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Exploring problem-based learning curricula in the metaverse: The hospitality students' perspective

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ABSTRACT

As the metaverse has been introduced into the education sector, higher education institutions have further promoted metaverse platforms for implementing problem-based learning (PBL) to enhance students' competencies. This research explored hospitality students' experiences of a PBL curriculum using grounded theory to understand the educational effect of PBL in the metaverse. The findings indicated that while participants were fascinated by the fact that the metaverse platform had novel features and functions with the creation of virtual space, they faced difficulties in using it due to linguistic and technical limitations in class. However, the participants actively participated in collaboration with the group members as their willingness to adhere to the lessons grew. Therefore, the core category was derived as "enhancing learning effectiveness through active participation in changing educational environments." Based on the research results, this study provides theoretical and practical foundations to create innovative and effective PBL educational environments in the field of hospitality education.

1. Introduction

The hospitality industry, which contributes greatly to most countries' GDPs (Gursoy, Rahman, & Swanger, 2012), nowadays requires competent people who have problem-solving skills as well as creative and critical thinking to deal with rapidly changing business circumstances (Dawson & Titz, 2012; Huang, 2005; Nadda, Arnott, & Sealy, 2022). Accordingly, many higher education institutions such as universities and colleges worldwide have introduced problem-based learning (PBL) to equip students with the personal qualities and skills desired by future employers in the hospitality industry, steering away from a traditional educational approach focusing on lecture-based learning (LBL) (Boer & Otting, 2011).

PBL is one of the active, student-oriented learning methods that emphasizes self-directed learning and small group work (Galvao, Silva, Neiva, Ribeiro, & Pereira, 2014; Sangestani & Khatiban, 2013). Students can enhance personal and professional competencies such as problem-solving skills, communication ability, collaborative skills, and knowledge related to their future careers through group participation in the PBL process (Boer & Otting, 2011). Thus, PBL is being increasingly recognized as a superior learning strategy in encouraging students to become self-directed learners by enhancing intrinsic motivation (Kivela & Kivela, 2005; Nadda et al., 2022) and is in the spotlight in hospitality education for developing future professionals (Boer & Otting, 2011; Clausen & Andersson, 2019; Hsu & Li, 2017; Zwaal & Otting, 2015).

However, the COVID-19 pandemic has caused serious disruptions in implementing PBL in higher education institutions. Given the

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transition to non-face-to-face classes through online learning applications, students have lacked the opportunity for cooperative learning activities such as PBL (Williams, 2022). Thus, universities have adopted metaverse platforms such as Zepeto, Roblox, Gather Town, and Fortnite for implementing PBL to overcome educational crises and enhance students' performance in cooperative learning activities and tasks (Tlili et al., 2022). Metaverse, which is an immersive digital environment that interacts with others through virtual representations called avatars (Suh & Ahn, 2022), can expand students' learning opportunities by enabling abstract or impracticable education and training in the real world through the convergence of various technologies (Dwivedi et al., 2022). Furthermore, the metaverse provides educational settings beyond time and space constraints, allowing for student-centered collaboration (Almarzouqi, Aburayya, & Salloum, 2022; Barry et al., 2015).

In particular, as the metaverse plays a complementary role between traditional face-to-face learning and online learning based on video conferencing platforms, e.g., Zoom, Webex, Google Meet, MOODLE, Adobe Connect, and Teams (Barry et al., 2009, p. 6066), PBL is more effective in the metaverse than classroom or video conferencing platforms (Latulipe & De Jaeger, 2022; Mustafa, 2022). Accordingly, since the metaverse is considered a medium for sustainable education for PBL (Park & Kim, 2022), research on students' experiences of metaverse-based PBL has been recently conducted in educational fields (Barry et al., 2009, p. 6066; Choi, 2021; Jovanović & Milosavljević, 2022; Latulipe & De Jaeger, 2022; Nunes et al., 2017; Pellas & Peroutseas, 2016), but hospitality students' experiences have yet to be examined in depth.

