Easy Induction: A Serious Game Using Participatory Design

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Abstract. College freshmen often face difficulties adjusting to the new academic and social environment of university life. It is critical to help them adapt to academic and personal life, while also improving their sense of belonging and engagement with the university. In this paper, we focus on the context of an international joint venture university, Xi'an Jiaotong-Liverpool University (XJTLU), and present a participatory design approach to identify potential solutions collaboratively. We conducted three participatory design workshops with freshmen in undergraduate and postgraduate studies, where we discovered specific challenges, developed serious game content and design alternatives, and delivered a board game that supports academic and social integration at XJTLU. To evaluate the effectiveness of the board game, we collected both quantitative and qualitative data. The quantitative analysis revealed that the board game is effective in improving freshmen's knowledge acquisition of academic affairs, increasing their familiarity with the environment and resources, and enhancing their ability to access information and resources. The board game also received high scores in system usability and user experience. The qualitative analysis indicated that the board game was engaging, interesting, and well-received by students. They found the board game helpful in their academic and social integration and expressed a desire to play it again in the future. Our participatory design approach and the resulting board game provide a promising avenue for universities to support freshmen's transition to university life.

Keywords: Serious games · Participatory design · Interaction design

1 Introduction

Getting adapted to university life is a significant process for freshmen and closely relates to their overall experience and learning in the university. However, many college freshmen struggle to adjust to their first-year life at university during the transition from high school to college, finding it hard to adapt themselves to the new environment [24]. It has been proven that a stronger sense of presence and engagement in the university can positively impact academic achievement and self-identity, as well as reduce problematic behavior [21]. Therefore, it is essential to help college freshmen adapt to the new environment and improve their campus engagement to increase their campus experience and

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personal achievement. This study focuses on an international joint venture university, Xi'an Jiaotong-Liverpool University (XJTLU) and aims to understand freshmen's campus experience and the issues that they are encountering. XJTLU has executed many online and offline activities, such as information sessions for freshmen, campus tours, an E-journey system, and social media engagement, etc. Despite the variety, some freshmen are not motivated to attend the activities and are still unfamiliar with the university resources. Therefore, this study aims to create a more effective and engaging induction system or product to support freshmen to fit into the university environment.

Initial research was conducted by studying related works and interviewing stakeholders, including freshmen students, senior students, and university advisors. Four general problems were identified: 1) unfamiliarity with the university environment and places; 2) unfamiliarity with academic affairs; 3) lack of ability to search and filter information; 4) lack of engagement in social activities. To address the aforementioned issues, we need to identify an effective and engaging approach to help freshmen learn about the campus environment and academic affairs, the ways to search for information, and increase social interaction. Tabibian et al. [27] found that spaced repetition is a successful technique to enhance memorization efficiency and strengthen long-term memory. A repetitive activity with an engaging and interactive format could be a potential solution for freshmen to adapt better to college life. Serious games, designed for educational purposes and behavior modification, have been used for knowledge learning and skill training [20]. Thus, developing a serious game will provide an entertaining way for freshmen to learn about XJTLU and improve their sense of campus engagement. With a high degree of acceptance among college students, multiplayer board games are a popular form of serious games and can be played in various settings such as class meetings, round table discussions, or small gatherings of friends. Playing board games is also a social activity in nature. Therefore, a serious board game is a suitable approach for freshmen to acquire university related knowledge while having fun. Some gamification mechanisms, such as team competitions and the discussion of game strategies, can increase communication and interaction among players while improving their understanding of the university and their sense of belonging.

In this paper, we present a serious game design that facilitates freshmen in their transition to university life and enhances students' sense of engagement and belonging. To achieve this goal, we conducted participatory design workshops to understand user requirements at an early stage of the design process. The results of this research showed the efficiency of our serious game design, Easy Induction, in supporting students to learn about the university environment, academic affairs, and information access. The evaluation also showed a satisfying usability and user experience of the system. Our research promotes further exploration and innovation in the domain of education and entertainment, contributing to the future design for knowledge acquisition and engaging user experiences.

2 Background and Related Work

2.1 Adaption Challenges for University Freshmen

In the context of university education, the transition from high school to college represents a critical period for freshmen to adapt to their new academic and social environments. Despite its importance, previous research suggested that many college freshmen experience difficulties adjusting to university life [1,5,24]. Challenges encountered by new students include increased academic demands, greater freedom, and reduced academic structure. As such, adjusting to the new environment is often the most common problem encountered by freshman students. Marshall et al. [16] identified a range of factors that can influence the transition from high school to university, including academic, social, and emotional components. Students' sense of belonging in the academic environment has also been found to be a significant factor contributing to their overall experience and success [9]. Midgley et al. [18] suggested that positive outcomes result when changes in students' needs are aligned with changes in opportunities, whereas negative consequences may arise when this alignment is lacking. Similarly, Tinto [29] proposed that managing both the social and academic aspects of the new environment is crucial for freshmen to adjust successfully to college. However, since freshmen enrollment conditions vary from university to university, it is hard to obtain a universal solution. Therefore, investigating specific adjusting methods of freshmen at a university is of significant importance.

