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Game On: Exploring the Effectiveness of Game-based Learning

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ABSTRACT

Game-based learning has emerged as an innovative learning technique that can increase student motivation, emotional involvement and enjoyment. Our study examines the effectiveness of game-based learning in planning education. Specifically, we explore the impact of gamification on planning students' perception of learning, engagement and teamwork. Two lectures in an undergraduate planning course were delivered using two different methods of teaching (one traditional lecture-style, one game-based). Feedback was gathered through an online questionnaire and semi-structured interviews. Results show that students favored and were more engaged in the game-based lecture. Finally, we contend that gamification is particularly well suited for planning education.

KEYWORDS

Gamification; game-based learning; active learning

Introduction

Active learning methodologies have been widely celebrated in recent years as pedagogical processes that engage students in activities to excite cognitive abilities and promote deep learning. Meyers and Jones (1993) describe active learning approaches as those that provide students the opportunity to discuss, interact and reflect on the content, ideas and issues of a subject. Experimental studies have shown the effectiveness of active learning methods over their traditional counterparts (Freeman *et al.*, 2014). Kotval (2003) highlights how active learning within urban planning curriculums can foster deep learning, teamwork, and greater student responsibility and accountability. Nevertheless, student engagement often remains a challenge. Deploying active learning techniques does not necessarily guarantee intrinsic or extrinsic motivation for learning among students. To address the challenge of furthering student engagement, researchers have been looking for innovative ways to motivate students to engage in active learning. New methods to increase intrinsic motivation for learning have emerged from research exploring the coalescence of games and pedagogy (Hollander & Thomas, 2009). One such method, known as game-based learning, is often defined as 'the use of game design elements in a non-game setting' (Deterding *et al.*, 2011, p. 10). A game-based learning approach refers to the use of gamefulness, gameful interaction and gameful design to motivate

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students to engage in class activities. The benefits and applications of games are incredibly diverse (Bogost, 2011). In the classroom, one important advantage is the ability of games and game-based activities to entice internal learning motivation by introducing various 'joyful' elements. Furthermore, game design patterns and 'game feel' can be used to motivate continued behavior and engagement (Lewis *et al*., 2012; Swink, 2008). Gee's (2003) work on integrating games into the classroom has demonstrated that game-based learning increases intrinsic learning motivation, emotional involvement and enjoyment – all of which are critical to learning.

The current literature on game-based learning does not provide a concrete methodology for deploying game-based techniques (Zichermann & Cunningham, 2011; Deterding *et al*., 2011). Most game-based learning techniques rely on technologies such as computers, handheld devices, and online applications. This holds true for the use of games in planning education. Hollander and Thomas (2009) note that computer games have been integrated into planning since the Model Cities movement of the 1960 s. These include Francis Hendricks's POGE (Planning Operational Gaming Experiment), Richard Duke's METROPOLIS, and Alan Feldt's CLUG (Cornell Land Use Game). When discussing virtual gameplay and urban planning, SimCity is an obvious example and has been used to teach planning and urban design for decades (Lobo, 2007). However, the pedagogical benefits of games are not limited to simulating real-world scenarios. According to Gaber (2007), it is the failure to approximate reality that limits SimCity's effectiveness as a teaching tool. Gameplay is a ubiquitous element of human social behavior. As such, it can be used to motivate students by providing a joyful experience while inducing competency and emotional and cognitive involvement.

In our study, we focus on the use of games and gameplay in their most fundamental way without the use of technology and computer-based equipment. Games and game dynamics do not only incentivize learners to engage in the classroom (Lee & Hammer, 2011; Richter *et al*., 2015), but also activate positive psychological arousal and increase the learner's focus and memory. Learners are capable of associating game elements such as objects, tasks, and events to a subject matter. Likewise, fun group activities that induce a level of competency indirectly force the analytical cognition to capture the main ideas. Positive emotions and pleasant experiences cause cognitive activation and psychological arousal. Positive affections are caused by enjoyment, excitement, hope, and group synergy. Such emotions increase learners' attention and motivation and help students acquire competencies (D'Mello & Graesser, 2012; Linnenbrink, 2007; Pekrun *et al*., 2002).