Thus, the purpose of this research is to explore hospitality students' experiences of the metaverse-based PBL curriculum to understand the educational effect of PBL in the metaverse. More specifically, this study investigates how hospitality students perceive and participate in the metaverse-based PBL curriculum, what difficulties they experienced in the curriculum, and what efforts they made to overcome the difficulties. This study provides theoretical and practical foundations for creating innovative and effective PBL educational environments in the field of hospitality education.

2. Literature review

2.1. Metaverse in education

The metaverse can be defined as a virtual reality existing beyond reality (Kye, Han, Kim, Park, & Jo, 2021) or a three-dimensional virtual space that emphasizes social connections or interpersonal relationships (Gursoy, Malodia, & Dhir, 2022). The concept of the metaverse, which is a compound word of "meta" meaning transcendence or virtuality and "universe" referring to the world, was first coined in 1992 in the science fiction novel *Snow Crash* by Neal Stephenson who is an American novelist (Tlili et al., 2022). The metaverse is continuously becoming more and more advanced as an integrated space that links the real and virtual worlds (Yu, 2022).

The metaverse enables collaborations, interaction, and immersion experiences that play an instrumental role in the socialization of an individual (Schlemmer & Backes, 2015). Users can interact socially, generate value, and co-create experiences using digital avatars in the metaverse (Gursoy et al., 2022). Users can also experience shopping, performances, exhibitions, traveling, flights, and cooking in an entirely virtual manner with a high level of presence and immersion through metaverse platforms (Gursoy et al., 2022; Koo, Kwon, Chung, & Kim, 2022) because the metaverse can transform unrealizable or infeasible experiences due to physical constraints into sensorial and realistic experiences that can satisfy sight, hearing, smell, taste, and touch (Buhalis, Lin, & Leung, 2022; Kye et al., 2021).

The metaverse has been introduced into daily life rapidly and is further promoted in the education sector (Kye et al., 2021). A metaverse can provide students with immersive learning opportunities that strengthen their learning motivation by creating the sense that they are in a real classroom in a virtual one (Tlili et al., 2022). Thus, metaverse-based education can produce positive learning outcomes for students. For instance, Sung, Mergelsberg, Teah, D'Silva, and Phau (2021) showed that students' higher level of immersion as well as attitudes and enjoyment of learning were higher in metaverse-based classes than in traditional learning methods. In Fitria (2021)'s study of students' perception of online English language learning via Gather Town, students felt like they were in a real classroom when they were in a virtual classroom, and they perceived increased interaction with educators and other students. Latulipe and De Jaeger (2022) found that students preferred the Gather Town class to Zoom as Gather Town offers social connection, a fluid switch between private and public discussions, fun, and a sense of place. Studies have shown that the metaverse is an effective educational tool that can facilitate learners' learning more effectively than traditional face-to-face instruction or e-learning using video conferencing platforms.

Students do not always have positive experiences in metaverse-based classes in spite of the advantages associated with achieving students' learning outcomes in the metaverse. Students expressed operable or technical difficulties such as poor Wi-Fi in metaverse-based classes (Barry et al., 2009, p. 6066; Latulipe & De Jaeger, 2022). Furthermore, Kye et al. (2021) argued that the metaverse can lead to the possibility of weaker social connections, maladjustment to the actual world, and privacy impingement for students whose identity has not been formed. In spite of the limitations of the metaverse in the education sector, most of the previous research indicated that students' positive learning experiences achieved through metaverse-based education far outweigh minor technical difficulties.

2.2. Problem-based learning

PBL refers to "an instructional method within transformational learning theory that applies learning to complex problem-solving contexts" (Freund, Iñesta, & Castelló, 2022, p. 3). The ultimate goals of PBL are to promote intrinsic motivation, flexible knowledge, self-directed learning skills, collaboration skills, and problem-solving skills (Hmelo-Silver, 2004). PBL has the characteristic that students form small groups to identify and address complex and multifaceted problems through collaboration and discussions with

fellow students in small groups (Mennin, Gordan, Majoor, & Osman, 2003; Slavich & Zimbardo, 2012).

