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Flow Theory and Learning Experience Design in Gamified Learning Environments

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Learning technologies should be designed in a way that facilitates student knowledge construction. While much of the learning technology literature often focuses on retention of content, less is known about the theories and models that influence how learners perceive and react to the interface. In this chapter, we describe the theoretical tenets of flow theory and its application for learning experience design, especially for gamified learning environments. We then present a design case that details how flow theory was applied towards the redesign of an online professional development course. Implications for theory and practice are also discussed.

1. Introduction

To date, various theories and models describe effective ways to implement learning technologies within classroom settings (Tosuntaş et al., 2015). Other theories and models describe how to best design interfaces in ways that supports constructivist principles, including self-directed learning (Ge et al., 2016; Loyens et al., 2008), scaffolding strategies (Kim et al., 2017), and collaborative learning approaches (Chen et al., 2018). Indeed, the empirical studies based on these theories or models underscore the importance of learning principles in supporting student success.

While much of the learning technology research is often focused on the student outcomes, less emphasis has been placed on the role of learning experience design (LXD). That is, how the interface design aligns with principles of human-computer interaction and learning processes to support student knowledge construction. As such, designers that approach the interface from only a learning theory perspective may encounter unforeseen obstacles due to user experience (UX) challenges. For example, a design might technically apply soft scaffolding but fail to do so in a way that is conducive for fluid navigation. Similarly, an interface could apply the First Principles of Instruction (Merrill, 2018) but overlook the role of aesthetics and error prevention during the design process. While learning theory provides the foundation for how one constructs knowledge and engages in meaning-

making, an equally important part is how the interface design mediates that process for the learner. A failure to consider both equally is disruptive to knowledge construction and thus renders the technology ineffective for meaningful learning.

This chapter argues that flow theory is an approach that equally describes the learning process and user-experience. Flow theory describes the state of flow in which learners are so engrossed in an activity that they lose sense of time and no other activity matters during that time. While in this mental state of flow, self-consciousness can fade and the sense of time can become distorted (Csikszentmihalyi, 1991). During this state of flow, learners' engagement is often high and they have intense concentration on the task. Moreover, the theory includes cognitive elements, such as feedback immediacy and focused attention, in addition to affective constructs (engagement, self-rewarding experience). In doing so, the theory describes the cognitive processes that influence learning, while also providing a purview to understand the human-computer interaction elements of interface design.

To better understand LXD, this chapter will describe the theoretical foundations of flow theory (Guo et al., 2016) and its implications for interface design. In terms of the latter, the chapter will detail a design case (Boling, 2010) about how the engagement construct within flow theory was applied towards LXD in a gamified learning environment.

2. Flow Theory

One of the principal theories associated with engagement and gamification is flow theory, also known as optimal experience theory (Guo et al., 2016). Csikszentmihalyi's (1975) research sought to understand how performers expend considerable energy and time on their activities. His research coined the term flow experience whereby concentration, interest, and enjoyment are experienced simultaneously (Csikszentmihalyi, 1997). The theory further argues that three channels exist for learning: boredom channel, flow channel, and frustration channel (Sharek & Wiebe, 2011). As a learner proceeds through a task, one's flow state is likely to be preserved if the task difficulty increases to match the developing skills. Furthermore, the "boredom area" will result if the challenge fails to increase as the learner's skills and ability develops. In the boredom channel, the individual is not interested in the task and quickly disengages from the activity. Alternatively, an individual can fall into the frustration area if their skill/ability level is not comparable to the difficulty inherent within the task. The tasks within the frustration channel may be of interest to her or him, but the task becomes so challenging that they lose motivation to persist. The goal is for the activity to fall between these channels so that interest and challenge is maintained over time (Csikszentmihalyi, 1991).

