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Collaborative creativity among undergraduate students as game creators during gamification in a university-wide elective course

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Abstract

Collaborative creativity is an essential skill for unleashing university students' skills in team building during complex problem-solving. The aim of this descriptive quantitative research was to examine undergraduate students' perspectives regarding their collaborative creativity experience as game creators for a gamification group assignment within a university-wide elective course on learning disabilities. The Assessment Scale of Creative Collaboration (ASCC) questionnaire was completed by 14 students. The results provide insightful perspectives by undergraduate students regarding their experience in collaborative creativity during game creation. The findings from the closed-ended questions of the ASCC demonstrate that most of the students valued the diversity of knowledge and skills of their team members, shared different ideas, adapted their ideas and practices according to the project difficulties, trusted their team members, co-constructed the game together, overcame conflicts in positive ways, developed multiple versions of their game, and coordinated well for their team project. Data from the open-ended questions of the ASCC, which provided detailed but nuanced perspectives of the students, were analysed thematically. Three main themes were identified: the positive aspects of gamification, the constraints related to the gamification project, and teamwork and collaborative problem-solving approaches. This study provides evidence on the feasibility of game creation that is embedded within gamification group projects for fostering collaborative creativity among undergraduate students. Gamification has the potential in supporting the acquisition of 21st century learning and innovation skills in higher education. Implications of the application of gamification in higher education are discussed.

Practitioner Notes

1. This study provides preliminary evidence on the feasibility of making game creation accessible to students. This study also supports educators wishing to embed gamification and game creation by students in the course assessment.
2. The undergraduate students reported positive responses about their game creation experience during the gamification project. However, teamwork could be an issue to be addressed more proactively. In this study, one of the students reported that bad teamwork had affected her gamification project although she felt the gamification was a good pedagogical approach. Thus, facilitators should provide the necessary guidelines on effective collaboration, communication, and teamwork approaches to students early in the semester.
3. Most of the students reported that time limitation was a factor in game creation. None of them had expected that an elective course would be so demanding on their time. A possible reason for the lack of time is the unfamiliarity of students with game creation. Given the promising value of gamification and game creation, we suggest that at the macro level, the university elective course committee could identify how innovative pedagogical approaches could be aligned. Specifically, gamification and game creation could be used more widely across university-wide elective courses to reduce the learning curve involved. At the micro level, instructional videos on gamification and game creation may ease the process of learning about the concept and implementation of gamification

and game creation.

Keywords

collaborative creativity, game creation, gamification, learning disabilities, higher education, 21st-century learning

Introduction

Gamification is increasingly used in higher education as a pedagogical approach to increase motivation, engagement, and knowledge transfer. Gamification is a promising educational approach that has gained substantial attention among practitioners and researchers for enhancing educational practices such as learner engagement and social connectedness (Majuri et al., 2018; Toda et al., 2019; Zainuddin et al., 2020). Gamification incorporates game elements such as mechanics and dynamics into the teaching-learning process. Using gamification in higher education is also seen as an innovative and impactful strategy that encourages empowering gameful experiences, without losing out on academic achievement, while developing necessary skills for the 21st-century workforce (Murillo-Zamorano et al., 2021). In recent years, there has been an increased interest in fostering collaborative creativity by making game design opportunities accessible to students within gamified learning environments (Arnab et al., 2017; Romero, 2016; Romero et al., 2019). Parallel to this new research trend is the nascent empirical findings that gamification in the workplace enhances co-creation practices, given that gamification provides rules and structure, such as game elements and goals for developing new products or services (Patricio et al., 2020). With the fast-changing landscape of the innovation economy, which requires a drastic shift from individual solutions to team-based creativity and innovation (Baruah & Paulus, 2019; Mavri et al., 2020), it has become crucial to prepare university students to acquire collaborative creativity skills. Correspondingly, institutions of higher learning are fertile grounds for fostering collaborative creativity among university students through group projects that require collaboration, communication, creativity, and critical thinking skills (Romero, 2016). Ultimately, advancing the theoretical and practical understanding of collaborative creativity during game creation in gamified educational environments is crucial for responding to the clarion call for job readiness among university graduates (World Economic Forum [WEF], 2020). Despite the urgency of reconceptualising university education, collaborative creativity among university students is an understudied aspect of gamification in higher education. The present study examines undergraduate students' perspectives regarding their collaborative creativity experience as game creators during a gamification group project within a university-wide undergraduate elective course on the introduction to learning disabilities. The following sections present a summary of the literature on gamification within educational environments, followed by game creation for collaborative creativity, and the four critical 21st-century learning competencies (4Cs).

Gamification within educational environments

Gamification is about making activities in non-game contexts more game-like by using game design elements (Deterding et al., 2011; Sailer et al., 2017). It is a learner-centred pedagogical approach with a high potential to foster active learning (Sailer & Homer, 2020) and enhance students' autonomy, participation, and creativity (Murillo-Zamorano et al., 2021). Gamified courses foster students' motivation, interest, and engagement in their respective courses (Hanus & Fox, 2015; Jones et al., 2022; Sailer et al., 2017; Subhash & Cudney, 2018). Gamified courses also foster better understanding, learning achievement (Zainuddin et al., 2020), and heightened ability

to apply learned theories in real life among students (Farkas, 2014).

Many studies have integrated gamification to improve student learning in various domains, including information science, software engineering, and music (e.g., Huang et al., 2019; Ivanova et al., 2019; Kim et al., 2019). For example, Huang et al. (2019) examined the effects of a gamified flipped learning environment on behavioural and cognitive engagement among first-year undergraduate students of an introductory information science course. They found that students in the treatment group were more likely to complete more activities on time and were more cognitively engaged in in-depth class submissions. Ivanova et al. (2019) applied educational gamification to teach software engineering methods and concepts to stimulate student motivation and engagement whilst in class. Kim et al. (2019) explored gamification in a robotic musical instrument building project and reported that students gained knowledge about their course, including design, process, application, and team engagement. Across all studies, the researchers reported favourable results in terms of learning. Thus, integrating gamification within the educational environment promises to improve student engagement, motivation, and learning (Hunt-Gómez et al., 2020; Sailer et al., 2017).