2.2 Participatory Design

Participatory design is a process and strategy that involves users and customers in the design process, enabling stakeholders, designers, and end-users to contribute to the design process, ensuring that the final product meets the users' requirements [12,25]. Participatory design considers co-research and co-design as crucial elements of the process [22], where the researcher or designer draws conclusions together with the user. In participatory design workshops, the participants will be encouraged to think about opportunities or situations where they feel things might be different, using a journey map [3]. Through the co-design process of the designer and participants, hidden opportunities and potential design value can be discovered [15]. Case studies had shown that insights into problems can be found through participatory design and participatory research [8]. Despite the effectiveness of the participatory design workshop as a research and co-design method, few studies have focused on university students. This study intends to employ the participatory design method by facilitating participatory design workshops with stakeholders to explore the possibilities of freshmen induction.

2.3 Serious Game Design

Serious games have become increasingly popular in recent years due to their potential to educate while entertaining [26]. These games are designed with a specific educational purpose in mind, whether it be to teach students about history, science, math, or any other subject [30]. In the field of education, serious games have been used to make

difficult or boring topics more engaging for students and to help them better retain information [7]. One of the key factors in creating a successful serious game is finding the right balance between game elements and educational content. This means that the game must be both entertaining and educational in order to be effective [11,31]. In other words, the game should be fun enough to keep players engaged, while also conveying important information or teaching them new skills.

Players were rarely consulted in early stage game designs, but a growing number of game designers have begun to combine participatory design workshops with game design sessions [10]. For example, Tan et al. [28] designed a serious game for children to develop their social skills. When children were invited to play an early prototype, they provided a wealth of information used to improve the game. Similarly, Mazzone et al. [17] invited young people to participate in the design of a game for improving the emotional intelligence of adolescents. Danielsson and Wiberg [6] were inspired by this modality to design a learning game for adolescents on gender identity. Lukosch et al. [14] developed an immersive virtual training environment to improve users' situational awareness skills. Based on the game feedback, the participatory design approach resulted in a meaningful experience for the users.

Thus, by developing a serious game in collaboration with participants in participatory design workshops, it may be possible to create an engaging and effective solution for helping freshmen adapt to university life. The game could be designed to address a variety of challenges, such as managing time, navigating campus, developing study habits, and building social connections. By involving stakeholders, designers, and end-users in the design process, the final product can be tailored to meet the specific needs of freshmen and help them succeed in their academic and personal lives.

3 Methodology

Based on the preliminary research, the study attempts to address four design goals (DGs). Achieving these design goals will facilitate freshmen's adaptation to the university.

DG1: To help freshmen get familiar with the campus environment and places.

DG2: To help with freshmen's knowledge acquisition about the university academic affairs.

DG3: To help freshmen develop a sense of well-being and belonging.

DG4: To help improve freshmen's abilities to access information and resources.

3.1 Double Diamond Model

The Double Diamond Model provides a framework for our design process. The model's essence is to solve problems and find solutions in the design structure, which is applicable to our serious game design. Its main focus is to *"design the right thing"* and *"design things right"* [4]. The model has four stages: Discover, Define, Develop, and Deliver. These stages can serve as a map for designers to organize their ideas and improve the creative design process.

In the first stage, *Discover*, preliminary online research and stakeholder interviews were conducted to gain insights into general problems faced by university freshmen during their adaptation process. The obtained data was then filtered in the second stage, *Define*, to identify the core contradictions underlying the phenomenon. The first participatory design workshop was held to achieve this goal. In the third stage, *Develop*, the actual design process began and the second participatory design workshop was conducted to generate potential solutions by co-designing with stakeholders based on the findings from the first two stages. In the final stage, *Deliver*, the third participatory design workshop was conducted to evaluate and select the most suitable solution through a process of design, testing, evaluation, and iteration conducted over three rounds.

3.2 Participatory Design Workshop

We conducted three participatory design workshops, run by a primary researcher and a facilitator. The first workshop serves to verify the initial research findings and to gain deeper insights into user requirements. The workshop took the form of a focus group, where participants discussed four workshop questions related to the four design goals. We gathered qualitative data on freshmen's behaviors, feelings, and attitudes toward XJTLU and filtered these requirements into specific design goals.

In the second workshop, we focused on ideation and development. Participants and researchers brainstormed and co-designed initial concepts, created rough prototypes, and worked on several possible solutions while considering their respective advantages and disadvantages. Low-fidelity prototypes were evaluated in the workshop, and participants voted for the most suitable concept.