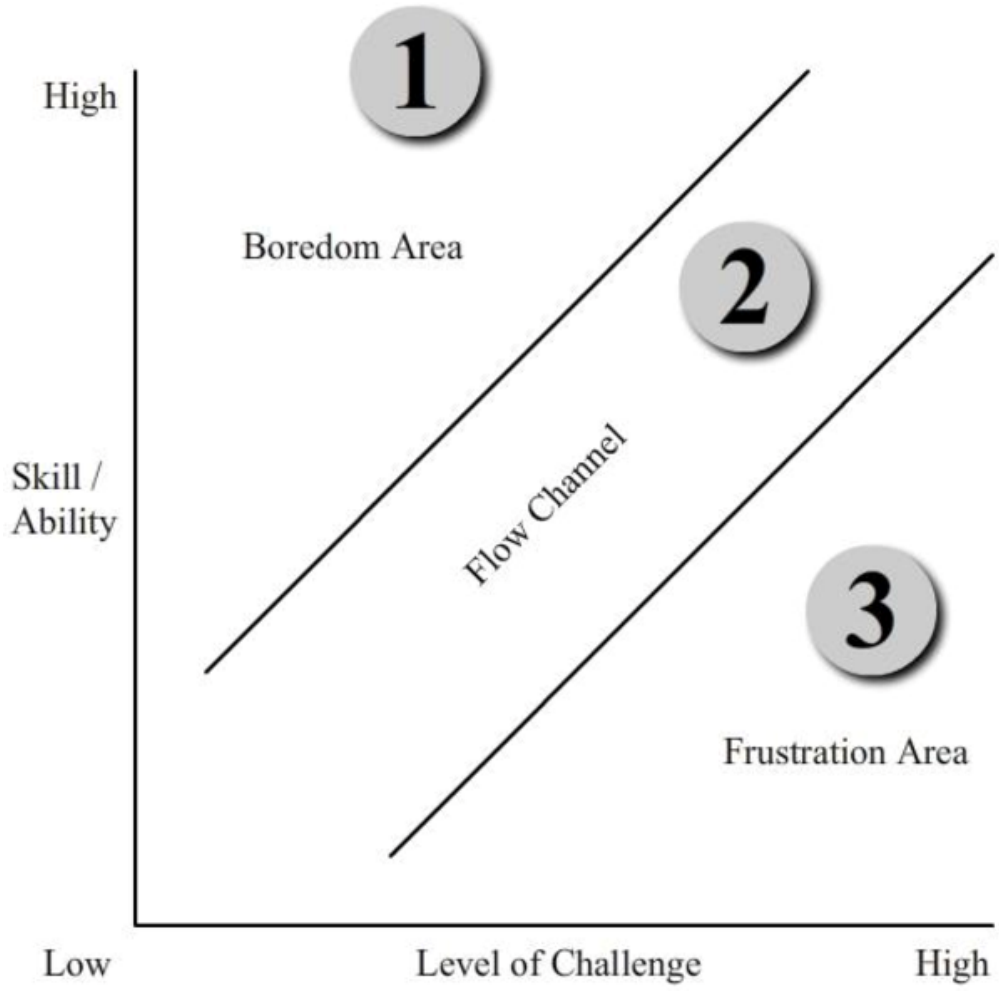

Figure 1

Three Conditions Based on Flow Theory

Note. Adapted from Csikszentmihalyi (1990).

In many cases, learners begin a new task with a knowledge gap and low set of skills; therefore, their task should correspond with an appropriate level of challenge in order to maintain within the flow channel. Csikszentmihalyi (1990) further argues:

"… when culture succeeds in evolving a set of goals and rules so compelling and so well matched to the skills of the population that its members are able to experience flow with unusual frequency and intensity, the analogy between games and cultures is even closer. In such a case we can say that the culture as a whole becomes a 'great game' " (Csikszentmihalyi, 1990, p. 81).

While in this mental state of flow, an individual's self-consciousness is minimized and perceptions of time are distorted (Csikszentmihalyi, 1997). It is during this state of flow that their engagement is high, and they have an intense concentration on the task.