Game creation for collaborative creativity

Collaborative creativity is associated with creative problem solving, where individuals contribute toward group creativity dynamically (Pirola-Merlo & Mann, 2004). During collaborative creativity tasks, new ideas are identified, shared, and developed through interaction with others (West & Hannafin, 2011). The group's level of intrinsic interest in the task, trust within the group, and the task atmosphere reinforces idea generation and exploration (Craft, 2008; Wishart & Eagle, 2014). Undergraduate students from different backgrounds who have worked on various collaborative creative projects together reflect better initiative, leadership, networking, and progressive responsibilities (Kim et al., 2019).

Designing games is reported to be more challenging and engaging to students than ready-made games (Smyrnaiou et al., 2012). Students develop a deeper understanding of lecture material when they undergo the game design process, including the integration of game mechanics based on knowledge acquired from lectures, references, and other sources. They are exposed to opportunities to use their imagination and creativity (Casey & Hastie, 2011). Differences in knowledge, expertise, and perspectives exist among individuals allowing for greater collaboration toward more creative and sustainable solutions in solving complex design problems such as problems existing in game design (Arias et al., 2000). Intelligently designed and creative products have often been attributed to increased interactions with materials and collaborations with other individuals compared to primarily working alone creatively (Csikszentmihalyi, 2016).

Using games in education involves various game design features such as creativity, rewards, challenges, feedback, and responses to motivate students to learn effectively and master the desired skills (Plass et al., 2015; Van Roy & Zaman, 2018). During game design, collaborative creativity, which involves interaction among the participants during the process and outcome of game co-creation, is fostered (Navarrete, 2013; Romero, 2016; Romero et al., 2019). Students

benefit from the knowledge gained, achieve better scores, and develop collaborative creativity skills (Domínguez et al., 2013; Romero et al., 2019). The co-creation activities among students while working in groups to design and create games for learning resources enhance the process of fostering team-based knowledge, experiences, diverse ideas, and creativity (Arnab et al., 2017; Romero et al., 2019).

As an example, in Athavale and Mohan's study (2018), a game design competition required 15 young designers to conceptualise a game and develop a prototype in a four-week duration; eight participants were required to make a paper prototype of a non-digital game such as a board game, card game, or game with props. The participants were predominantly male (mean age was 25), either undergoing master's in design or engineering and had no prior game design experience. The study demonstrated that bouncing ideas (for individual creativity) and brainstorming (for group creativity) were the major techniques employed for the idea generation and game ideation process. The creative game ideation process comprised four phases of the creativity model: preparation, incubation, illumination, and verification. The students' game design process generally followed the four-phase creativity model.

Adopting gamification as a pedagogical approach in higher education also synchronously aligns with the current demand for universities to prepare future-ready graduates (Minocha et al., 2018). Moreover, the World Economic Forum (WEF, 2020) emphasises innovation, active learning, creativity, originality, and initiative as some of the top job readiness skills expected by employers by 2025. Thus, game creation within gamified educational settings is a topic worthy of investigation in response to assertions that game creation holds promise in driving creativity among students (Arnab et al., 2017; Romero et al., 2019) and collaborative innovation and management in workplaces (Patricio et al., 2020).

The four key competencies for 21st century learners

Critical thinking, creativity, communication, and collaboration are core learning and innovation skills that 21st-century learners should possess (Partnership for 21st Century Skills, 2019; Voogt & Roblin, 2012). Game creation is a team-based knowledge modelling activity that affords the development of these four competencies by engaging game creators to inquire, analyse interactively, and model a topic (Romero, 2016).

- Critical thinking provides awareness for rational and conscious thought (Butler et al., 2017). It is crucial for engaging in reflective scepticism, capitalising on thought processes while solving problems using detailed knowledge of the problem areas, and undertaking activities that require mental effort (McPeck, 2016). It includes recognising and analysing clues, prioritising hypotheses, generating solutions, identifying actions, and evaluating outcomes (Seibert, 2020). Critical thinkers engage in metacognition, which includes identifying the purpose, information, implications, assumptions, and conclusions; evaluating the clarity, accuracy, relevance, logic, depth, and significance; and engaging in communication and argumentation (Fisher, 2011).

- Creativity is the ability to generate ideas or products that are original, find alternative solutions that might be useful for solving problems and communicate effectively with others (Sternberg, 2006). It entails meaningful actions and interactions with open-endedness, nonlinearity, plural perspectives, and future orientation (Glăveanu & Beghetto, 2020). Creativity can often present something surprisingly different, new, unplanned, innovative, useful, valuable, of good quality, and appropriate (Carruthers, 2011; Hennessey & Amabile, 2010; Kaufman, 2016).

- Communication is vital for gaining information, increasing motivation level, quality, and productivity (McCorry & Mason, 2020), and facilitating social bonding, which is a pivotal contributor to team effectiveness (Cayzer, 2020). Communication skills include one's ability to interact with others in a social context and in specific ways that are valued to ensure that individuals achieve their goals through social interaction (Rider & Keefer, 2006). Communication skills also involve the ability to identify emotions and intentions expressed by others, make appropriate judgments, and provide appropriate responses (Rosengren, 1999). Effective communication involves empathy, understanding, active listening, honesty, open disclosure, and an ability to gain trust (Kyaw et al., 2019).

- Collaboration involves social interaction (Le et al., 2018). Through verbal exchange and opportunities to construct, discuss, monitor, repair, and combine ideas and knowledge, conceptual understanding becomes apparent while individuals share divergent perspectives and knowledge to achieve a common goal (Craft, 2008; Häkkinen et al., 2017; Van Boxtel et al., 2000). Collaborative learning enhances the learning process by building knowledge, cultivating interpersonal skills, developing higher levels of understanding (Bruffee, 1999), improving flexibility and productivity, increasing innovative ideas (Sawhney et al., 2005), promoting diversity, and increasing motivation levels among students (Cayzer, 2020; Scager et al., 2016).