In PBL, educators act as learning facilitators to guide learning by offering encouragement and feedback to learners, rather than knowledge providers that emphasize the explanation and delivery of topics (Freund et al., 2022). On the other hand, students play the roles of learners and educators at the same time (Mennin et al., 2003). Accordingly, PBL is more effective than LBL, which focuses on learners' memorization and simple acquisition of knowledge through educators' verbally transmitting information directly to learners (Ding et al., 2014; Zahid, Varghese, Mohammed, & Ayed, 2016), in developing students' learning satisfaction, academic motivation, knowledge acquisition, and breadth of interest (Faisal, Bahadur, & Shinwari, 2016; Hwang & Kim, 2006; Sangestani & Khatiban, 2013; Wong & Day, 2009).

PBL was first implemented in the medical education sector in the 1960s (Faisal et al., 2016). However, since then, PBL has been widely applied to various teaching settings including sport and exercise science, nursing, engineering, tourism, and hospitality. A wide range of literature maintains that PBL has a positive effect on learning outcomes along with learners' higher-order thinking and various skills. For instance, Martin, West, and Bill (2008) found that sport and exercise science students considered that knowledge and intrinsic motivation increased by working in cooperation with teams in PBL classes. Ding et al. (2014) showed that PBL improved students' higher theoretical examination scores, learning attitude, collaborative skills, self-directed learning skills, and problem-solving skills. Similar to the above studies, in Choi, Bae, Shin, Shin, and Lee (2022)'s study that verified the learning effect of PBL in dental hygiene education, PBL-based classes improved students' self-efficacy and problem-solving ability. In conclusion, PBL is an effective learning method to enhance students' flexible knowledge and various skills including communication, self-directed learning, problem-solving, and collaborative skills.

2.3. PBL in the online environment

Due to the successful educational effect of PBL, research on PBL has recently expanded to an internet-based environment. Prior research demonstrated that an online approach to PBL has as much educational effect as a classroom-based approach. Şendağ and Odabaşı (2009) discovered that engaging PBL via MOODLE helped students improve their critical thinking skills. Ng, Bridges, Law, and Whitehill (2014) found that undergraduate speech/language pathology students perceived that distance learning PBL was a time-efficient learning method while maintaining pedagogical quality. Wong and Kan (2022) identified that online PBL via Blackboard Collaborate Ultra, Zoom, and WhatsApp led to improved students' knowledge, problem-solving skills, and self-directed learning skills. However, online education for PBL using video conferencing systems is not very different from the existing face-to-face PBL (Park & Kim, 2022) and makes students boring (Fitria, 2021).

More recently, some researchers have attempted to evaluate the educational effect of PBL in a virtual environment. Nunes et al. (2017) showed that metaverse-based PBL enhanced students' learning motivation and immersion in class. Jovanović and Milosavljević (2022) verified the effectiveness of the metaverse system VoRtex for educational purposes. Through the use of avatars, users felt as if they were in a video game, enabling them to learn more efficiently and effectively. Choi (2021) found that students' creative thinking was strengthened by thinking and imagining in various directions while conversing with their group members. Furthermore, the students replied that the experience of solving problems by collaborating with the group members they met for the first time was very fun and helped them develop a cooperative spirit.

Although an extensive body of research has demonstrated positive learning experiences for students from PBL, there is also some research that indicates difficulties and limitations in the process of PBL. For instance, Dennis (2003) showed that the students group participating in online PBL spent more time-on-task than the face-to-face PBL group. Similarly, Spronken-Smith (2005) found that students suffered from difficulty dealing with group dynamics as well as increased workload and time. Hussain, Mamat, Salleh, and Harland (2007) demonstrated that students had difficulty adjusting at the beginning of PBL class. In Foo, Cheung, and Chu (2021)'s study, which compared skill acquisition scores according to a type of PBL, the skill acquisition scores of students who participated in face-to-face PBL were higher than those who participated in online PBL. Consequently, students can be more stressed in online PBL classes than in traditional classrooms since they need time to become familiar with and adapt to changing learning environments and methods.

While diverse research on students' learning experiences and outcomes in PBL has been investigated, most research tends to focus on face-to-face PBL or online PBL using video conferencing platforms. Accordingly, there is a dearth of empirical data on hospitality students' academic experiences in metaverse-based PBL. To understand how hospitality students experience metaverse-based PBL, we need to explore hospitality students' cognitive and affective experiences, educational strategies, learning outcomes, and practical implications in more depth.