2.1. Dimensions of Flow in Learning Experience Design (LXD)

As the theory evolved, Csikszentmihalyi (1991, 1997) defined the following eight dimensions of flow to define optimal flow performance:

- Clear goals and immediate feedback
- Equilibrium between the level of challenge and personal skill
- Sense of potential control
- Merging of action and awareness
- Focused concentration
- Loss of self-consciousness
- Self-rewarding experience

The first construct of flow theory includes clear goals and immediate feedback. The implementation of this construct through learning experience design allows the learner to know what is expected of them and receive instantaneous assessment on their performance. The sense of anticipation resulting from feedback is an important aspect of sustaining flow. Clear goals and feedback immediacy is balanced with the second construct: equilibrium between the level of challenge and personal skills. The experience should be designed in a balanced way where the challenge is comparable to the skillset of the learner. If the challenge is too demanding, the learner can get frustrated or easily bored with the task. In terms of interface design, the user should feel engaged by the task but not overwhelmed by the design or learning requirements. The next construct necessitates the design include a sense of potential control that engenders investment with the task at hand and thus makes the activity relevant to the learner. Collectively, these constructs describe elements of learner control and engagement.

The above elements of flow set the stage for an altered state that sustains the flow experience. The fourth requirement of flow design includes merging of action and awareness. In order for a learner to experience flow, they should be completely absorbed in the task at hand. In terms of LXD, interface designs that do not facilitate fluidity in learning are likely to disrupt flow. The previous construct mirrors the next construct of focused concentration; that is, being locked into a task creates an optimal environment for flow to occur. By experiencing high levels of increased concentration, learners become absorbed in the activity and enter into a state of flow. The interface should thus balance design features that allows a user to progress in their learning journey, while also limiting distracting information that may preclude sustained attention. Over time, the design helps learners to engage in a loss of self-consciousness whereby they becomes so immersed in the task they lose awareness of their surroundings. Moreover, flow experience design is also characterized by time distortion due to the high levels of concentration. The flow experience is therefore perceived as a self-rewarding experience. If the goals are clearly defined and obtainable by the learner, the task becomes autotelic and an intrinsically rewarding activity.

2.2. Learning Experience Design and Flow Theory in Game-Based Learning

According to the literature, researchers argue that individuals participate in an activity with a fuller sense of self-initiation if they find the activity to be interesting and engaging (Choi et al., 2007; Guo et al., 2016; Holyoke & Larson, 2009). To better leverage this affective component, research studies

have sought to explore the degree to which gamification can improve learning outcomes within higher education (Breuer & Bente, 2010; Hanus & Fox, 2015; Rawendy et al., 2017). Indeed, one of the core purposes of gamification is to use design principles from games to make learning a more positive and enjoyable experience (Baxter et al., 2015). In line with gamified approaches, flow begins with recognizing and expounding one's goals and creating actionable objectives to attain those goals (Antonaci et al., 2018; Liu et al., 2017). For example, a well-developed game supports flow because it affords a challenging, goal-oriented activity as one moves towards an attainable, objective goal (Moneta & Csikszentmihalyi, 1996). Games also provide the individual with autonomy and control over the learning experience. Research has shown a direct link between increased levels of engagement and the introduction of gamification elements to learners in online courses (Buckley & Doyle, 2016; Hanus & Fox, 2015).

3. Design Case of Flow Theory and LXD

As noted earlier, the theoretical tenets of flow theory align well with gamified approaches to learning. In the section that follows, we detail a design case that describes how the principles of flow theory were applied towards the gamification of a professional development course. The following design case describes the constraints, tensions, and decisions as part of the overall design experience of the artifact (Boling, 2010). Specifically, we describe how features such as leaderboard, adaptive release, and other tools facilitated states of flow especially as it relates to engagement.

3.1. Stakeholders

Studies show that higher education institutions continue to expand their online programs to meet student demand for distance courses (Brinkley-Etzkorn, 2018). Online education in a web-based format is thus the fastest-growing segment of higher education in the United States; two-thirds of higher educational institutions offer courses using this approach (Bozkurt et al., 2015). In response, faculty are now encouraged to design and migrate their courses to digital formats. This creates a need for professional development defined as organized opportunities designed to enhance faculty practice (Belland et al., 2015; Nathan & Petrosino, 2003). Professional development is especially important for online faculty because it allows them to work together, share ideas, and reflect on various teaching strategies using the new technology (Zygouris-Coe & Swan, 2010). Indeed, there is a vast amount of literature on the importance of providing adequate professional development to faculty so they are properly prepared to teach online (Elliott et al., 2015; Weschke & Canipe, 2010; Wingo et al., 2017). For these reasons, faculty continue to engage in professional development to align their instruction with the shifting educational landscape. At the same time, trainers are needed to provide professional development in a way that is engaging and effective for faculty.