Our overarching interdisciplinary case study comparatively assessed undergraduate student perceptions of the effectiveness of game-based teaching techniques in the School of Planning and the School of Computer Science. The primary objectives of the study were to pursue new instructional development opportunities within higher education and to examine the importance of interactivity, communication, and social belonging through the deployment of game-based teaching techniques. In this paper, we focus primarily on the role of game-based learning in planning pedagogy. Our exploratory case study examines the effectiveness of game-based learning techniques in improving students' perception of learning, engagement and teamwork.

In the first section of this paper we explore the concept of student engagement through key motivational theories, how to implement game-based learning, and the potential integration of game-based learning in urban planning pedagogy. After which we detail

the methods, findings and conclusions of our study and briefly discuss some of the observations and directions for future work.

Motivation, Game-based Learning and Planning

Motivational Theory

One the main challenges of current learning systems across all disciplines is motivating students to get involved in the process of discovery, learning, and mastery of subject matter (Bridgeland *et al*., 2006). Generally speaking, motivation is why people engage in different activities at various degrees of interests and involvement. Motivation is generally categorized in two types: *intrinsic* motivation and *extrinsic* motivation.

Intrinsic motivation is defined as 'the doing of an activity for its inherent satisfactions rather than for some separable consequence' (Ryan & Deci, 2000a, p. 56). Self-determination theory (Ryan & Deci, 2000b) states that there are three innate needs that drive intrinsic motivation: autonomy, competence and relatedness. Autonomy can be described as an internal need to have control over an activity and its outcomes. For instance, students may be more motivated in participating in a project in which they perceive a higher degree of autonomy towards the direction that the project may take. Competence is the perceived mastery and knowledge of doing an activity. Students may be more motivated to participate in projects for which they perceive to have the required skills. Relatedness is an internal need to connect and interact with other people. Students may be more motivated to participate in projects whose results affect other people or projects in which they can interact with other students to achieve a goal.

Extrinsic motivation, on the other hand, is induced from external sources such as rewards, grades, money, and social recognition. Comparisons between people who are intrinsically versus extrinsically motivated to engage in a behavior or activity reveal that the former are more confident, interested, and excited (Ryan & Deci, 2000b). This results in better performance, increased creativity, and more persistence in the activity. Furthermore, studies have shown that inducing extrinsic motivation decreases the degree of intrinsic motivation for an activity in the long run (Ryan & Deci, 2000a; Vallerand, 1997). Meaning that a learning system based solely on external rewards could harm students' creativity and persistence. Therefore, it is necessary to understand the degree to which one can utilize external rewards to motivate learning, so as to not impair students' originality and intrinsic motivation for learning.

Intrinsic motivations arise from internal sources and, consequently, are hard to provoke externally. Nonetheless, it is possible to incorporate intrinsic motivation's components (i.e. autonomy, competent, and relatedness) in designing a learning system. By incorporating the components of intrinsic motivation in an external reward, we can internalize the external motivation for engaging in a specific activity or behavior (Ryan & Deci, 2000b). For instance, although a course may not be very interesting for some students, designing the class environment in a motivating way might induce students' interest in attending and engaging in the learning process.

One way to engage students in learning is to utilize game-based learning. Games and game-based activities provide a natural framework for engaging students and enticing their inner desire to learn. In recent years many scholars in education have utilized games

to motivate various learning behaviors in students (Sung & Hwang, 2013; Yien & Lin, 2011; Watson *et al.*, 2013). In addition to traditional games, employing digital artifacts in educational systems (e.g. Desire to Learn, Kahoot, and Socrative) provide an opportunity to embed games in educational systems.

Implementing Game-Based Learning

Game-based learning is the use of game elements, game thinking, and game mechanics in non-game contexts to engage users in an activity (Tu *et al.*, 2014). Games enable the integration of both intrinsic and extrinsic motivational components to cultivate an environment where players feel more motivated to engage in the target activities. For example, in a video game such as *The Sims*, the player is in full control of what happens in the game (autonomy) or in games similar to *Farmville* the players experience a lot of social interactions with other players (relatedness). Both of the features used in these games (i.e. autonomy and relatedness) are basic components of intrinsic motivations that attract millions of players to play these games (Deterding *et al.*, 2011). In a similar manner, game-based learning can employ intrinsic motivation's components to motivate students towards learning or exercising a desired skill (Hartt & Hosseini, 2019).

