fifth article is by Cecilia Temilola Olugbara and Moeketsi Letseka based at the University of South Africa in Pretoria (South Africa): "Factors Predicting Integration of E-Learning by Preservice Science Teachers: Structural Model Development and Testing" describes an analytical study of the factors that promote the integration of e-Learning into the teaching activities of preservice teachers. Methodologically, hypotheses are generated, and a survey is conducted among 100 preservice teachers. The survey results are processed in a structural path analysis using the partial least square structural equation modeling technique. The aspect "Skill" is confirmed as the most important factor for the integration of e-Learning in the South African context.

Josephine Lutaaya Najjemba and Johannes Cronjé, the authors of the sixth article are also located in South Africa, the first at the University of Free State, Bloemfontein and the other at the Cape Peninsula University of Technology, Cape Town. Their article is entitled "Engagement with and Participation in Online role play Collaborative Arguments: A Sociocultural Perspective" and examines the extent to which online role play influences literacy practices and attitudes on social issues. Methodologically, a sample of 20 pre-service students was studied in both online and face-to-face sessions, again using qualitative methods. Among the findings is that the environment provided was very conducive to learning for the learners, which also promoted own activities and critical thinking among the learners. Based on further findings, this article may also serve as inspiration for the design of own activating learning activities.

The final article by Ying Xiu (University of Illinois Urbana-Champaign, USA) and Penny Thompson (Oklahoma State University, Stillwater, USA) introduces video discussion posts. In their article "Effects of Video Discussion Posts on Social Presence and Course Satisfaction", the authors depart from the premise that videos, in comparison to texts, can convey more information, for example through gestures and facial expressions, and that as a result social presence as an important component of learning processes might be strengthened. The study is able to prove a correlation between satisfaction with the course and perceived social presence but does not provide evidence that increased social presence can be achieved through video discussion posts compared to the control group. Thus, in addition to the inspiration for own learning activities, the study also raises the need for further research into possibly counteracting effects, such as those that may result from too large freedom of anytime/anywhere flexibility.

Journal Editors

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