3.2. Context

The design case took place at a southeastern urban research university with approximately 23,000 students and 1,400 faculty within 13 colleges and schools. The university offers over 250 areas of study and over 120 different degree programs. The university is accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC). The university offers over 70 different fully online programs, many which are nationally ranked in their disciplines. In line with prior studies (Brinkley-Etzkorn, 2018; Elliott et al., 2015; Herman, 2012), faculty members at this

institution commented on being dissatisfied with the current professional development opportunities for online instruction within the institution. In this design case, many of the university' PD opportunities were not on-demand, seen as irrelevant to the targeted audience, and perceived as boring.

As a researcher and a practicing instructional designer, the first author is often faced with the challenge to foster engagement in professional development within higher education contexts. The researcher believed that flow theory and related empirical evidence supported the idea that gamification can be used to engage faculty in professional development opportunities. Additionally, the first author believed this information would provide great value not only to researchers and instructional designers, but also to the institution's professional development initiatives. Specifically, faculty could develop their own engaging course content and instructional strategies that could directly impact student success.

3.3. Course Description

The institution originally offered traditional face-to-face professional development sessions. However, the traditional face-to-face onboarding was poorly attended and failed to support faculty working remotely. Eventually, due to the sizable growth of new online programs at the university and increase of educators operating remotely, the institution decided all faculty onboarding would be conducted online. As digital learning options increased, the institution leveraged an initiative called the Universal Design for Learning (UDL) to support teachers as they design classes for all learners. The UDL content was therefore digitized and incorporated within the university's LMS into an asynchronous, self-paced professional development course for online instructors. As we will describe later, the UDL's online, professional development course was specifically redesigned using elements of flow theory and gamification.