The push for education reform requires more significant realignment between pedagogical approaches in higher education and 21st-century skills for future jobs (WEF, 2020). Courses that are theoretical and taught in a conventional manner, where passive learning instead of active learning is likely to occur, require overhaul (Deslauriers et al., 2019). Course instructors ought to be facilitators of learning while students learn actively (Hong et al., 2014; Murillo-Zamorano et al., 2021). Emerging evidence demonstrates that social interaction during the process of participative game creation, which is collaborative, is a practical approach to learning collaborative creativity skills (Romero et al., 2019). To date, the effects of game creation by undergraduate students on their collaborative creativity experience in higher education are not widely researched.

The present study

In this study, gamification, which entailed game creation as a co-creation group project, was aimed at fostering active learning and collaborative creativity among undergraduate students. In a

university-wide undergraduate elective course on Introduction to Learning Disabilities, the study thus sought to evaluate the participants' perceptions regarding their collaborative creativity experience during a gamified group project where the participants played the role of game creators.

Method

Context of the study

The present research was conducted at a Malaysian public university in the context of a 14-week-long university-wide undergraduate elective course on Introduction to Learning Disabilities. At this university, undergraduate students must undertake up to nine credits of university-wide elective courses from a smorgasbord of electives offered by other programmes within their faculty or by other faculties. Students choose these courses based on their interests, skills, and basic knowledge. The university elective courses aim to create opportunities for students to enhance their experience and diversify their knowledge beyond their core discipline.

The Introduction to Learning Disabilities course has been team-taught by the first (JL), fourth (CKG), last author (FM), and invited speakers for the past eight years. The course delivery is conducted entirely in the English language in line with the aspiration stated in the Malaysian Education Blueprint for Higher Education (2015-2025) (Ministry of Education, 2015) that Malaysian students should be bilingually proficient in both English and the national language (i.e., Malay language). The university-wide elective course aimed to promote awareness, understanding, and knowledge of persons with learning disabilities (LD); and to enhance advocacy for the rights, independence, real choices, and inclusion in society of persons with LD among university students without any prior background knowledge in learning disabilities. In Malaysia, LD refers to intellectual capabilities that do not conform to the biological age (Department of Social Welfare of Malaysia, 2021). Examples of learning disabilities include global developmental delay, down syndrome, and intellectual disabilities, which are characterised by limited intellectual functioning and adaptive/social functioning (Department of Social Welfare of Malaysia, 2021; Gates & Mafuba, 2016). The Department of Social Welfare (2021) also defines LD as conditions that affect the learning ability of individuals (e.g., autism spectrum disorder, attention deficit hyperactivity disorder, and specific learning difficulties such as dyslexia, dyscalculia, and dysgraphia; see Dzalani and Shamsuddin (2014) regarding the heterogeneous definition of learning disabilities used in Malaysia). The social model of disability and the underlying concepts, principles, historical development, theories, current practices, and international and national recommendations for supporting persons with

LDs were emphasised. Common LDs and their characteristics, screening, assessment, behaviour modification, and intervention strategies commonly employed to detect and understand LDs were included in the syllabus. A 3-hour slot on intervention strategies in reading and writing for children with specific learning disabilities (Grigorenko et al., 2020) was also covered in this course. The typical instructional design of the course included a combination of lectures,

discussions, small group exercises, movie reviews, and field visits to non-governmental organisations for persons with LDs to provide experiential learning opportunities to the students.

Pedagogically driven approach: The gamification project

The gamification project in this course, which was funded by the university's Scholarship of Teaching and Learning (SoTL) grant, was intended to enhance active learning, student engagement, meaningful learning, and knowledge acquisition and application of the concepts on LDs among undergraduate students. Gamification was embedded into the course as a student-developed game-design group project.

First, we began the course with the business-as-usual weekly lectures on the topics to be covered as assigned by the fourth author (CKG), the course coordinator. An assigned lecturer facilitated these lecture sessions; second, we maintained the business-as-usual field trips made by students to various centres such as Kuching Autistic Association and community-based rehabilitation associations, and third, as part of the course redesign initiative for the SoTL project, we embedded a gamification component where the students were facilitated to participate as game creators to complete a group project by gamifying a small topic related to the course content. The gamification project entailed a minor course redesign to the course delivery and assessment.

Overall, the formative course assessments were as follows: 1) gamification product by the groups (20%), 2) group case presentation based on the field trip (10%), 3) individually written movie review (10%), and 4) an individually written reflective journaling (blog) (30%). There was a multiple-choice-item final exam at the end of the semester (30%). For an example on the individual reflection (blog), see tfarahhanumnor.wixsite.com.

At the start of the course, the students were informed that each group had to complete one gamification group assignment, which would carry 20 per cent of the total course marks and other forms of assessments. Two 1-hour gamification workshop sessions conducted on weeks 4 and 5 of the semester and a half-day visit to the Gamification Centre (http://www.mycapsule.my/) were arranged. During the gamification workshops, provided by the third author (FS), the students were given a briefing and hands-on training on gamification, game design and development, game mechanics, and what they had to produce on Game Play Day (scheduled on week 13 of the course; see Figure 1). The students were also exposed to various gamification products such as board games, puzzles, and other off-the-shelf games, including games that had been co-created by other students from other courses. Reflective journaling about the game was made towards the end of the semester. For an example of how the game worked in practice, see https://tfarahhanumnor.wixsite.com/website/post/gamification-jenga-law.

Figure 1

Game Play Day: Students as Innovators through Creative Collaboration

The gamification project required students to form a group of 6-7. Each group was required to choose one of the three topics on (1) signs and symptoms of LD, (2) national and international declarations of support for persons with LDs, and (3) intervention strategies in reading and writing for children with SLDs. All groups chose to remain in the same group for the field trip and the gamification project.

The students were instructed to create a game demonstrating their understanding of the contents learned in the course that required the game players to recall and/or analyse the content. All the groups chose to develop games that required recall of content knowledge. The students were required to use game mechanics, which may include elements such as points, levels, challenges, and rewards. In week seven, the students were required to prepare preliminary game ideation on the game the group would like to design (e.g., board game, puzzle) using a game mapping template, which facilitated the students' game design process. The game ideation process included group planning, online research on learning disabilities, and game design options for non-digital games. All the groups designed their games around the core game mechanics. The course instructors (JL, CKG, and FM) and the third author (FS) guided the students toward completing their game design project.