The third workshop aimed to deliver the concept into a real product and to test, evaluate, and iterate the design. Through the three rounds of participatory design workshops, a final product was produced and delivered.

4 Participatory Design of the Serious Game

We present the design process of the serious game in this section, structured by the three participatory design workshops in sequential order. Each workshop will detail the study design, participants, procedures, and results. The aim is to provide a comprehensive overview of the design process and illustrate how the project progressed through active involvement and collaboration with the users. Since the researcher could influence users' engagement level in the design process [13], the participatory design workshops were held in an organized way, following a clear procedure structure and prepared scripts.

4.1 First Participatory Design Workshop: Discover and Define

Study Design. The first participatory design workshop aimed to identify the challenges faced by freshmen during their adaptation process and explore potential solutions through intense brainstorming and discussions. Based on the focus group methodology,

this workshop utilized a qualitative research approach to uncover insights into the adaptation process of freshmen. We followed the focus group guidelines [19] to define the purpose, select participants, facilitate a conversation, and summarize the findings.

Participants. Given the project's objective of improving the adapting experience of XJTLU freshmen, the workshop participants comprised Year 1 undergraduate and postgraduate students. We sent out recruitment flyers online via social media, which ran for a week, and a total of 20 volunteers (8 undergraduate students and 12 master students) signed up for the activity. The undergraduates aged between 18 and 19 ($M = 18.25$, $SD = 0.21$). The postgraduate aged between 21 and 26 ($M = 23.08$, $SD = 1.90$). We thus had two groups of four undergraduate students and two groups of six postgraduate students.

Procedure. The workshop lasted about 60 min and was divided into four sections.
(1) Introduction and Warm-up. The first section involved a 5-min warm-up, where the researcher welcomed the participants, explained the workshop's purpose and procedures, and collected informed consent.
(2) Brainstorming. The second section was a 20-min brainstorming activity. The researcher proposed four questions[1] about the participants' experiences at XJTLU, from the general to the specific.

The researchers wrote the questions on a whiteboard to cultivate an active brainstorming atmosphere and encourage more ideas. Participants were given 3 min and encouraged to write down their answers on sticky notes, after which the researchers then collected the notes and moved on to the next question. To keep the focus group organized and clear, a script was prepared to guide the brainstorming session, emphasizing that participants were free to share all their ideas without judgments or comments. All verbal instructions were given by the primary researcher in a consistent way.
(3) Classification. After the brainstorming session, the participants and the researcher spent 15 min working together to put the sticky notes onto the whiteboard under their respective categories. We encouraged them to group similar keywords together to identify recurring trends.
(4) Discussion. Once the sticky notes were classified, the participants engaged in a 20-min open discussion about the four brainstorming questions.

Results. We transcribed the texts on sticky notes and used Excel to categorize the problems and determine their frequency. The outcomes confirmed the validity of our

[1] Workshop questions:
Q1: Generally, how do you feel about your academic and social life at XJTLU?
Q2: Did you encounter any issues when adapting to the campus environment (DG1), academic affairs (DG2), and social life (DG3)? Can you give some examples?
Q3: Are there any happy moments that you can think of at XJTLU? Can you give some examples (DG3)?
Q4: Where do you seek information about the university? How do you use university resources (DG4)?

four design goals and offered valuable insights into the design solutions. The workshop helped us gain a better understanding of the difficulties that freshmen face when adapting to college life, and several potential solutions have been identified. We summarize the key lessons learned from this workshop in response to the four design goals.

1. Introduce maps and buildings to help freshmen navigate the campus. Participants (N = 9) found the abbreviated names of buildings difficult to memorize and recognize.
2. Survival guides (e.g. late submission penalty calculation) (N = 5) and tips about academic affairs (e.g. how to book a discussion room) (N = 10) are useful and needed, but largely unknown.
3. The happy moments are related to the participation in social activities (e.g. board game) (N = 7), campus activities (e.g. buddy programme) (N = 5), student club activities (e.g. arts and sports) (N = 13), awards and achievements (e.g. winning a scholarship or championship) (N = 8), and their time spent with their friends and classmates (N = 9).
4. Many freshmen were not aware of some official accounts on social media that provide easy access to university information (N = 11), and did not realize the importance of checking their university E-mail.

4.2 Second Participatory Design Workshop: Develop

Study Design. During the second participatory design workshop, we transitioned from the initial requirements phase to the design phase. We invited five freshmen (3 males and 2 females), aged between 18 and 19 (M = 18.40, SD = 0.30) to engage in cooperative design for potential solutions based on the data collected in previous workshops.