3. Methodology

This study employed grounded theory, which was first introduced by Glaser and Strauss (1967), to gain more insight into the students' experiences with metaverse-based PBL. Grounded theory is a qualitative methodology for "systematically collecting and analyzing data about a phenomenon through discovering, developing, and testing theories from the data" (Zhang et al., 2022, p. 6). Many researchers have adopted this approach to understand students' learning experiences comprehensively and systematically (Castanelli, Weller, Molloy, & Bearman, 2022; Deepa, Sujatha, & Mohan, 2022; Miles, 2018; Zhang, Ye, & Wang, 2022). As Strauss and Corbin (1990) noted, grounded theory is suitable for less explored research domains. Since research on students' experiences of metaverse-based PBL is insufficient, it is expected to provide a rich and contextualized understanding of students' experiences of metaverse-based PBL through meticulous analysis processes.

3.1. Problem-based learning (PBL) class using Gather Town

PBL is a student-centered approach in which students learn about a subject by working in groups to solve an open-ended problem. Students come up with solutions based on individual learning and cooperative learning, and focus on realistic and authentic problems. Gather Town is a virtual meeting platform with various functions of chatting, interworking with external links, and building spaces (Kye et al., 2021). As the platform offers tailored support for educators to design specific learning spaces that can be communicated between groups (McClure & Williams, 2021), it has been gaining attention in the field of metaverse-based education (Fitria, 2021; Zhao & McClure, 2022).

An author of the current study lectured on the course of PBL applying Gather Town during the first semester in 2022 for second-year students at a university in Suwon, South Korea. As the aim of the curriculum was to train and educate restaurant management experts by applying the learned theory, the course was designed to allow students to practice the restaurant operation plan in the group. As shown in Fig. 1, the author created classrooms including a lecture hall and group class similar to those in the real world with desks and chairs. Furthermore, various virtual spaces including mini game rooms, gardens, kart racing, and swimming pools were organized so that students could use them during break time (Fig. 2). Students cooperated in groups to select and decorate menus, furniture, kitchen appliances, and so on for restaurant operations based on creative ideas in the virtual space.

The participants in this study were 24 college students taking the Restaurant Management course in the Division of Hotel & Tourism. A total of six groups with four students per group participated in the Gather Town PBL class. None had any prior experience using the Gather Town platform. Therefore, an orientation of two lectures and practice sessions was offered on how to use Gather Town. The first discussed Gather Town utilization guide, and the second described the Gather Town map build function. PBL classes using Gather Town were held on Tuesday of every week for four weeks from March 15 to April 5, 2022. In the first class of Gather Town, the participants learned about restaurant brand concept development; in the second, dining space design; in the third, menu development; and in the fourth, human resource management and marketing communication.

Each class was split into three parts and lasted a total of 3 h. The first part was an online lecture by a professor in the Gather Town classroom (Fig. 1). After the lecture, the professor conducted an O/X quiz in the O/X quiz room (Fig. 2b) to check that students understood the content of the lesson. In the second part, in private areas for group learning (Fig. 1) in the Gather Town classroom, the theme of each week was discussed in terms of managing the group's own restaurant. In the third part, the students built their group's restaurant directly inside the Gather Town platform. To create a restaurant, they imported and used either an object that already existed in Gather Town or an image created with an online site design tool. In the project room, a transporter was installed to move to the restaurant space for each group (Fig. 2a). The participants then developed a restaurant brand concept according to the theme, designed a dining space, developed a menu suitable for each restaurant, established a human resource management plan, and determined a marketing communication tool to appeal to customers (Fig. 3).