Tu *et al.*'s (2014) outline four key elements for the implementing of game-based learning: goal setting, player engagement, environment building and progressive design. The first step of a gameful design, goal setting, is crucial to the success of almost any learning approach. Goal setting creates the framework from which environment design, rules, dynamics, rewards and all other components follow. Therefore, the main goal and the target behavior must be clearly identified before constructing the game.

Player engagement, the second key element, is central to the adoption and effectiveness of game-based learning. In order to maximize engagement, it is imperative to know your audience. This includes designing reward systems and game dynamics that are appropriate for your audience in terms of their age, skill sets, major, and personality. Beyond your own knowledge of your students, approaches such as the Bartle Test of Gamer Psychology (Bartle, 1996) can be used to identify the gaming personality of the target audience in order to design more efficient and motivating games. It is important to provide some degree of autonomy in the design of the game. A game in which there is only one way to win provides less autonomy for players compared to a game where the players can employ various strategies to win the game. Juul (2009) highlights the importance of the opportunity for failure in game design. He argues (2009, p. 250) that 'failure is more than a contrast to winning – rather failure is central to the experience of depth in a game, to the experience of improving skills.' Additionally, studies have shown that having an element of uncertainty (or randomness) in the design makes the game more fun and engaging (Malone, 1981). It is also important to include components that involve some levels of social interactions. A game in which the players interact (e.g. help, compete, trade) with each other is more engaging and creates more opportunity for synergetic learning. Lastly, it is important to provide feedback at the end of each task in the game. Feedback is what motivates players to go forward in the game. Visual (e.g. an explosion), verbal (e.g. recognition by an instructor), or reward feedback (e.g. gaining points) is vital in keeping the learners engaged.

Third, the gaming environment should be fun and engaging (Hosseini & Hartt, 2016). Tu *et al.* (2014) stress that social collaboration, meaningful rewards and a variety of game mechanics are essential in building a gameful environment. Social collaboration fulfills the intrinsic need to interact with others, meaningful rewards provide autonomy, and including a variety of game mechanics helps accommodate different learning styles. The physical space is also part of the learning environment, and as such, should be optimized to cultivate a comfortable, engaging and open atmosphere.

Lastly, game design should be a progressive exercise (Tu *et al.*, 2014). Game-based learning is a cyclical, iterative process that includes motivation, action and feedback. Game design should be developed and redesigned as the audience, goals, and available resources change. Giannetto *et al.* (2013) highlight several key game design components, such as tracking mechanisms (tool to measure students' progress), currency (unit of measurement), level (amount of currency needed to accomplish an objective), rules (boundaries for what students can or cannot do) and feedback (mechanism the instructor and/or students can use to learn about progress being made). Moreover, game components and mechanics should be compatible with the audience preferences and the main goals of the game.

As with any teaching strategy, it is crucial that the instructional technique is appropriate for the type of knowledge and the intended learning objectives. In his book *The Gamification of Learning and Instruction*, Kapp (2012) illustrates the connection between levels of learning (knowledge), possible instructional strategies to achieve those learning objectives, and various game types that could be used to support the learning outcomes. For example, to gain problem-solving knowledge, Kapp (2012) states that a learner must confront novel situations and apply previous knowledge to solve the problem. This can be taught using multiple examples of different types of similar problems. Games that emphasize multiple scenarios and different settings (such as resource allocation and quest games) are recommended. Designing the game elements and instructional strategy to match the level of learning and meet the intended learning objectives will optimize its effectiveness.

Game-based learning activities can be categorized into two overarching classes: *immersive* design where an entire lecture or course is designed with a thematic view of a game, and *modular* design where each game-based module can be thought of as an independent activity. An immersive educational game design is a holistic approach that treats the whole classroom (or an entire lecture) with a gamified theme. In these settings, learners often choose an avatar to represent their characters and every one of their actions progresses them toward achieving points or climbing up a leaderboard. Immersive games can help create a safe and adventurous environment for learning by distancing the learners from the typical learning anxieties. However, immersive designs could potentially divert the focus of the learning activities to extrinsic motivations, which in turn may harm the initial purpose of game-based learning.