Rewards, punishments, and challenges were the fundamental principles that were applied to increase the motivation level of the game players. Four 1-hour gamification progress sessions were held after class on weeks seven, 10-12 to ensure that the groups continuously improved their game design. During the gamification progress sessions, the game designers (students) received feedback from the course instructors, facilitating the group's game development process. During Game Play Day (week 13), the groups showcased the games they had developed; students from other groups took turns playing them.

Game creation

The students were guided to engage in game design and development to develop content-driven games comprising game design thinking (Mohamad et al., 2019). The pedagogical approach comprises four steps: 1) Understand the needs, context, and audience; 2) Get inspired by existing games and gameplay; 3) Game mapping according to the needs and goals of the game; and 4) Game design (Romero et al., 2019). A game design hands-on session was conducted (http://www.mycapsule.my/) to introduce the students to game design. Traditional games were studied and used as references by students in the course. Several students referred to classic games such as Snakes and Ladders, Monopoly, Trivial Pursuit, and Jenga. Various game design elements, which could also be found in the groups' games, such as rules, goals, rewards, challenges, motivation, collaboration, and interaction, are explained below.

- Rules refer to a set of rules that could be easily understood and provided to the players for each game.

- Goals refer to the goals and objectives of the games provided to the players. Game goals that were clear, specific, and challenging could generate more remarkable persistence and enhance the players' performance (Locke & Latham, 2004). The team with the highest points at the end of the game would be declared the winner.

Rewards included points and different types of badges that were given to players. The reward systems implemented in games are a vital source of player engagement (Reeves & Read, 2009), with rewards being associated with higher levels of dopamine in the brain resulting in higher pleasure observed in gamers (Howard-Jones & Demetriou, 2009).

- Challenges such as problem-solving tasks, questions related to the knowledge of learning disabilities, creativity, and time pressure were embedded in the games. The challenges were employed to cultivate cognitive stimulation.

- A scoreboard was provided to each team. The team could calculate game points. The role of the scoreboard was to allow players to keep track of their progress, elevate optimism, and foster a sense of motivation and competition in the game.

- Collaboration was addressed because the games naturally embed collaboration through team communication, goals, and motivation to win. The state of flow (Csikszentmihalyi,

2016) was recognised in the game design process, as team members were fully absorbed in the journey and motivated by the quality and end goal of their experience.

- The games enabled players to interact highly between and among players in a team and other teams through the game objectives. Players had to interact with the game and determine how to complete the necessary tasks to win. Interaction also allows teams to work together to solve game challenges within a timeframe, where teams need effective interaction to best exchange ideas and perspectives. Players experience high levels of interaction with players of other teams where the opponent gets to punish the other team with face paint or dares (e.g., Jenga Law Game designed by one of the groups).

Participants

Fourteen (13 females, one male) undergraduate students who provided informed consent responded to an online survey. These 14 participants were from a larger 2019 cohort comprising 41 students (36 females, five males). Given that it was a university-wide elective course, students from other disciplines registered for this course. The participants were either in the second or final year of their studies in the following fields: electrical and electronic engineering, mechanical and manufacturing engineering, psychology, counselling, marketing, human resource development, industrial relations and labour studies, and cognitive sciences. Their ages ranged from 19 to 21 years. At the beginning of the semester, the course instructors asked the students the reasons for taking up the course. Many had expressed that they joined the course out of personal interest, had a relative with a learning disability, or were curious about the course. Ethical approval (HREC (NM)/2020(1)/01) was granted by the Human Subjects Committee of Universiti Malaysia Sarawak.

Research design

A descriptive quantitative research design was used in this study (Creswell & Creswell, 2018), to allow for a rich depiction of the participants' journey as game creators.

Measures and procedure

The Assessment Scale of Creative Collaboration (ASCC) questionnaire (Romero et al., 2019), comprising both closed-ended Likert-like items and open-ended questions, was adapted and used for data collection. The adapted ASCC was constructed using online survey administration software (constructed using Google Forms) and distributed to the students by the second author (LRX). Students answered the ASCC, which took approximately 15 minutes to answer, individually. The questionnaire was comprised of 48 questions that were divided into seven sections. Section 1 (Questions 1-5): demographic information and the group's game information; Section 2 (Questions 6-18): self-assessment of the individual's orientation towards collaborative creativity; Section 3 (Questions 19-22): creative characteristics of the game; Section 4 (Questions 23-38): process and quality of collaborative creativity, which included questions on time pressure

(Questions 34-36); Section 5 (Questions 39-42): positive and negative aspects, difficulties encountered, and the methods to overcome problems faced regarding collaborative creativity; Section 6 (Questions 43- 47): Game Play Day; and Section 7 (Question 48): recommendations on the improvement of future projects. The closed-ended survey questions (Sections 2-4; 6; 8) adopted a five-point Likert scale comprising 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, and 5-strongly agree. The open-ended survey questions were presented in sections 5 and 7.

Data analysis

Data from the closed-ended ASCC Likert scale questionnaire were analysed using descriptive statistics. In contrast, the data from the ASCC open-ended questions were analysed using the thematic analysis detailed by Xu and Zammit (2020): 1) Familiarise oneself with the data, 2) Generate initial codes, 3) Identify themes, 4) Review themes, 5) Define and name the themes, and

6) Produce the report. Trustworthiness of the data analysis was addressed by adopting an approach detailed by Nowell et al. (2017); the second author (LRX) independently read the responses, reviewed all transcripts independently, and identified the codes, themes, and sub-themes. Word processing software was used for the data analysis. The first author (JL) also independently read the responses and reviewed the themes extracted from the data. Data were charted using a matrix according to the themes using Microsoft Word. Potentially important and interesting quotes were highlighted for reporting purposes. After the report's final draft had been prepared, the team members vetted the themes and sub-themes, and a team consensus was reached after discussions.