Procedure. The second workshop lasted about 90 min and was divided into three sections: (1) Introduction, (2) Map Drawing, and (3) Discussion.
(1) Introduction. During this section, we introduced the results from the first workshop to the participants. In addition, the researcher explained the purpose and procedures of this workshop, and collected informed consent. This part lasted for around 10 min.
(2) Map Drawing. To clearly understand the actions and patterns of freshmen and to spot similar activities and events, we arranged a 10-min session for participants to map out their daily routes on the XJTLU campus map (see Fig. 1a–c). Then, we invited them to describe their daily lives based on their routes and locations for around 25 min.
(3) Discussion. The discussion lasted for 45 min. We superimposed the potential solutions proposed in the first workshop onto the map and invited participants to add more ideas related to the map in terms of the physical environment, academic affairs, social activities, and information access of XJTLU. Finally, we categorized different kinds of events with color codes, and summarized different forms of game solutions (see Fig. 1d–e).

Results. After the Map Drawing section, we gained some information about the participants' campus life. For example, most of the participants had lectures to attend in

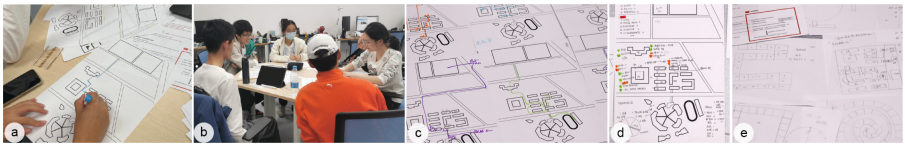

Fig. 1. Second participatory design workshop. Participants (a) drawing routes on the university map, (b) discussing their daily lives based on the routes and locations, (c) routes drawn by participants, (d) notes of questions, events, and tips about the physical environment, academic affairs, and (e) exploration on various forms of game solutions.

the Foundation Building (FB) and the Science Building (SA, SB, SC, SD) (as shown in Fig. 1c). This information could be considered in the subsequent game design. Moreover, participants confirmed the importance of the WeChat official account to provide tips on accessing information, the necessity for students to use email, and the feasibility of using board games as a medium to deliver faculty information—WeChat is the most popular instant messaging and social media network application. Participants agreed that board games promote engagement and communication among players. Thus, we ultimately chose to use a board game to better help students be familiar with the campus environment, including building locations and facility usage.

During the Discussion section, we explored two map design alternatives for connecting buildings and creating game routes. We compared two forms of routes and spots and ultimately chose the second form, as it was reported to reflect the events on the map in a visually simplistic way, allowing the placement of activities and questions next to the relevant buildings with more flexibility and regularity. We also explored two ways of game control: spinning a wheel and rolling a dice. Compared to spinning a wheel, participants preferred to move to points set up on the route by rolling a dice. This allowed users to have interactions around the buildings and maintain a sense of uncertainty.

The mechanics setup for this game was based on the possible solutions from the first workshop and was supplemented in the second workshop. The specific extension process of the game mechanics has been demonstrated in Fig. 2. The events and activities identified by participants were grouped into *Question* and *Event* on the map, highlighted in green and orange, respectively. In addition, the discussion showed that the happy moments and survival guides can be categorized by their emotion states, where the positive events (e.g. winning a scholarship) were included in the *Chance* cards, and the negative events (losing the student ID card) were included in the *Accident* cards. Based on the above results, we came up with the initial design of the board game, Easy Induction: XJTLU Adventure for Freshmen. The format of the game is similar to the *Monopoly*[2], where 3–8 players will be divided into two groups, each group will work together to gain or lose credits and building cards via various actions throughout the game. The first group to collect all the building cards wins.

Overall, the second participatory workshop allowed us to define the problems and develop an initial design to solve the problems. It yielded results in following:

[2] https://en.wikipedia.org/wiki/Monopoly-(game).

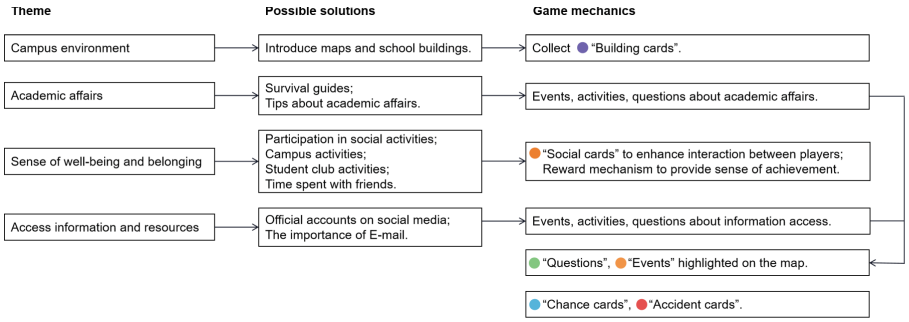

Fig. 2. Game mechanics extended from possible solutions of design goals.

1. Since participants agreed that board games could promote their engagement, we decided to incorporate a board game into XJTLU.
2. Building on the results of the first workshop, we expanded the related content about academic affairs, social activities, and information access, and developed the game mechanics.
3. Based on the information added by the participants, we finalized the map and route design, and identified three types of cards (*Social*, *Chance*, and *Accident*) and two types of activities (*Event* and *Question*).
4. A low-fidelity prototype was created based on the results obtained so far.