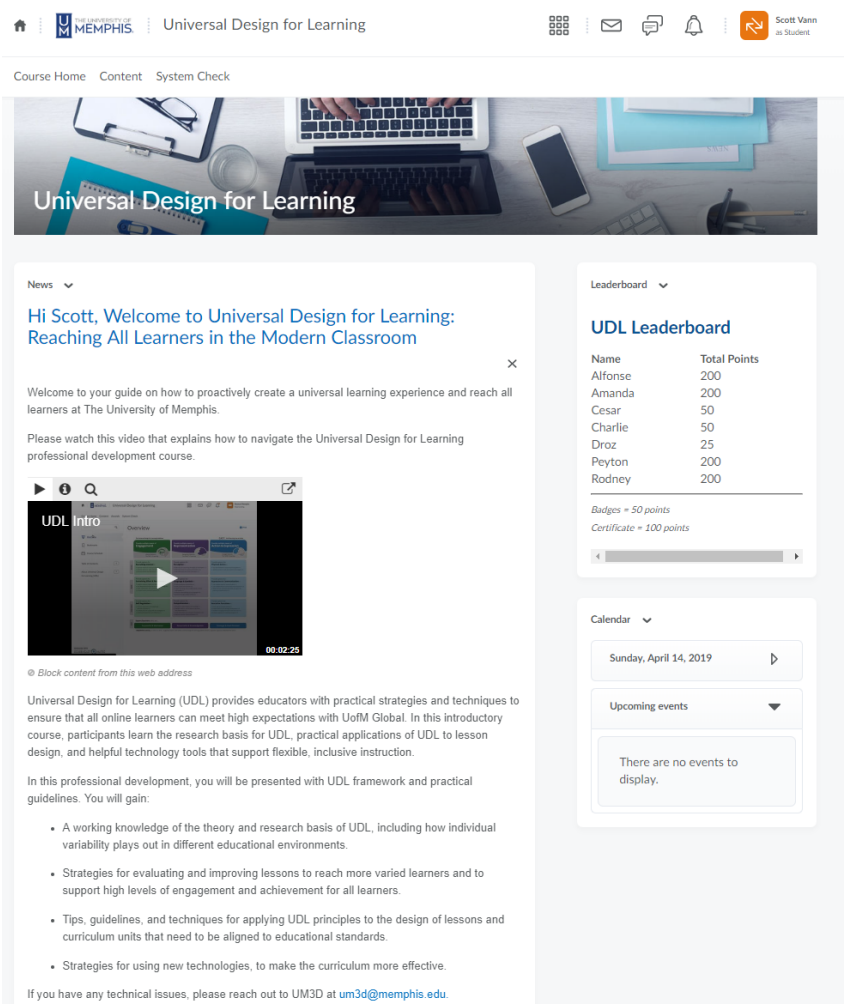

Figure 2

Welcome Page From the Gamified PD Course of Universal Design for Learning

The course had the following organization. After watching an online video orientation on how to navigate the professional development course, faculty were given access to the materials by the Center for Innovative Teaching and Learning (Figure 2). The introduction video to the professional development also explained the various gamification elements added to the course (badging, leaderboards, content leveling, etc.) and how they are applied to the learning objectives. The course, titled "Reaching All Learners," consists of four instructional modules: (a) Introduction to Universal Design for Learning, (b) Engagement – The Why of Learning, (c) Representation – The What of Learning, and (d) Action & Expression – The How of Learning. The course corresponded with the following learning goals:

- A working knowledge of the theory and research basis of UDL that includes how individual variability plays out in different educational environments.
- Strategies for evaluating and improving lessons to reach more varied learners and to support high levels of engagement and achievement for all learners.
- Tips, guidelines, and techniques for applying UDL principles to the design of lessons and curriculum units that need to be aligned to educational standards.

- Strategies for using new technologies, to make the curriculum more effective.

Each instructional module was self-paced and took participants an estimated 10-15 minutes to complete. Participants were presented with the research basis for UDL, practical applications of UDL to lesson design, and helpful technology tools that support flexible, inclusive instruction. Additionally, the course provided online faculty with practical strategies and techniques to ensure that all online courses at the university met the high expectations of online learning at the institution. Before starting the first instructional unit, learners were also presented with a pre-knowledge check that assessed their prior knowledge of UDL principles within the "Getting Started" module. This pre-assessment pulled questions from various knowledge checks within the course. At the end of each module, a comprehensive knowledge check of that module was provided using multiple choice questions. The assessments were designed with unlimited attempts, but learners could advance to the next module only after scoring an 80% or higher.

3.4. Rationale for Flow Theory

The professional development's design sought to increase faculty's engagement using gamification elements and flow theory within the course to improve faculty's understanding of UDL. The design choice was based on prior studies that show gamification increases learners' engagement within various online settings (Brigham, 2015; Buckley & Doyle, 2016; Kuo & Chuang, 2016; Mekler et al., 2017). The portion of the research on gamification-based learning is specifically grounded in the theoretical framework of flow theory, which includes the principle of learner engagement (Csikszentmihalyi, 2014; Dicheva et al., 2015; Kuo & Chuang, 2016). In line with the literature (Landers et al., 2017), gamified elements were chosen to place the faculty member at the center of learning and promote engagement within the professional development course. By affording decision making opportunities and creating challenges throughout the course, the learner adopted more ownership of their knowledge construction.

3.5. Course Design Using Flow Theory and Gamified Learning

Multiple design elements were included to support flow theory and gamified learning. As participants progressed within the online professional development (PD) course, instant feedback mechanisms were used in the course to maintain their flow. Once a participant completed a knowledge check, they were immediately provided the results and feedback on the questions that were missed. The missed questions provided information on where participants could locate relevant content within the course. Successfully completing the knowledge check in the module awarded the participant the badge for the associated UDL competency. Badges were displayed as icons and served as a visual representation when mastery had been achieved on a particular concept. Additionally, the participant was also awarded points for each badge obtained and associated point values were added to the course leaderboard. Once a participant successfully obtained all the badges within the instructional module, a certificate of completion was automatically generated and awarded to the participant.