In contrast, in a modular game design, each activity is treated independent of other activities. Activities could vary from simple to more complex tasks; nevertheless, each activity is self-contained and learners do not need to progress toward certain achievements. Modular activities are, in general, easier to implement as educators do not require to create a clear-cut connection with other activities or the acquired points. In addition,

modular designs target intrinsic motivations by removing the extrinsic nature of rewards/punishments and focusing only on engaging activities.

The choice of which type of game designs to adopt in classrooms depends on the content, nature of the subject matter, and the discretion of educators. An educator may choose to use a hybrid strategy and deploy modular game-based activities to offset the negative repercussions of extrinsic motivations in an immersive approach. A hybrid approach may also be a more plausible way of introducing new pedagogical tools to higher education learning as it provides an easy transition with an acceptable mixture of novelty and familiarity.

Games and Planning Education

Game-based learning can be applied to any discipline in higher education. However, planning education is particularly well suited for game-based learning. In her examination of three decades of planning education, Frank (2006) found that planning practitioners today need different skills than their predecessors as planning is no longer based on a rational paradigm. This shift in practitioner roles has presented both challenges and opportunities for planning education (Myers & Banerjee, 2005; Afshar, 2001; Hartt, 2015). Myers and Banerjee (2005) emphasize that planning education should focus on the fundamental, generic skills distinct to planning. These include facilitating civic engagement, stakeholder collaboration, negotiation, and communicative action. Game-based learning provides a vehicle to build these necessary skills. Much like projects, workshops or studios (which are all familiar pedagogical tools in planning), game-based learning promotes deep learning and helps develop interpersonal and problem-solving skills. Learning techniques that incorporate autonomy require students to take responsibility and team-based work (relatedness) reflects modern-day planning and necessitates leadership (Frank, 2007). The element of randomness inherent to most games forces students to be creative and adapt, much like planning practice. Games can also promote management and people skills – both of which have gained importance over technical skills in private and public sector planning (Turok & Taylor, 2006).

Research has shown that planning educators are interested in keeping planning education relevant to societal needs and willing to experiment with different pedagogical approaches (Frank, 2007). The benefits of game-based learning largely reflect the pedagogical needs of urban planning. Combined with the ongoing shift in planning education to match changes in professional practice and the openness of planning educators, game-based learning has the potential to be an important and prevalent teaching method in planning education.

Methods

The objective of this study was to explore the effectiveness of game-based techniques in improving students' perception of learning, engagement and teamwork. In order to do so, two lectures in an undergraduate course, *Introduction to Planning Analysis*, were delivered using two different methods of teaching (one traditional lecture-style, one game-based). Student feedback was gathered through an online questionnaire and semi-structured interviews.

To create a framework for testing our hypotheses, we started by designing a systematic study to be conducted in the classroom. First, to select the specific lectures, we identified two topics within the course with close pedagogical outcomes and student perception. This was done by reviewing previous offerings of the course, analyzing students' grades and performance, as well as ensuring that these topics stand independent of others in the course. Following Eisenhardt (1989), we chose to concentrate on polar implementations of game-based teaching. The first topic was offered using traditional teaching techniques that rely heavily on lecturing. The second topic was presented using an immersive game-based approach that incorporated newly designed gamified tasks and activities. This methodological approach maximized the contrast between lectures in order to capture student perceptions of distinctly different teaching techniques. Throughout this paper the first lecture will be referred to as 'traditional' and the latter as 'gamified'.

The first (traditional) lecture was an introduction to regression-based population forecasts. The lecture had three intended learning outcomes: students will be able to (1) explain the regression-based forecast method, (2) calculate simple forecasts using linear regression, and (3) explain how regression-based forecasts inform the planning process. Relying upon instructor-led lecturing and questions, students were explained the conceptual underpinnings of the topic, introduced to multiple examples, and provided with a set of steps to conduct simple linear regression.

The second (gamified) lecture was an introduction to cohort-based population forecasts. The intended learning outcomes of the lecture were for students to be able to (1) explain the cohort-based forecast method, (2) calculate simple forecasts using cohorts and changing demographic factors, and (3) explain how cohort-based forecasts inform the planning process. In order to do so, students participated in 'The Game of a Lifetime.' Through this game, developed specifically for the lecture, students actively demonstrated different demographic processes (births, deaths, migration) that impact a select population. The game promoted relatedness and autonomy as the students were organized in groups but controlled their own progress through individual gameplay. The goal of the game was for students to live as long as possible and birth as many children as possible.