Limitations of the Study

This study has several important limitations. The study's first flaw is its small sample size, which makes it impossible to extrapolate the results to a larger population. Secondly, no observations of the game development process were made. Another drawback was the absence of a think-aloud or diary writing technique to record the participants' reflections on the experience of collaborative creativity and game production. Finally, due to the students' need to master both the game design techniques and the content throughout the 14-week semester, time was a problem that constrained the outcome.

Results and discussion

The following results are the participants' perspectives derived from the online survey questionnaire, which comprised closed-ended and open-ended questions. The closed-ended results were grouped into two broad sections, namely 1) the creative characteristics of the games created collaboratively by the groups and 2) the characteristics of the collaborative creative process and quality of collaboration experienced.

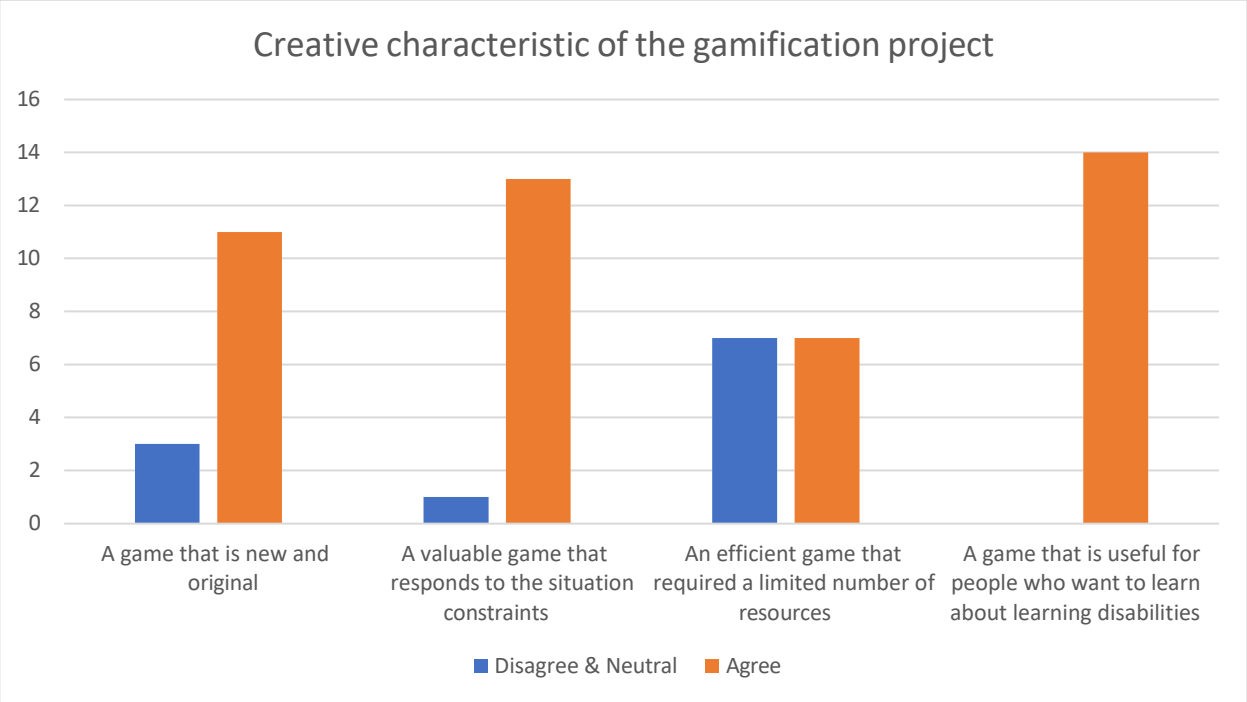
Creative characteristics of the games created collaboratively by the groups

Regarding the creative characteristics of the games created collaboratively by the groups, most

participants agreed that they had developed novel and useful games. Approximately 78.6% (n = 11) of participants believed the games they created were new and original; 92.8% (n = 13) of the participants agreed that they built a valuable game that responded to the situation constraints, and half of the participants stated that they built an efficient game that required a limited number of resources. All the participants highlighted that their game was useful for people who wanted to learn more about learning disabilities (see Figure 2).

Figure 2

Creative characteristics of the gamification project (n = 14)



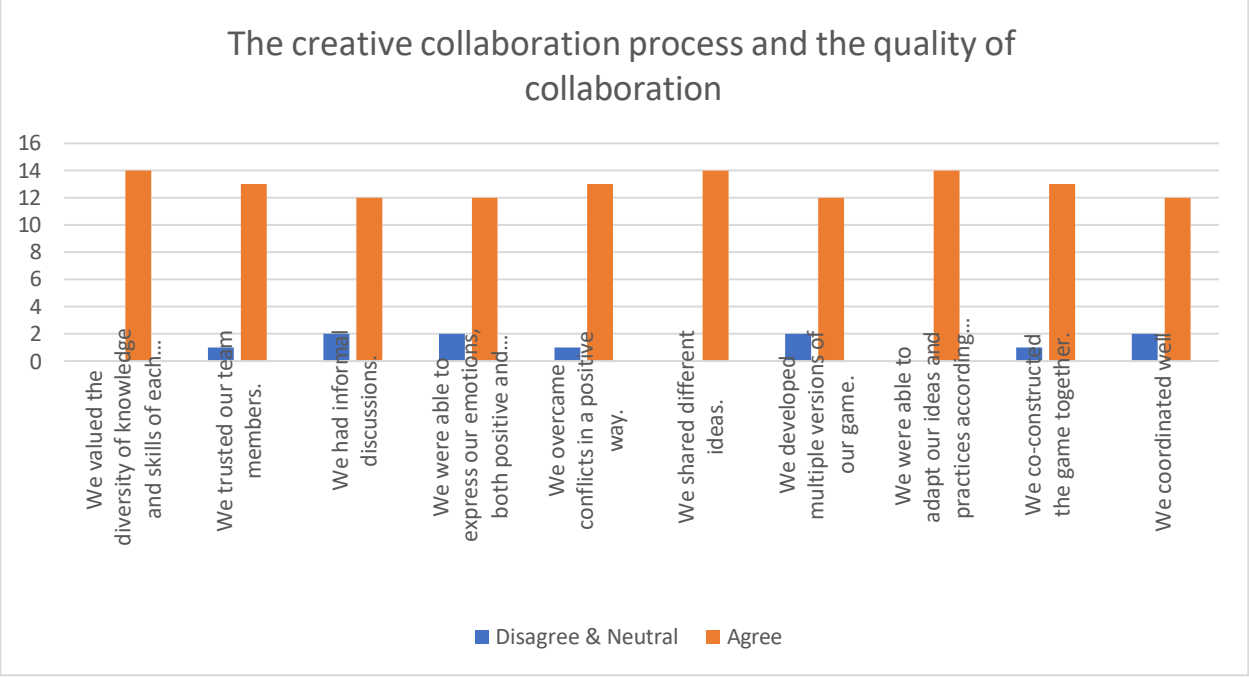
The result from the descriptive analysis highlights the participants' understanding that the creative process during game creation involved designing and developing games that were novel (Sternberg, 2006), could help other people to enhance their awareness and knowledge about learning disabilities, and was appropriate for the course requirements (Carruthers, 2011; Hennessey & Amabile, 2010; Kaufman, 2016).