3.2. Data collection

This study collected data through in-depth interviews, which is the most established data collection method in grounded theory (Goulding, 2005). At the end of the semester, the author explained the research purpose and asked if any students wanted to participate in an interview with the author. Twenty-four students who agreed to participate in interviews with an interview guide participated in the interview. Of the interviewees, 10 were male and 14 were female; eight were hotel management majors and 16 were restaurant management majors. The interviews were conducted in the author's office between June and July 2022 and each lasted approximately 30–45 min. Before the interviews, the participants were provided with a thorough explanation of the purpose and content of the research, following which they signed a consent form to participate in the study. The participants agreed to have their interviews

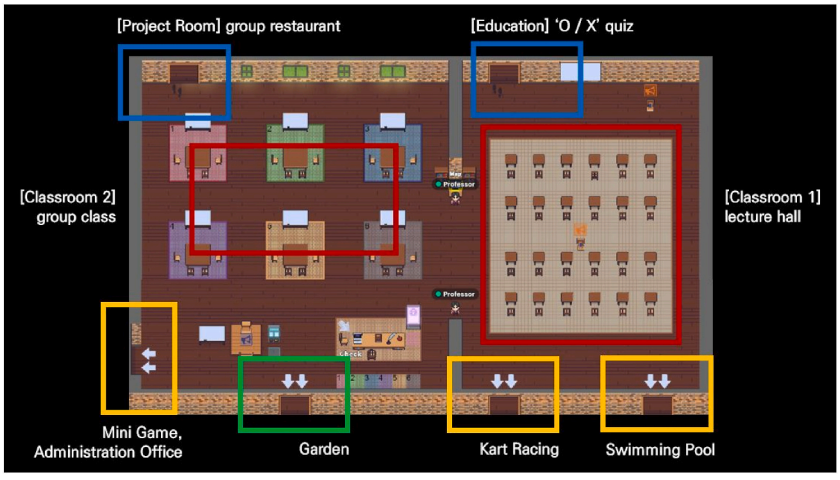

Fig. 1. Created classrooms via Gather Town.

Fig. 2. Gather Town templates used for the class.

audio-recorded, and confidentiality and anonymity were guaranteed. After the interviews, the audio-recorded data were transcribed verbatim for data analysis.

A semi-structured interview was conducted with students who took the metaverse-based PBL curriculum. Before conducting the interviews, the interview guide was developed from the existing literature related to online education and learning including the metaverse (Barry et al., 2009, p. 6066; Fitria, 2021; Latulipe & De Jaeger, 2022). The interview guide using open-ended questions includes: (1) Were you interested in the PBL class utilizing the metaverse platform? (2) If you were interested in the PBL class on the metaverse platform, what is the reason? (3) If you were not interested in the PBL class using the metaverse platform, what is the reason? (4) What were the advantages and disadvantages of the PBL class using the metaverse platform? (5) What were the difficulties in this class? (6) What efforts did you make to overcome these difficulties? (7) What did you achieve through the class? (8) How do you think about the PBL class using the metaverse platform in comparison with a conventional face-to-face learning class or online learning class such as Zoom?

3.3. Data analysis

Corbin and Strauss' (2015) grounded theory approach, which is open, axial, and selective coding, was used to analyze the data collected from the interviews. While open coding is a process of concisely fracturing raw data into concepts, axial coding is a procedure for causally linking concepts using the paradigm model, which is composed of causal, contextual, and intervening conditions, action/interactional strategies, and consequences (Webb & Mallon, 2007). Selective coding is "the process of selecting the core category, systematically relating it to other categories, validating those relationships, and filling in categories that need further refinement and development" (Strauss & Corbin, 1990, p. 116).

The analysis results were reevaluated by the other researcher who did not participate in the coding process. Subsequently, the validity and reliability of the analysis results were ensured by inviting qualitative research experts and interviewees. We received verification of the analysis results from three qualitative research experts with research experience applying grounded theory. We also showed the analysis results to three interviewees and verified whether they were consistent with their experiences.