The design of the online PD used additional gamification elements (badging, leaderboard, content leveling, and certificate of completion) to promote engagement and create an optimal learning environment for a flow state to occur. Each instructional module had an associated badge based on a

set amount of points that could be earned once the module was successfully completed (Figure 3). By incorporating attainable goals through badging, this feedback provided the learners with short term sustained engagement (Brigham, 2015; Hamari, 2017). Related literature explains how badges might further drive motivation in the short term by presenting learners with specific tasks which unlock extrinsic awards (Kyewski & Krämer, 2018). Therefore, the badges were micro-learning goals that allowed the learners to perceive a sense of achievement and progression as they were awarded for completed modules. By being presented with smaller challenges, the badges design supported short term concentration on tasks and thus supported flow.

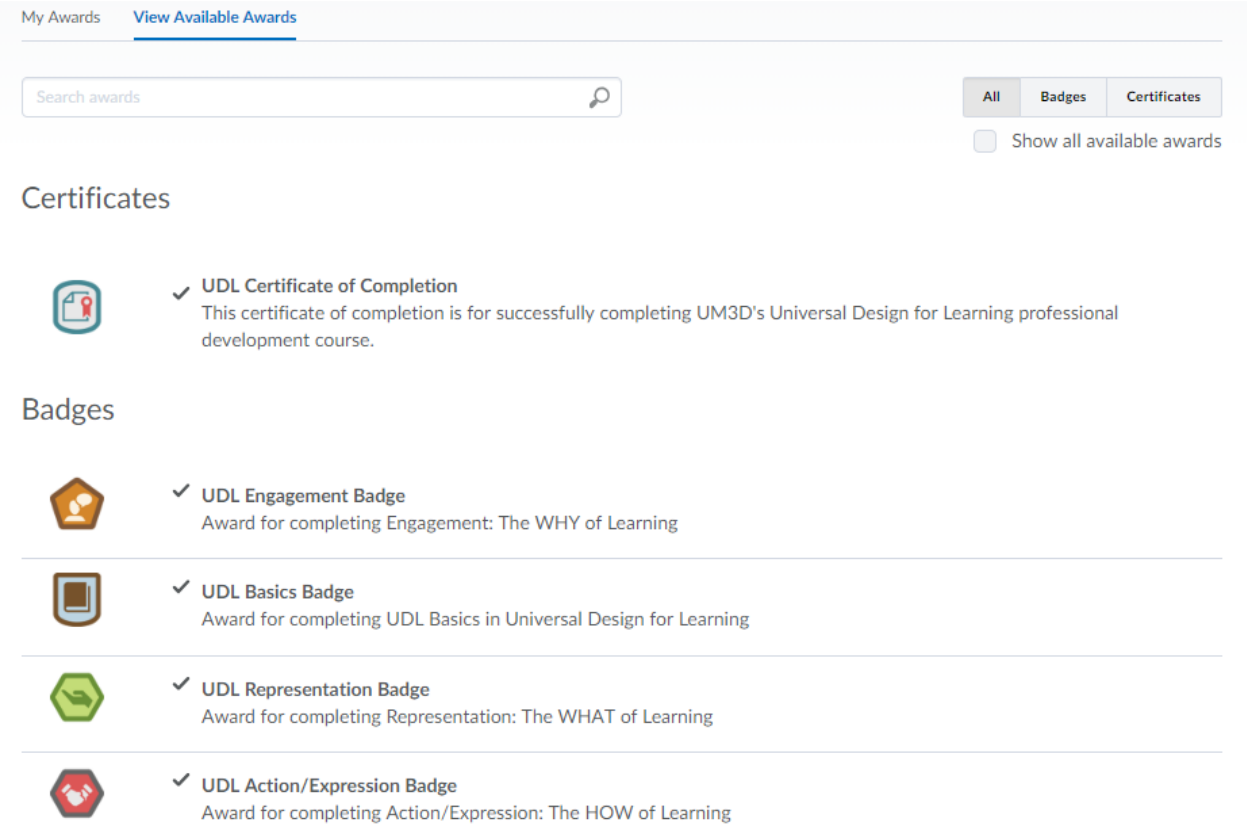

Figure 3

The Badges Available to a Participant Within the Universal Design for Learning Gamified Online PD