Characteristics of the collaborative creative process and quality of collaboration experienced

Regarding the creative process and quality of collaborative creativity experienced by the participants, most responded positively. Approximately 92.9 % (n = 13) of the participants trusted their team members, co-constructed the game together, and overcame conflicts in positive ways; 85.7% (n = 12) of the participants reported the usefulness of engaging in informal discussions; 85.7% (n = 12) of the participants were able to express their emotions, both positive and negative; and developed multiple versions of their game and coordinated well in their team project (see Figure 3). All participants valued the diversity of knowledge and skills of their team members, shared different ideas, and they were able to adapt their ideas and practices according to the project difficulties.

Figure 3

The creative collaboration process and the quality of collaboration (n = 14)



The descriptive analysis of the creative collaboration process and quality of collaboration indicated that the gamification project fostered the team members' communication skills, hence enhancing their ability to engage in social interaction (Rider & Keefer, 2006) to achieve their goal of developing a game, which was the problem they had to solve (McPeck, 2016). They were able to share different ideas and then developed multiple versions of the game, which suggest that the participants also used critical thinking skills that entailed generating solution, identifying actions, and evaluating outcomes (Seibert, 2020). In turn, the critical thinking process was made possible through active communication (Fisher, 2011). They had informal discussions, and they could express their positive and negative emotions, which required empathy, understanding, active listening, and open disclosure (Kyaw et al., 2019; Rosengren, 1999). Collaborative teamwork also elicited skills to overcome conflicts positively, which is typical of social interactions while achieving a common goal (Craft, 2008; Le et al., 2018; Van Boxtel et al., 2000). The present findings also support past findings that trust is essential during collaborative creativity projects because trust is a key element for reinforcing idea generation and exploration (Craft, 2008; Wishart & Eagle, 2014). Using gamification in the present study sheds light on how the game creation project enhanced the creative climate, which, in turn, facilitated knowledge creation, like the study by Hong et al. (2014).

Based on the open-ended data, three major themes were identified: (1) positive aspects of the gamification project, (2) constraints encountered in the gamification project, and (3) teamwork and collaborative problem-solving approaches.

Theme 1: Positive aspects of the gamification project

Four sub-themes were identified regarding the positive aspects of the gamification project. These sub-themes were the promotion of creative thinking through gamification, collaborative creativity in action, engagement in critical thinking during gamification, and helping others learn about learning disabilities through games.

- Sub-Theme 1: One of the positive aspects of the gamification project that the participants reported was the promotion of creative thinking through gamification**.** The participants reported that their game design project forced them to think creatively and engage in an enjoyable idea-sharing manner to convey their knowledge through the game, which had to be completed towards the end of the course. Furthermore, the participants reported that they had to keep the players of the games in mind about the learning disabilities concepts they had learned. Example quotes are presented below:

  Before this, I have never try [*sic*] *this kind of gamification and I have been* [*sic*] *realised its impact in* [*sic*] *learning processes. It was a great way to enhance learning by making it more interesting and enjoyable*. (Participant [P]9)

  Thinking creatively on how to convey knowledge through [the] game [*sic*]. *(P11)*

Make us unleash our creativity. (P13)

The participants demonstrated that they were aware that the requisite characteristics of the gamification project were to create something new and original, efficient, valuable, and helpful in teaching others about learning disabilities (Carruthers, 2011; Hennessey & Amabile, 2010; Kaufman, 2016). Furthermore, the participants acknowledged that the game creation process provided them with opportunities to engage in meaningful actions and interactions (Glăveanu & Beghetto, 2020) to find useful solutions (Sternberg, 2006). To create the games, the participants themselves had to apply the various elements they had been exposed to in the course, such as creativity, rewards, challenges, and feedback, in order to better motivate game players so that the game players could learn effectively and master the desired skills (Plass et al., 2015; Van Roy & Zaman, 2018).

- Sub-Theme 2: The participants reported that collaborative creativity in action was another positive aspect of the gamification project. The participants also experienced the importance of teamwork in the process of game creation, where collective effort "we" was explicitly mentioned.

  The main positive aspect in [*sic*] *this game is to create a simple game that can give a lot of knowledge about people with LD. We need to move every gears* [*sic*] *in our head and dig every possibility that we can find to create this games* [*sic*]. *(P1)*

  The facts [*sic*] *that we have no choice except [sic] think and be creative. It is truly help* [*sic*] *a person to develop their critical thinking skills. (P4)*

  Creating an alternative way of how we can use games to share with people about learning disabilities. (P6)

  The participants generated new ideas while planning and developing their team-based game, including generating multiple versions and utilising different ideas and perspectives involving creativity, communication, collaboration, and critical thinking skills (Romero, 2016). The game creation project seemed to have brought the team members together as they worked together to obtain information, worked productively, interacted socially, and made an effort to understand the intentions of the team members to achieve the common goal of designing and developing a game about learning disabilities (Cayzer, 2020; McCorry & Mason, 2020; Rider & Keefer, 2006; Rosengren, 1999). Like Cayzer's (2020) findings, collaboration promotes diversity and increases student motivation levels. Furthermore, the group's intrinsic interest in the game creation project, trust within the group, and the task atmosphere reinforced idea generation and exploration is typical of groups engaged in collaborative creativity tasks (Craft, 2008; Wishart & Eagle, 2014).