4.3 Third Participatory Design Workshop: Deliver

In the third participatory design workshop, we focused on testing, evaluating, and iterating the game design, with a specific emphasis on delivery. This workshop included a series of short discussions with stakeholders, who evaluated the prototype design and provided suggestions.

Evaluating the Low-Fidelity Prototype. We invited four participants (3 males, 1 female, aged between 18–22, $M = 19.25$, $SD = 3.58$) to test a low-fidelity prototype produced by the second workshop. Participants suggested that the annotations on the map appeared disorganized (P1, P2, P3, P4), and the annotations reduced the sense of surprise and randomness of the game (P2, P4). Therefore, we decided to move the annotations to a script held by the game host.

Improving the Low-Fidelity Prototype. According to the user feedback, we proposed two types of map spots with accompanying scripts. Map spots of different colors trigger different actions. The blue, red, orange, and green spots represent the drawing of a *Chance* card and an *Accident* card, and the encountering of an *Event* and a *Question*, respectively. The white spots do not trigger any action. In *Type A*, each spot was assigned a unique number. As for *Type B*, on the other hand, we only assigned numbers to spots of *Event* and *Question*, and mapped them to the host scripts.

Evaluating the Improved Low-Fidelity Prototype. For the two types of spot and script forms, we invited six participants (3 male, 3 female, aged between 18–21, M = 18.83, SD = 1.34) to conduct another user test. The results showed that *Type B* was preferred because of its simplicity and clarity. The cluttered numbers in *Type A* confused participants, who tended to follow the numbers consecutively, even though they could move in any direction. However, participants were also confused when they saw identical numbers in different colors in *Type B*. To address this issue, we replaced the numbers on the *Question* spots with letters to distinguish them from the *Event* spots.

Developing the Mid-Fidelity Prototype. Based on the results from the two workshops and the participant feedback in the iterative evaluations, we improved the design and produced a mid-fidelity prototype with enhanced game content, including cards, events, and extended maps. 5 participants (3 male, 2 female, aged between 18–21, M = 18.80, SD = 1.70) evaluated the mid-fidelity prototype and confirmed that the content in the game design was clear and easy to understand. They only suggested that the visual appearance of the map and the cards need to be improved.

5 Design Outcome: Easy Induction

5.1 Game Presentations

The final map design was optimized for visual appeal (see Fig. 3a) The visual effects of the mid-fidelity prototype's cards were also optimized (see Fig. 3b–d). Graphical design in a flat style was also utilized for the buildings (see Fig. 3e). The final prototype of game board, cards, and accessories brought visual aesthetic experience to users (see Fig. 3f–i). The game board was made of KT board, with a size of 841 mm × 594 mm. The building pieces were made of wood. The total cost of the board game was around 20 USD.

Fig. 3. Digital graphics view of the (a) map, (b) social cards, (c) accident cards, (d) chance cards. Photos of physical prototype showing the (e) building cards, (f) game board with accessories, (g) building cards, (h) Accident, Chance, and Social cards, and (i) pawns and tokens.

Some participants gave suggestions that it would be more cheering if there was a celebration session at the end of the game, using emerging technology such as

Augmented Reality (AR). Therefore, we combined AR at the end of our game. Upon completion of the game, players who collect all building cards can exchange their paper cards for wooden building pieces and place them in their corresponding locations on the map. They can then use their smartphones to scan the map and view the celebratory AR effects (see Fig. 4).

Fig. 4. AR celebration at the end of the game could provide a sense of achievement and a celebratory game atmosphere.

5.2 Rules of Easy Induction

Players. The game can include 3–8 players. Every player receives 10 tokens at the beginning. One player can act as the host to lead the game and give instructions. The rest of the players are divided into 2 teams.

Objective. Players' objective is to collect all building cards as fast as possible while earning tokens. If anyone loses all the tokens, he or she will be out. The team who collects all building cards first will win. The winning team could exchange the paper cards of the buildings on wooden boards and put them in the corresponding places on the map. This will trigger the AR celebration, the effect of which was unknown to the players.

Equipment. The equipment consists of a board, a dice, several pawns and tokens (see Fig. 3i). There are 7 Chance cards, 7 Accident cards, 8 Social (interaction) cards, and 19 Building cards.

Preparation. Place the board on a table and put the Chance cards, Accident cards, and Social cards face down on their allotted spaces on the board. Each player chooses one pawn to represent them and move on the board.

Rules. On each turn, the active player rolls the dice and moves their pawns to the same number of spots. When there is more than one way to go, the player can choose the direction freely.

Building. Players can gain the building cards when they stop in buildings.

Event. When they stop on orange spots, the host will read the instruction according to the script, in which the player may gain or lose tokens depending on the event.