A leaderboard was also applied to the course and displayed as a widget on the homepage, which informed each participant how their colleagues performed within the class. Each badge earned within the course and certificate awarded at the end contained a set point value. After a badge was awarded to the participant, the leaderboard was updated to reflect the points obtained. The leaderboard was used to examine the relationship of gamification's competitive aspect to increased flow and engagement within the PD course. According to the literature, leaderboards have had varied results on increasing engagement in online learning (Kuo & Chuang, 2016; Özhan & Kocadere, 2020). Throughout the PD, some learners checked the leaderboard routinely to compare their score against their peers. The leaderboard thus provided increased engagement by allowing learners to compare their achievements with their peers in a communal setting. The focus on obtaining points to increase

their communal ranking on the leaderboards produced competition that may have renewed interest in completing tasks, increased engagement, and therefore prevented learners from drifting into the boredom channel. Our research study may have vindicated previous research results showing that a sense of self-reward and task-based challenges provide an optimal state for flow to occur (Csikszentmihalyi, 1991, 2014).

To avoid the frustration channel, content leveling was also included to segment the PD (Mayer & Moreno, 2003; Su, 2016). Content leveling was achieved by applying release conditions to the modules, which were linked to learning competencies within the PD. For example, the module on "Representation: The What of Learning" would not be unlocked until the competency was completed for "Engagement: The Way Learning" (Figure 4). As noted earlier, a competency is achieved by scoring an 80% or better on the knowledge check assessment within the module. The PD was purposely designed with segmentation in mind, allowing for the learner to stay within the optimal channel of flow and releasing content at the ideal time. By providing content leveling through segmentation, the participant could avoid the boredom channel by not having to wait on additional content to be released. Furthermore, the participants were provided with a clear sense of progression and earned points by "leveling up" with the release of the corresponding badge and next module of content. By providing clear goals and immediate feedback on level completion, the design was able to facilitate and sustain flow for the user.

Figure 4

An Example of a Release Condition Linked to the Achievement of a Competency

As participants progressed within the PD, instant feedback mechanisms were used in the course. Once a participant completed a knowledge check, they were immediately provided the results, along with information on the questions that were missed. The missed questions provided information on where participants could revisit the content within the course. Knowledge checks were configured for unlimited attempts and participants passed the assessment only after they scored an 80% or better. Additionally, the participant was also awarded points for each badge obtained and the point values were added to the course leaderboard. This allowed for the learner to be certain of the decision-making, progressing at their own rate. Successfully completing the knowledge check in the module awarded the participant the corresponding badge for the corresponding UDL competency.

Once a participant successfully obtained all the badges within the course, a certificate of completion was automatically generated and awarded to the participant. The certificate was customized to the

participant and contained their full name, along with the university logo and signature from the Director of Distance Learning (Figure 5). The LMS provided the ability to add replace strings on the award certificate, which allowed for the automation of the award information (ex. name, date, issuing department, and the name of the PD). In addition to badges, summative certificates serve as an additional external motivator and catalyst for flow to occur. That said, the certificate differed from badges in terms of perceived rigor and length of concentration required for obtaining the award. While the badges were a reward for short-term, individual achievement, the participants found the certificate was the primary external motivation for completing the PD because they could be shared with their peers (i.e., department chair, colleagues). In doing so, the PD interface design suggests the different external motivators could have attributed to a sustained state of flow by providing a longer concentration on task and presenting a greater challenge for this macro-learning artifact.

Figure 5

An Example of a Certificate of Completion That Was Generated for a Participant Within the Online PD Course of Universal Design for Learning

3.6. Lessons Learned and Implications

The focus of this case study was online faculty's perceptions of engagement within a gamified

professional development course. The results of the study suggest that online faculty PD is not a uniform approach. While the literature has described PD characteristically lacking engagement, using flow theory to design the course may be one way to offset this flaw in the PD's potential learning experience. Furthermore, the design case also suggests that providing participants with a challenge not only drives engagement, but also can provide a sense of reward and accomplishment by completing the challenge. By providing challenges in a way that aligns with flow theory, participants can experience increased engagement to complete the required tasks to further progress within the PD.