  Making game design accessible to university students was an atypical approach to developing the skills of collaborative creativity among university students (Arnab et al., 2017; Romero et al., 2019). The opportunities to engage in the identification, sharing, and

development of new ideas through interaction that unleashed group creativity (West & Hannafin, 2011) reinforced the exploration of fresh ideas (Craft, 2008; Wishart & Eagle, 2014), which in turn enabled the participants to interact with materials and collaborate with other individuals which would not be possible when working alone creatively (Csikszentmihalyi, 2016). The present finding also supports Sawhney et al.'s findings (2005) where collaboration improves students' flexibility, engagement, and productivity and helps increase innovative ideas. They worked diligently to convey knowledge of learning disabilities through their game designs. They debated relevant ideas with their group members. Collaboration and mentoring, a sense of community, learning through design criticism, moderate support for others, dynamic expertise, and idea prototyping promote collaborative creativity (West & Hannafin, 2011). Thus, having to deal with differences in knowledge, expertise, perspectives, and the problem at hand, the "problem" of creating a game on the learning disabilities content was simultaneously challenging and engaging (Arias et al., 2000; Smyrnaiou et al., 2012).

Overall, the collaborative "we-ness" about their collaborative creative project that the participants reported suggests that the team had engaged and dynamically contributed toward group creativity (Pirola-Merlo & Mann, 2004) to solve the problem of creating a relevant, practical, and creative game (Sternberg, 2006) while being able to communicate effectively about the game design (McCorry & Mason, 2020). The skills obtained by the participants from the collaborative creativity game creation project included an increased value in the diversity of knowledge and skills of other team members while placing the goal of game design as the top priority of the collaboration process. The present finding supports past studies that collaboration is demonstrated when students accept others' knowledge, exchange ideas, and repair identified divergences to achieve a common goal (Craft, 2008; Häkkinen et al., 2017; Van Boxtel et al., 2000).

- Sub-Theme 3: Engagement in critical thinking during gamification. The participants also believed that their gamification project helped to develop their critical thinking skills, with one participant stating that "the fact was we had no *choice except to think and be creative and that it was truly helping a person to develop their critical thinking skills*." (P4)

  The present finding is similar to Romero's (2016) finding that participants in her game design study reported higher use of communication and collaboration than critical thinking from the list of 4C skills. Nonetheless, only one participant in the present study specifically mentioned critical thinking and the response was only briefly made. The present findings highlight the significance of being able to capitalise on thought processes while solving problems using knowledge of the problem areas to generate solutions, identify actions, and evaluate outcomes (McPeck, 2016), despite the lack of emphasis on critical thinking among the participants in the present study (Seibert, 2020).

- Sub-Theme 4: Helping others learn about learning disabilities through games.

  Thinking creatively on how to convey knowledge through game. (P11)

We get to implement the gamification techniques using our knowledge on [*sic*] *learning disabilities to help others to learn it too. (P14)*

Creative products must be novel and useful (Sternberg, 2006). Thus, appropriately designed, useful and valuable products are expected (Carruthers, 2011; Hennessey & Amabile, 2010; Kaufman, 2016). The present study sheds light on the participants' perception that gamification plays a vital role in education as it conveys knowledge about content knowledge through games and enhances the learning process. In this study, the participants had been provided with the necessary game design and development training (Romero et al., 2019) that was supposed to be content driven. Hence, they were familiar with the game elements that included challenges such as questions related to the knowledge of learning disabilities that should have been embedded in the game and employed to cultivate cognitive stimulation.

Theme 2: Constraints encountered about the gamification project

Two sub-themes were identified regarding the constraints faced by the participants regarding the gamification project. These sub-themes were time pressure and constraints faced during game creation and Game Play Day.

- Sub-Theme 1: Time pressure. The primary constraint regarding the gamification project was time pressure. The participants reported that they experienced time limitations not only in terms of preparing for the game but also in playing the game. They also reported that collaborative creativity tasks such as game creation for gamification projects require extensive time to prepare quality games and play during Game Play Day.

  One of the greatest difficulties we encountered was the [*sic*] *time constraints. We need to complete our project during the busiest week of the semester. Luckily, we managed to break through it. (P2)*

  We need lots of time to think about what kind of task we need to provide for the gamers so that they can enjoy and learn at the same time. Its [*sic*] *really required lots of time because we need to go through lot of processes to make it a successful project. (P9)*

  Time constraints as we need to buy and prepare the things by ourselves. (P6)

  Not enough time to play. (P12)

  The timeline of the project is too short to create a quality product that deliver the goals. (P14)

- Sub-Theme 2: Constraints faced during game creation and Game Play Day. Overall, the participants experienced difficulties in identifying the game mechanics that were most suitable to deliver the content and creating games that were fun to play while

simultaneously having to make several considerations such as the delivery of knowledge, application of theory, production of game instructions, and the creation of motivation and reward elements during gameplay in order to make the players want to play and win. Other challenges the participants encountered included difficulty designing the game mechanics, which took time to develop.

Finding the ideas and create [*sic*] *the game mechanics which include many aspects such as cognitive process and take time to develop it. (P3)*

To develop the motivation and reward element during the game. It is truly need [*sic*] *to make people wanted to play and fight to win. (P4)*

To apply the theory and produce instructions in the game. (P12)

To actually [*sic*] *build the games on your own. (P13)*

To think which game mechanics is the most suitable to be able to deliver the content. (P14)

Theme 3: Teamwork and collaborative problem-solving approaches

Most participants reported that they overcame difficulties through group discussions. Communication between group members was key to overcoming difficulties.