Organized into groups, students built game pieces out of paper and progressed through cohort lifecycles represented by progressive stages on a game board (Figure 1). At each turn, they would be exposed to one of four 'random' life events: survive, death, birth or migration to other groups. If they survived, they would 'age' five years and move along the board. If they died, they would go to the front of the class to analyze the demographic changes occurring in and between groups. If they had a child, they would create a new game piece and enter it onto the game board. For subsequent turns, they would need to play for themselves and each of their children. If they immigrated, they moved their entire 'family' to the newly assigned group and placed their game pieces on that board. Each group represented a real country and the likelihood of life events reflected real birth, death and migration rates. For example, students randomly assigned to a group representing Germany would be more likely to live long and have few children. Furthermore, they would witness their group grow by immigration. In contrast, students in a group representing Angola may experience very high birth rates and low life expectancy. Following the game, the students were asked to reflect on their experience. This led to a wider student-led discussion of the fluidity of populations, migration and demographic trends, the relationship between population dynamics and planning.

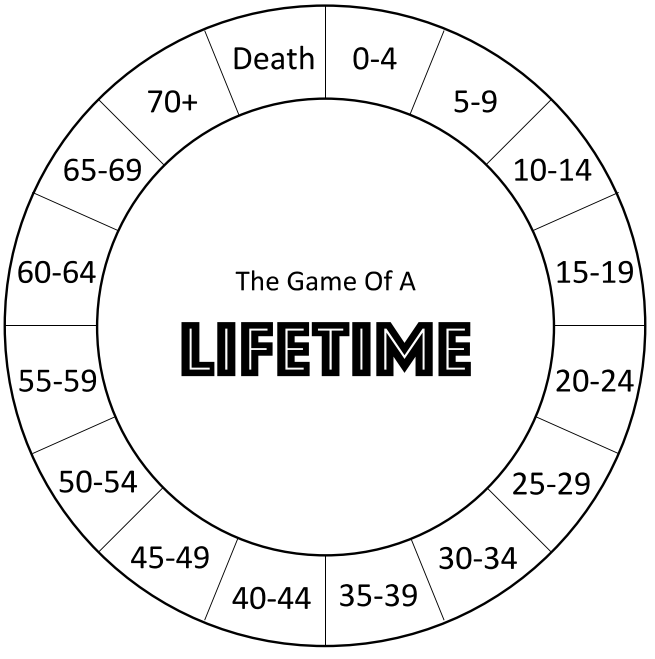

Figure 1. The Game of a Lifetime game board.

To evaluate the effectiveness of gameplay in the classroom, student perception and attitudes towards the two lectures were collected using online questionnaires as well as semi-structured interviews. The mixed method approach allowed us to capture students' general perceptions of game-based learning as well as their personal experiences. The questionnaires provided a quantitative framework to which the interviews added important qualitative context. The assessment was conducted following both lectures in order to afford a better understanding of how the students compared the lectures after experiencing both methods of teaching. Our questionnaire was based on the Experiences of Teaching and Learning Questionnaire developed in the United Kingdom by the Economic and Social Research Council's Teaching and Learning Research Programme (Economic and Social Research Council, 2002). The questionnaire was part of nationwide initiative developed specifically to enhance teaching-learning environments in undergraduate courses. We adapted the questionnaire to better suit the evaluation of individual classes. The order to the questions regarding the lectures was randomized. Half of the students were first asked about the gamified lecture and the other half were first asked about the traditional lecture. Furthermore, the order of the questions within each questionnaire was also randomized. After the questionnaires were collected, we conducted several semi-structured interviews with volunteer students. The interview questions mirrored the questionnaire, however they were re-written to be of a more open-ended nature.

Findings

For this exploratory study, 19 of 60 planning students fully completed the online questionnaire for a response rate of approximately 30%. In addition to the questionnaire,

semi-structured interviews were also conducted with four volunteer students. In this section, results and analysis from the online questionnaire are presented followed by the qualitative analysis of the semi-structured interviews.