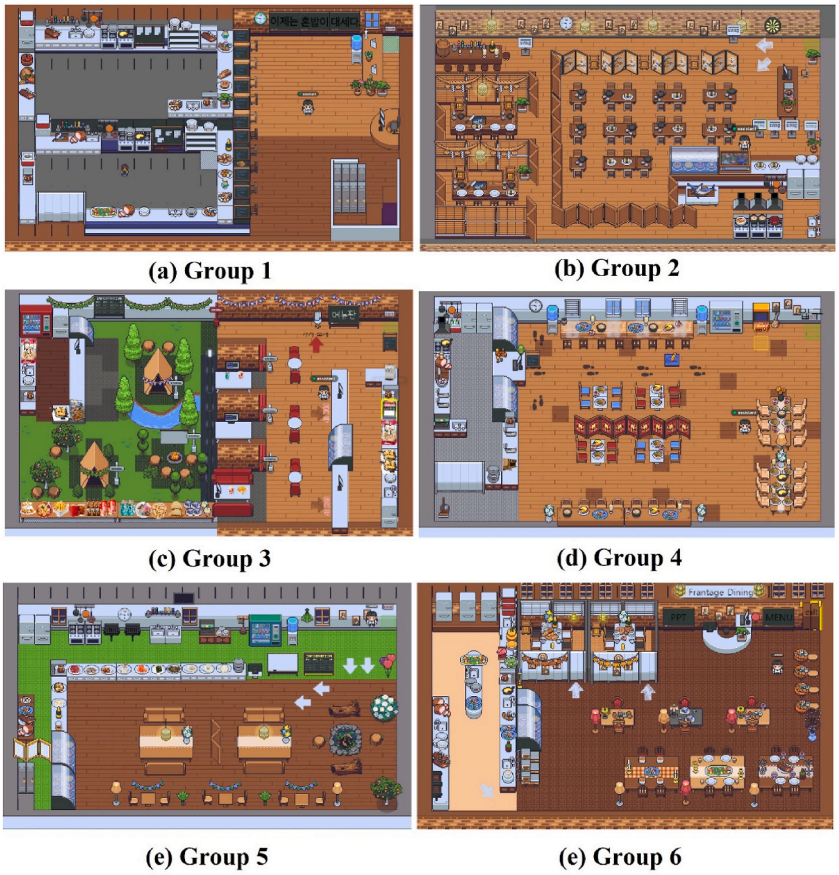

Fig. 3. Virtual restaurant for each group by Gather Town.

4. Findings

4.1. Open coding

In the open coding process, we repeatedly read and compared the transcribed data. Data were organized into concepts, which were then classified into categories and subcategories. The open coding analysis results represented 97 concepts, 18 subcategories, and 7 main categories.

4.2. Axial coding

In the axial coding process, the data were reassembled into the paradigm model, which is composed of causal conditions, contextual conditions, central phenomena, intervening conditions, actions/interactions, and consequences, according to relationships between the main categories. Fig. 4 represents the paradigm model resulting from the interviews on students' learning experiences of metaverse-based PBL.

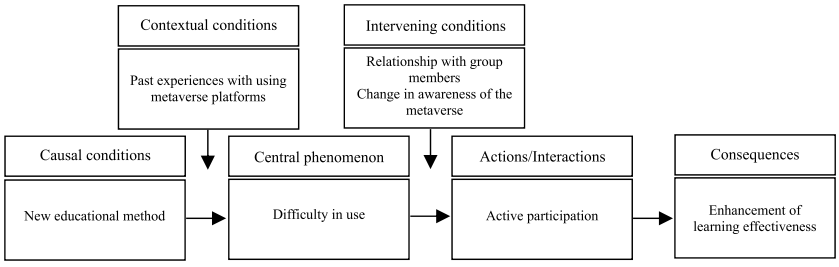

Fig. 4. Paradigm model.

4.2.1. Causal conditions

Causal conditions describe the events that lead to or determine the occurrence of central phenomena (Ashtaria, Darvishib, Bakhshandehc, & Hematid, 2022). The main category of the causal condition is "new educational method" as shown in Table 1. The classes applying metaverse platforms attracted participants, as they created a virtual space and offered diverse and novel features and functions. In addition, participants perceived a clear distinction between the classes applying metaverse platforms and those employing other learning methods such as face-to-face classes, video recording lectures, or Zoom-based classes. These conditions engender "difficulty in use," which is the central phenomenon in this study.