Question. When players stop on green spots, they have to answer the question, if correct, they can win one token; otherwise, they will lose one token.

Chance. When players stop on blue spots, they should draw a Chance card. The player may collect extra tokens or win a building card. For example, *"Gained scholarship, +3 tokens"*; *"Participated in club activity, +1 token"*; and *"Lucky guy, you can win a building card"*.

Accident. When players stop on red spots, they should draw an Accident card. The player may lose their tokens or get a penalty. For example, *"You lost your ID card, –1 token"*; and *"You got lost in the building, pause for one turn"*.

Social. When two or more players stop at the same spot, they should draw a Social card and discuss the given topic. For example, *"Talk about your favorite sport/ music/ book"*.

6 Evaluating Easy Induction

6.1 Study Design

We evaluate the serious game in three aspects: knowledge acquisition, usability, and user experience. Pretest and post-test questionnaires were applied to measure participants' knowledge acquisition. The System Usability Scale (SUS) [2] was applied to measure the system usability of the game. The User Experience Questionnaire (UEQ) [23] was applied to measure user experience from six dimensions: attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. A total of 14 students from XJTLU (9 males and 5 females) participated in the user evaluation and we coded them from P1 to P14, including 6 freshmen and 8 junior students. Their ages are ranged from 18 to 25 (M = 20.29, SD = 4.68).

6.2 Experimental Procedure

The evaluation procedure starts with the study briefing and a pretest questionnaire, followed by a gameplay session with instructions from the researcher, and a post-test questionnaire and debriefing. Participants were encouraged to provide their comments and suggestions during the post-tests. The experiment lasted for about 50 min on average.

6.3 Measures and Scoring

Pre-Test and Post-Test. The pre-test consisted of 15 questions. There were 5 questions related to the university's physical environment (e.g. *"Where is the university museum?"*); 5 questions related to academic affairs (e.g. *"What will happen if you submit your coursework late?"*), and 5 questions related to information access (e.g. *"How to make an appointment for counseling service?"*). The same questions were asked again after the gameplay in the post-test. For each question, participants scored 2 marks if correct, 1 mark if partially correct, and 0 marks if they did not know the answer or provided a wrong answer.

System Usability Scale (SUS). The SUS includes ten questions rated on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Following the scoring procedure suggested in [2], we get a score ranging from 0–100, where a SUS score above 68 is considered above average, and anything below 68 is below average.

User Experience Questionnaire (UEQ). The UEQ measures the user experience of a system or product's attractiveness, pragmatic quality (efficiency, perspicuity, and dependability), and hedonic quality (stimulation and novelty). It includes 26 items, rated from –3 (horribly bad) to 3 (extremely good). Values between –0.8 and 0.8 represent a neural evaluation of the corresponding scale, values greater than 0.8 represent a positive evaluation, and values smaller than –0.8 represent a negative evaluation.

7 Results

Data collected from the evaluation study was analyzed in this section. It comprises three parts: participants' knowledge acquisition before and after the experiment, the system usability scale, and the user experience questionnaire.

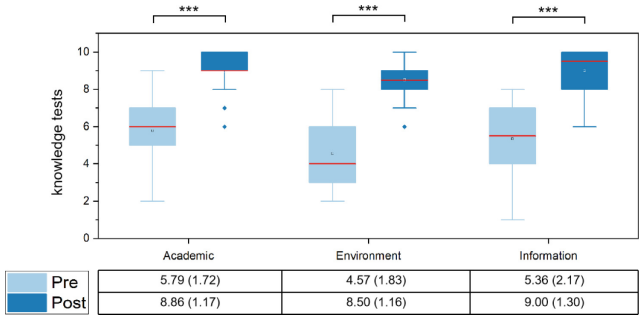

Fig. 5. Box plots and means (with standard deviations) for the comparison of pre-test and post-test. $***p < 0.001$.

7.1 Knowledge Acquisition

We calculated participants' scores on knowledge tests related to the physical environment, academic affairs, information access, and the total scores before and after playing the board game. We conducted Shapiro-Wilk tests to assess the normal distribution of data. For normally distributed data, paired-samples T-tests were conducted to identify significant differences (see Fig. 5).

Physical Environment. Results from the Shapiro-Wilk test indicated that both environment pre-test ($W = 0.920, p > 0.05$) and environment post-test ($W = 0.909, p > 0.05$) were normally distributed. Paired-samples tests demonstrated a significant improvement in participants' knowledge acquisition of the environment before and after playing the board game ($t(13) = -6.577, p < 0.05$), with a higher mean score in the post-test. These findings suggest that the serious board game significantly enhanced freshmen's familiarity with the environment and locations of XJTLU.