The questionnaire was organized into four sections: About You, About the Lecture, Working Together, and Opportunities. We asked the students to state the degree to which they agree or disagree with the statements using a 9-point Likert scale ranging from 'Do not agree' to 'Completely agree'. The first section, About You, asked a set of questions regarding the general characteristics of the students, such as 'On the whole, I am systematic and organized in my studying.' These questions were asked to gauge the study habits, self-confidence and overall perspective of the students' own abilities. The subsequent sections were each designed to measure various aspects of the teaching and learning experience. This included questions regarding the students' perceptions of the clarity, organization and effectiveness of the lecture, effectiveness of peer-instruction and interaction, and the opportunity to engage critically with the material.

The questionnaire responses showed that students saw clear relevance of the taught material, found the content well organized and to the point in both lectures. This counters the myth that game-based activities often cause chaos and misunderstanding in the learning process. In fact, students on average favored and were more engaged in the gamified lecture. They reported that their enjoyment, peer interaction and ability to share ideas were more pronounced in the gamified lecture. Figure 2 summarizes questionnaire results and compares the traditional and gamified lectures across several of the questionnaire categories.

In addition to the descriptive analysis, we also conducted a statistical analysis of the questionnaire results. We defined an average score for each section based on the average of responses of students to all the questions in each section. Two paired-samples t-test were conducted to compare the students' perceptions of the lectures and working together in the gamified and the traditional lectures. Regarding the students' perceptions of the lectures, there was not a significant different in the general scores of the traditional (mean = 7.75, SD = 0.72) and gamified (mean = 7.97, SD = 1.14) lectures. Similarly, there was not a significant difference between the students' perceptions of working together in the traditional (mean = 7.73, SD = 1.05) and gamified (mean = 7.96, SD = 0.59) lectures.

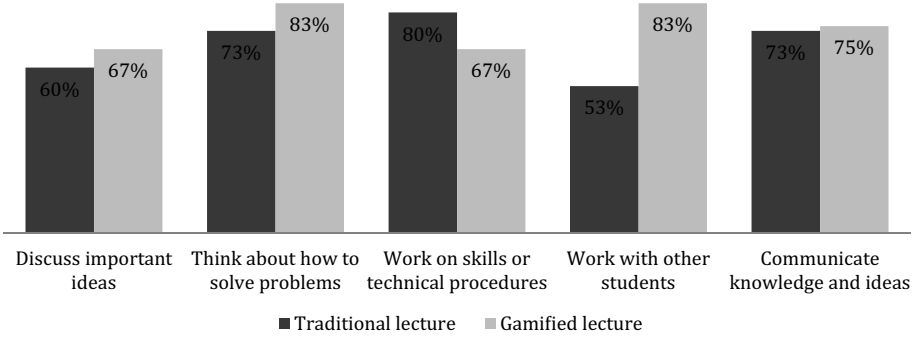

Figure 2. Summary of planning student responses to online questionnaire.

The relatively high scores across all questions in both lectures barred any statistical significance. Therefore in order to augment our analysis, we turn to the semi-structured interviews to further explore students' opinions and perspectives.

After transcribing the interviews, the transcripts were coded using qualitative data analysis software. Three main themes emerged: (1) students' understanding of the material, (2) students' enjoyment during the lecture, and (3) learning style of the students.

Theme 1: Understanding the Material

Students were able to understand the materials in both lectures. Responses regarding the ability to discuss important ideas and think about how to solve problems were both marginally better in the gamified lecture. One student felt that in 'the game-based [lecture] it was easy to see how it related to the real world and real cities.' However, the analysis did reveal that students found traditional lectures to be more appropriate for working on technical skills or procedures. The applicability of game-based techniques for different types of learning was raised several times in the interviews. 'When talking about the real world, game methods come in handy, but . . . game methods aren't helpful if you just need to know it.' Furthermore, one student noted that when a lot of material needs to be covered 'games are not that effective' and that 'it is more efficient to talk to students directly and almost tell a story versus having them play a game.'

Theme 2: Enjoyment during the Lecture

Students said that they enjoyed the game-based lecture and found it to be more memorable. This was due in part, as one student noted, to the monotony of the traditional lecture. According to another student, '[the traditional lecture] was good, it was standard. Nothing special. It was fine. Moderately effective. If you compare it to the [gamified] one, it was less effective. I will always remember the game lecture, but the material from the [traditional] one will fade in my memory.'