Additionally, PD design should be centered around a gamified design that provides participants not only with intrinsic motivation, but also extrinsic motivation to stay engaged. The results of this study showed how badges provided participants with an instant reward for obtaining a learning goal, drove the participant to obtain all the badges, and consequently sustained flow within the PD. The didactic offerings of PD traditionally do not provide participants with extrinsic motivation (e.g., awards) to stay engaged. That said, instructional designers should keep in mind that the awards should be implemented in a way that brings value and are applicable to the participant. In terms of game competition, the design case describes how competition drove engagement and created an optimal environment for flow to occur. The design case thus suggests that competition is not only a community driven idea, but can also be done on an individual basis within the gamified learning environment. As stated previously in literature review, studies have shown the positive effect that competitive gamification features, such as a leaderboard, has on engagement as participants interact on tasks to increase social ranking. However, the results of the study suggest participants were also motivated to obtain all the available awards for personal accomplishment and not solely for community recognition. The final suggestion to sustain flow regards segmentation of the content. The results of the current study suggest that segmentation can lead to an optimal flow state of concentration and intense focus. As stated earlier, if the PD is not instructor driven, the design should be centered around self-directed learning. However, for self-directed learning to be effective, design strategies should take cognitive load into account. These design strategies include checkpoints for progression of content, clearly identifying the PD learning goals, and using consistent organization of the modules. The results of the study show that gamification can assist with segmentation by using content leveling tactics to release content based on a set of required conditions. By creating PD around segmentation design, participants could experience increased engagement, maintain cognitive load and have a clear path of completion.

4. Limitations

Although the design case highlights how flow theory could be applied to a gamified approach, there are opportunities for other designers implementing LXD. The design case was limited to the gamification features of badging, award certificate, content leveling, and a leaderboard due to the limitations of the selected LMS. Ideally, the design would have examined additional gamification features not afforded by the LMS. For example, the design could have benefited from additional gamification elements such as digital avatars, a progress bar within the content modules, and actual games within the PD course. By including additional gamification features in the design, a more holistic understanding of engagement and flow could be gained from these different elements. Future design cases could also examine flow perceptions over time from a longitudinal perspective, instead of the short amount of time that learners were engaged with this course.

5. Conclusion

Researchers argue the application of theory towards interface design is an important element in how learning is supported (da Rocha Seixas et al., 2016; Hwang et al., 2012). We argue the elements of effective LXD have yet to be addressed within many approaches to learning systems design. To better address the intersection of learning theory and human-computer interaction, Csikszentmihalyi (1991) provides the following eight dimensions of optimal flow performance to increase user engagement: clear goals and immediate feedback, equilibrium between the level of challenge and personal skill, merging of action and awareness, focused concentration, sense of potential control, loss of self-consciousness, time distortion, tutotelic or self-rewarding experience. As it relates to learning experience design, interfaces should be designed to experience the flow channel using the above constructs. For example, a well-developed LXD often causes individuals to experience flow through a challenging activity that requires skill and has an attainable, objective goal (Moneta & Csikszentmihalyi, 1996). Alternatively, flow theory highlights how a poorly designed interface can preclude meaningful learning; that is, interface design can disrupt learners attainment of flow status and lead towards the boredom or frustration channel.

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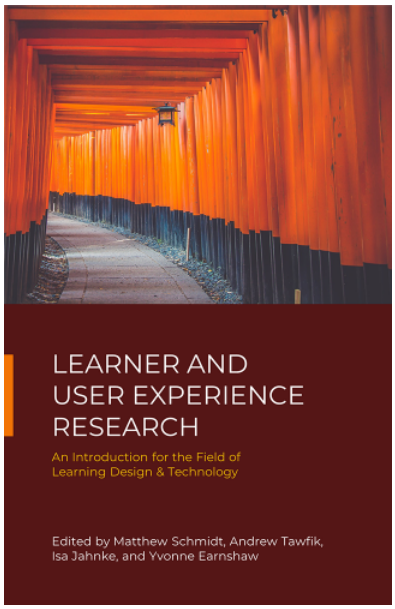

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