Academic Affairs. Shapiro-Wilk test revealed that academic pre-test ($W = 0.944, p > 0.05$) conformed to the normal distribution. However, the data of academic post-test ($W = 0.801, p < 0.05$) was not normally distributed. Thus, related-samples Wilcoxon signed rank test was used to analyze the data. The results in Fig. 5 showed a significant difference in the participants' knowledge acquisition of academic affairs between before and after playing the board game ($z = 3.190, p = 0.001$). Moreover, the mean of post-test was significantly higher than the pre-test. The results indicate that the serious board game effectively enhanced freshmen's understanding of XJTLU's academic affairs.

Information Access. The normality test indicated that the data of information pre-test ($W = 0.916, p > 0.05$) conformed to normal distribution, whereas the data of information post-test ($W = 0.790, p < 0.05$) did not. Therefore, a related-samples Wilcoxon signed rank test was conducted, and the results showed a significant difference in the participants' knowledge acquisition of information access before and after playing the board game ($z = 3.194, p = 0.001$). These findings suggest that the board game enhanced freshmen's abilities to access information and utilize resources at the university.

Overall Performance. The Shapiro-Wilk test showed that both the total pre-test ($W = 0.958, p > 0.05$) and total post-test ($W = 0.925, p > 0.05$) data conformed to the normal distribution. Paired-samples t-test showed a significant improvement in participants' total knowledge about XJTLU, including physical environment, academic affairs, and information access, before and after playing the board game ($t(13) = -9.427, p < 0.05$). The post-test mean was also significantly higher than the pre-test mean. These results demonstrate that the serious board game effectively helped freshmen familiarize themselves with the campus and its resources.

7.2 System Usability Scale

The SUS was utilized to assess the system usability of the board game. Figure 6 presents the scores for the ten SUS questions from the 14 participants. The mean value of the SUS score was 73.6, which surpassed the average SUS score of 68, indicating that the board game performed well in terms of system usability, with potential for further improvement.

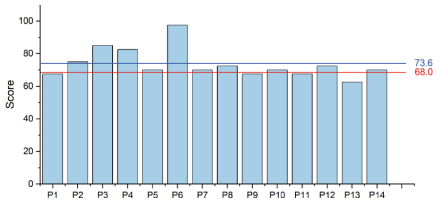

Fig. 6. The SUS scores provided by all participants. The blue line is the mean value of our SUS score (73.6), and the red line is the SUS reference score (68). (Color figure online)

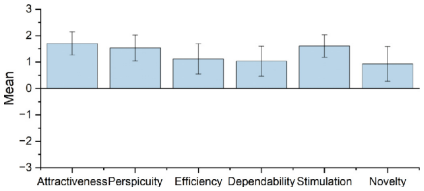

Fig. 7. The means of scale of attractiveness, perspicuity, efficiency, dependability, stimulation and novelty.

7.3 User Experience

The UEQ data analysis toolkit was employed to obtain analysis results. The results of the user experience evaluation demonstrated a positive evaluation on all scales (see Fig. 7b). An initial analysis indicates that the values of attractiveness (1.70), stimulation (1.61), and perspicuity (1.54) exceeded 1.5, nearly double the value of 0.8, suggesting that the serious game performed well in these aspects. In contrast, the values of novelty (0.93), dependability (1.04), and efficiency (1.13) were around 1, slightly higher than 0.8, indicating that the product has potential for improvement in these areas.

In order to get a better picture on the quality of a product, the measured user experience of the game was compared with the results of other established products, from a benchmark data set offered by UEQ, which contains the data of 452 product evaluations with the UEQ. In terms of attractiveness and stimulation, our product performed well, ranking the top 25% to 10%. Perspicuity, efficiency, and novelty were above average, ranking the top 50% to 25%. However, dependability was below average, with 50% of results being better and 25% of results being worse. In summary, our product performed well in attractiveness and stimulation, and above average in perspicuity, efficiency, and novelty. The only area that requires improvement is dependability, which suggests a need to enhance users' sense of control during interaction with the product.

Based on the evaluation experiment and quantitative data analysis, it was found that the serious board game effectively addresses the design goals. Specifically, the game assists freshmen in becoming familiar with the environment and locations of XJTLU, enhancing their knowledge acquisition of XJTLU's academic affairs and improving

their ability to access and use university resources. Moreover, the overall user experience and system usability showed positive results. While the game was found to be attractive, stimulating, and clear, there is room for improvement in terms of novelty, dependability, and efficiency.

8 Discussion

8.1 Summary of Findings

Knowledge Acquisition, Usability, and User Experience. Our serious game board design was found to have significantly improved students' learning about the university's physical environment, academic affairs, and information access. They also enjoyed the social activities during the gameplay, showing that the four design goals were satisfied. The system usability was above the suggested threshold value, indicating good usability. The user experience questionnaire showed that our game performed well except for dependability, and we could find some reasons from participants' comments in the post-test. P1 mentioned that *"When I play the game, I am not sure what will happen next. The game events are a bit random"*. P2 also mentioned that *"The game is not that predictable, but this increases the sense of surprise"*. Other participants also commented that randomness is an acceptable property for a board game. Combing the feedback, we will enhance users' sense of control in the future, such as adding icons to suggest related events on the map.