However, despite differences in the perception of effectiveness and memorability between the two teaching techniques, both lectures were virtually identical in the students' perception of their ability to communicate knowledge and ideas effectively. Students generally appreciated the change in teaching style, as post-secondary education was perceived to have less variety in teaching methods than high school. As one student stated, 'I don't understand why game-based learning has to stop when you go to university. There are so many ways to learn. Why should [learning] conform to one box just because it's post-secondary education?'

Theme 3: Learning Style

In addition to the type of material and teaching style, the preferred learning style of the student also appeared to play a role. Although students agreed that the gamified lecture gave them considerably more opportunity to work with one another, opinions varied on whether this was a positive outcome. Emphasizing the benefits of increased peer interaction, one student noted the differences in their own role in the learning process: '[In the

traditional lecture], I took notes, I asked questions. I didn't talk to my peers, because when you are in a lecture, you are usually listening. [In the gamified lecture], I got to help out. I found myself really wanting to talk to my peers about the material and I was excited.'

However, two students who had highlighted the positive aspects of game-based learning also noted their own personal preference for traditional lectures:

'[Traditional] presentation is more effective for me because it allows me to sit down and focus on the content itself. I don't have to worry about other factors such as following rules of the game or participating with other classmates.'

'The [traditional] method is an effective method for me. Not every lecture can be a game based one. Sometimes I would like the information to be told to me so that I can process it that way individually instead of having different people saying different opinions. It can get very confusing for me.'

Their positive view of game-based learning, but discomfort in the classroom demonstrates the importance of game design. It also shows that novel pedagogical approaches at first may seem unfamiliar, which could result in student push back, if not done right. Moreover, students may have preferred different games that better suited their personality and learning style. This finding supports the notion that there are significant differences in how extroverts and introverts interact with game-based teaching techniques and achieve playfulness (Butler, 2014; Codish & Ravid, 2012).

Interdisciplinary Comparison

As noted in the introduction, this study was a collaborative interdisciplinary project conducted in concert between the School of Planning and the School of Computer Science. Similar to the approach detailed above, two lectures were given in an undergraduate computer science (CS) course – one traditional and one gamified (see Hosseini *et al.* (2019) for detailed CS analysis).

The lectures covered the topics of data structures and algorithm design. A game using playing cards was developed to teach sorting algorithms. The same online questionnaire was used for both the planning and CS students. 48 of 80 CS students responded to the survey and one student volunteered for follow-up interviews.

Similar to the planning students, the questionnaire results from the CS students (Figure 3) show relatively high scores across all questions in both lectures. In harmony with the planning student responses, the CS students also felt that the gamified lecture was more effective for thinking about how to solve problems and less effective when working on skills or technical procedures specific to the subject. Unlike the statistical analysis of the planning questionnaire responses, the CS analysis yielded one significant result. We found that there was a significant difference ($p = 0.003$) in the general scores for the students' perceptions of working with other students in the gamified lecture (mean = 7.16, SD = 1.40) and the traditional lecture (mean = 6.83, SD = 1.46). Students felt that they could work better together in the gamified lecture.

However, unlike the planning students, the CS students did not show a general preference for the gamified lecture. In the CS student questionnaire results, the traditional lecture was found to be marginally more effective for discussing important ideas and communicating knowledge and ideas. The CS students felt that they received less guidance

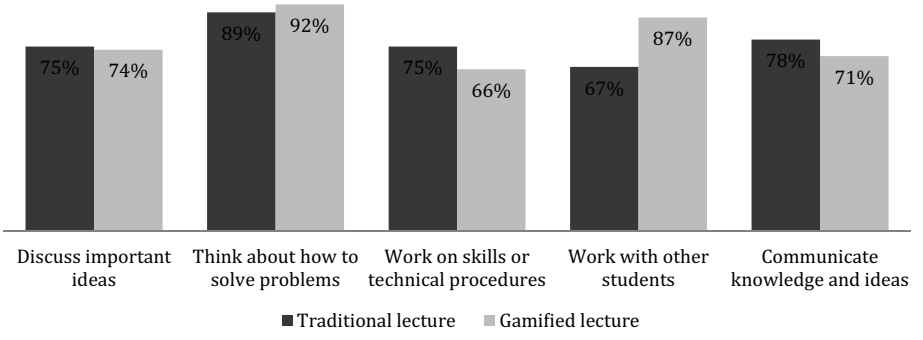

Figure 3. Summary of CS student responses to online questionnaire.

from the instructor throughout the gamified tasks. We hypothesize that the differences between the CS and planning student responses could be due to the nature of the courses, or more likely the differences in disciplinary cultures. Planning, as a professional discipline, requires significant interaction, negotiation and collaboration with other individuals and parties. Furthermore, planning students are accustomed to group work and active learning through group projects, role-play, studio work and experiential learning.