First of all, we communicate with each other, weighting the pros and cons. Then we come out with a solution. 3 simple step [*sic*] *but need every edge* [*sic*] *from each member. (P2)*

We share each other's opinion and dividing task to develop the game such as who does the printing, who responsible in designing the board base and others. (P3)

Discuss among the members and the help of lecturers. (P4)

Teamwork make [*sic*] *it easy to overcome. (P7)*

We discuss among the team member and try all possible ideas from them. try to imagine the process of the game (try and error) to make the whole play is fun and enjoyable. (P8)

In terms of communication, the students engaged in informal discussions with their team members and expressed emotions positively and negatively throughout their gamification projects, thereby demonstrating freedom of expression in their communication (Cayzer, 2020). The findings related to student expressions in conveying intended meanings to exchange or strengthen ideas, experiences, and feelings in an emotionally charged, honest, and open manner support past studies (Kyaw, 2019; West & Hannafin, 2011). As West and Hannafin (2011) reported, new ideas are identified, shared, and developed through interaction with others during collaborative creativity tasks.

However, teamwork during the collaborative problem-solving process was challenging as the participants also reported the problems they had faced. For example, one of the participants reported that it was challenging *to build the games on your own* (P13). One group had a problem with teamwork; one participant reported that *bad teamwork* (P11) led to project collaboration difficulties, which relates to the importance of teamwork and collaboration in gamification projects. One major setback, as highlighted by one of the participants related to teamwork, suggests that students could benefit from undergraduate programs and training focusing on the value and dynamics of collaborative teamwork.

Teamwork was an essential part of the collaborative process, where participants benefited from the exchange of ideas while developing their project's game mechanisms. Teamwork benefits were also reported by Kim et al. (2019), where collaborative creativity was presented to students to stimulate and enrich their creativity to create games by exchanging ideas and sharing their understanding of the course and their gamification ideas.

Practical Implications

The evidence gathered from the current study has demonstrated several practical implications. First, collaborative game creation by the students presents vast opportunities for enhancing collaborative creativity skills among future graduates. Second, the application of gamification holds promise in revolutionising collaborative creativity in higher education institutions by encouraging students to use the 4Cs approach, namely critical thinking, creativity, communication, and collaboration skills through their game creation process. Next, this study shows that gamification helps explore how university-wide elective courses could expose students to complex content beyond the students' disciplines, such as the course on Introduction to Learning Disabilities in the present study, which aimed to create awareness about learning disabilities among undergraduate students. Last, the evidence from the current study suggests that universities

could strategically and systematically explore how the acquisition of 4Cs might be fostered across more university-wide gamified elective courses.

The benefit of game creation is that it naturally encourages students to work together and be creative, allowing them to finish a good quality game in the allotted amount of time. From the beginning of the game's conception until the end, it was supported by the ongoing direction of the course instructors and a lecturer who acted as a gamification coach. The other strength of gamification in this study was that the games were content driven; specifically, the students, as game creators, had identified a narrow content area (e.g., law related to people with disabilities) to be converted into a game. The content-driven game enabled the group to engage more with the course materials and conduct the necessary research about the topic. These games could be made accessible to future cohorts who could play with the games and improve the game mechanics and content covered by the previous cohort. Finally, all innovative teaching and learning do incur some costs. The allocation of funds for the gamification project provided the students with opportunities to collaborate meaningfully toward a product. In turn, the game creation opportunity provided the students with a platform to be exposed to creative collaboration skills that are crucial in future

workplaces.

There are several weaknesses of the gamification project. First, none of the students had been exposed to a gamification project and game creation concept prior to the present study. Second, given that it was a university-wide elective course, many students did not know one another prior to the course except for several students from the same disciplines or faculty. Hence, group dynamics proved to be a complex issue to tackle as the students had not bonded much and communication between group members was difficult, as reported by one participant who reported that she felt like she was the only one doing all the work. Therefore, one primary weakness of the current teaching-learning approach was the assumption that group dynamics and communication skills need not be explicitly taught. The present study suggests that ineffective teamwork was a primary cause of the "unhappiness" in the group. Thus, course instructors should focus on affective development, collaborative learning skills, and teamwork management at the beginning of each course instead of assuming that the students will learn and resolve the teamwork and communication problems. Finally, based on the reports by the students, gamification requires much time. Thus, course instructors across courses should work closely to ensure that the learning curve is shortened by introducing more courses that are suitable for gamification to be included. A video on game creation should be uploaded to the course's learning management system to reduce the time it takes to familiarise oneself with the necessary knowledge on gamification and game creation at the beginning of the course and to allow students to access this instructional video repeatedly and freely.

Conclusion

The present study aimed to examine undergraduate students' perspectives regarding their collaborative creativity experience during a group game creation assignment to gamify a small topic learned in a university-wide undergraduate elective course on Introduction to Learning Disabilities. The adapted Assessment Scale of Creative Collaboration (ASCC) was administered to elicit the participants' perspectives regarding the creative characteristics of the games produced, the collaborative creative process, the quality of team collaboration, the positive aspects encountered, the negative aspects and difficulties faced, and the problem-solving approaches used

during their gamification project. This study's evidence on collaborative creativity suggests that game creation should be explored more extensively in higher education to cultivate collaborative creativity skills among university students. Educators could integrate gamification approaches in their teaching environments to help students develop valuable relationships and trust with their classmates, provide opportunities for them to communicate with each other as they would in the workplace, and provide students with a platform to unleash their creativity without providing too much restriction on their projects. Future studies should include larger sample sizes with additional focus on gender differences, age groups, and varying levels of academic and socioemotional competency.

The collaborative creative process should be directly seen and measured in future investigations.

For instance, it would be wise to conduct qualitative interviews to trace the ideation processes, including idea triggers, content element identification, ideation technique use, outside support, and the impact of the development environment. In conclusion, future research should focus on elements including time restraints, effective teamwork abilities, emotional intelligence, and crucial 21st-century learning competencies related to optimal and high-quality collaborative creativity outputs.

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Conflict of Interest

The authors have no relevant financial or non-financial interests to disclose.

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