Perceived Value of the Serious Board Game. During the gameplay, we observed joyfulness and positive emotions from participants. At the end of the evaluation study, they also expressed happiness and a sense of competition and cooperation while playing the board game. Participants reported that they tried their best to step into the buildings to get the building cards, which required them to weigh several paths and different directions. They also expressed that the events were just like real events that happened in their daily life. Playing the board game can trigger their empathy, especially when moving on the map, and encountering some events or activities also reminds them of their memories. Participants found the board game valuable since they learned lots of knowledge and tips about XJTLU through the questions. This was not only supported by the freshmen, but also the senior students. When players were not sure about the question they met, their teammates would always think together and try to give some hints. The process was found engaging and can improve the interaction between players. At the end of the experiment, one participant even asked if he can get a copy of the question scripts, because he thought these tips and answers were really helpful. We thus conclude that the board game is useful and meaningful for not only freshmen, but also senior university students.

Game Duration. In the experiments, it was found that the game duration and pace are related to the number of players. For example, when there were only 2 players, they collected all the building cards in 20 min, while in another test with 6 players, the increased time in rolling dice, encountering events and questions, and social card activities have

slowed down the game pace. If there are more players, they may step on the same spot, so they have the chance to draw a Social card to interact and communicate with each other about their hobbies, which will take longer time and slow down the game pace. Further experimentation is needed to identify the most appropriate time limitation and game mechanics in the future.

8.2 Research Implications

The research methods employed in this study can be extended to other universities, educational institutions, and other groups and organizations. As the issue of induction is prevalent in universities worldwide, participatory design workshops that involve stakeholders such as freshmen, senior students, and teaching fellows can be organized to discover and define problems, develop solutions together, and deliver them. The evaluation and testing of the serious board game in this study demonstrated its potential to enhance students' knowledge about the environment (DG1), academic affairs (DG2), and information access (DG4) while also promoting a sense of well-being and belonging through communication and interaction with peers (DG3). Therefore, our research implicate that serious board games have huge potential to contribute to student engagement in other educational institutions and facilitate learning through play.

8.3 Limitations and Future Work

First, the workshop series' limited sample size and participant number may have resulted in incomplete data collection. The workshops included mainly freshmen students, considering that they are the main target users. However, our results suggested that the game design was also perceived as valuable by senior students. To improve this, future workshops should consider increasing the sample size and involving more senior students and teaching fellows in the co-design process to offer more beneficial suggestions and tips for freshmen. Additionally, administering questionnaires or directly requesting freshmen to provide written feedback on university-related issues could enhance the efficiency of data collection. Second, a participant (P5) from the design school, who paid special attention to the color code, suggested that the colors of "Events" and "Social cards" were very similar, which was rarely noticed but may cause confusion to some rigorous players. The color of "Social cards" could be changed to distinguish it from other components, such as purple or pink. Third, participants reported that the AR celebration is an interesting and novel mode, which provided them with a cheering feeling after they collected all the building cards. It provided them with a sense of achievement. However, they suggested that the content and form of the AR celebration could be improved. Currently, the game can only be completed by scanning the entire map with a phone after placing all building blocks on their corresponding locations, which can be difficult to achieve within a limited time frame. To address this issue, additional AR features can be incorporated into the game, such as allowing players to scan building cards and trigger 3D models of the buildings when they enter a building on the map. They also suggested the AR collection of 3D building models as a game mechanic. This could give players a better understanding of the physical

environment of XJTLU. Future improvements in the AR content and form can also be explored.

9 Conclusion

In this paper, we present the development and evaluation of a serious board game, Easy Induction, aimed at facilitating freshmen's adaptation to the academic and social life at XJTLU. The game was designed through a participatory design process that involved stakeholders from the university, in a total of three workshops. The purpose of the game was to enhance freshmen's sense of well-being and belonging, and the level of engagement with the university, by providing a fun and interactive tool for learning about the university physical environment, academic affairs, and information access. To evaluate the effectiveness of the game, we conducted both quantitative and qualitative analyses. Specifically, we compared participants' knowledge acquisition before and after playing the game, and gathered feedback through the system usability scale and the user experience questionnaire. The results indicated that the game significantly improved freshmen's understanding of the university's academic affairs, enhanced their abilities to access information and resources, and helped them become more familiar with the campus environment and facilities. Overall, the findings of this study contribute to the growing body of research on gamification and serious games in educational contexts, and provide valuable insights for designing and implementing effective interventions for supporting students' academic and social integration in universities. We hope that this work will inspire further exploration and innovation in this area, ultimately leading to enhanced student experiences and success.

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