These comparative results provide additional support for the notion that game-based learning is relatively well suited for planning education. The planning students' consistent preference for traditional lectures when learning skills or technical procedures suggest that game-based learning should not be haphazardly applied across the board. The instructional strategy must match the type of knowledge to be learned (Kapp, 2012). And, as Tu *et al.* (2014) emphasized, the teaching approach must stem first and foremost from the learning goal. Goal setting creates the framework from which environment design, rules, dynamics, rewards and all other components follow – if, and only if, game-based learning is an appropriate approach.

Conclusion

The objective of this study was to explore the effectiveness of game-based techniques in improving students' perception of learning, engagement and teamwork. Driving this objective was the question of whether the integration of game-based learning into planning pedagogy could help students acquire the skills necessary for the flexible, participatory and creative planning workforce. Planners emerging from their post-secondary education are now expected to have leadership, visioning and enterprising skills in addition to the more traditional planning skillset (Frank, 2007). Role playing techniques have been shown to bring realism and experience into the classroom and help students critically evaluate complex problems requiring moral and judgmental competencies (Frank, 2006). Games can do the same and more. In addition to these benefits, game-based learning has also been shown to entice intrinsic motivation, enjoyment and emotional involvement (Gee, 2003).

The results from our exploratory study demonstrate the potential of game-based learning in higher education. Students on average favored and were more engaged in

the gamified lecture. Enjoyment, peer interaction and the ability to share ideas were reported as more effective in the gamified lecture. The use of games and gameplay in their most fundamental way without the use of technology inherently involves social interaction, leadership, creativity and strategy. All of which are essential components of planning practice. Our findings together with research that has demonstrated the potential for game-based learning to motivate learners (Lee & Hammer, 2011; Richter *et al.*, 2015) indicates that game-based learning can help planning students build the skills necessary to succeed in planning practice.

Our findings highlight the potential for game-based learning in planning education and provide a foundation for further investigations into student perceptions of game-based learning, and the development non-technical gameful teaching activities. Future research could build upon our exploratory study by expanding the size and scope to allow for more rigorous quantitative analysis. Including both formative and summative assessment could provide additional quantitative evidence and help triangulate findings. Comparisons across multiple lectures could provide evidence of how applicable game-based learning was to a particular subject. And comparing gamified lectures in multiple courses at multiple levels (first, second year, etc.) could shed light on the benefits of game-based learning in different settings.

Future investigations could also build directly on this study by exploring hybrid structures of modular games, their effectiveness and student perception. Additional future work could shed light on what types of games are most suitable for various courses, learning styles, topics, and much more. Game-based learning is an emerging area of research with considerable potential. According to de Freitas (2007), the lack of empirical data supporting game-based learning is one of the main obstructions to the uptake of games in post-secondary pedagogy. Furthermore, it has impeded the understanding of how to incorporate games and how to use them most effectively. Moving forward we are especially interested in encouraging students to not only participate in gameplay, but to design games themselves. As we have noted in this paper, gameplay can help build many of the soft skills necessary to be a planner. In the same vein, game design reflects many of the complex and 'wicked' problems inherent to planning. The act of game design encourages students to think holistically about the intricate nature and development of place. Non-technical games in particular offer a rich opportunity to prototype new pedagogical approaches to planning education. As Fullerton (2014, XXVI) explains, eschewing the incorporation of digital components allows students to 'learn what works and what does not work in their game system.' Fullerton's statement echoes the fundamental intention of planning education, for students to learn what works and what does not work in the complex development and management of cities, towns and regions. The integration of game-based learning into planning curriculums presents a unique opportunity for the mutually beneficial advancement of both planning pedagogy and game-based learning techniques. And as we have learned from both the literature and our study, such an advancement will occur most effectively and tenaciously if it is fun.

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