4.2.2. Central phenomena

Central phenomena refer to outcomes caused by the influence of causal conditions (Corbin & Strauss, 2015). The central phenomenon of this study was found to be "difficulty in use" as mentioned in Section 4.2.1. Participants struggled to use metaverse platforms when they had low levels of computer competence. They faced difficulties with the complicated operation methods and linguistic limitations of the platforms, which is available primarily in the English version and even the instructions and advice on using the platforms are in English. Moreover, network or system errors and lack of decorative objects also contributed to the difficulty in use. Participants encountered issues such as network lag, login or logout errors, and a lack of necessary furniture, kitchen appliances, or menus in restaurants. Resultantly, they required significant time to adjust and become proficient in using the metaverse platforms. Table 2 shows the results of the analysis of the central phenomena.

4.2.3. Contextual conditions

The contextual conditions explain the structural conditions that change the influence of causal conditions on the central phenomena (Chen, Yao, Tseng, & Sun, 2022). These contextual conditions have been described as "past experiences with using metaverse platforms." Participants had a limited understanding of the metaverse due to their lack of knowledge and experience with metaverse platforms such as Gather Town, Zepeto, and Roblox. Table 3 details the results of the contextual conditions.

4.2.4. Actions/interactions

Actions/interactions represent possible strategies or routine responses for the purpose of managing or overcoming central phenomena (Corbin & Strauss, 2015). As shown in Table 4, the result of the actions/interactions was "active participation" consisting of subcategories such as "increased enthusiasm for learning" and "cooperative interaction". When participants faced difficulty in using metaverse platforms during classes, they demonstrated their enthusiasm and strong commitment to learning by actively engaging in the class, both for themselves and for their group members. Participants were eager to learn how to operate Gather Town effectively, utilizing resources such as YouTube or the internet for assistance. Participants also had collaborative interactions with their professors, classmates, or group members to solve the problems. In other words, participants actively participated in the class as a strategy to overcome the central phenomenon.

Table 1
Results of causal conditions.

Concepts	Subcategories	Main categories
Creating avatars	Diverse and novel features and functions	New educational method
Designing avatars characters such as skin tone, style of hair, clothing, and accessories		
Moving around a map through avatars		
Chatting through avatars		
Activities through avatars		
Checking attendance through avatars		
Individual as well as group chat		
Video chat		
Screen sharing		
Proximity chat		
OX quiz map		
Various kinds of games		
Supporting the team-based active learning experiences		
Interactive whiteboard		
Creating virtual classrooms	Creation of virtual space	
Creating virtual restaurants		
Creating virtual pool		
Creating a virtual racing room		
Creating a virtual outdoor garden		
Designing virtual restaurants with furniture, kitchen appliances, and menus		
Familiar with Zoom-based classes	Differences from other learning methods	
Familiar with video recording lectures		
Familiar with face-to-face classes		
Feeling bored with Zoom-based classes		
Theory-oriented classes		
One-way teaching without interaction		

Table 2
Results of the central phenomena analysis.

Concepts	Subcategories	Main categories
Limitations for students who are unfamiliar with using a computer	Low levels of competence in computer skills	Difficulty in use
Difficulty adapting for students who have low levels of computer skills		
Providing the English version of Gather Town	Linguistic limitations	
Providing instructions and advice on using Gather Town in English		
Not supporting Korean version		
Network lag	Networks or system errors	
Error of logging in due to network instability		
Logging out due to network instability		
Disappeared implemented virtual space		
Complicated operation method	Incomprehensible operation method	
A lot of time to learn how to use it		
Not easy to learn how to use		
Lack of furniture needed in restaurants	Limitation of decorative objects	
Lack of kitchen appliances		
Lack of kinds of menus		

Table 3
Results of contextual conditions.

Concepts	Subcategories	Main categories
Lack of knowledge of metaverse	Lack of understanding of the metaverse	Past experiences with using metaverse platforms
Lack of knowledge of Gather Town		
Lack of knowledge of Zepeto		
Lack of knowledge of Roblox		
No experience in using Gather Town	Lack of experience with metaverse platforms	
No experience in using Roblox		
No experience in using Zepeto		

Table 4
Results of actions/interactions.

Concepts	Subcategories	Main categories
Increased willingness to learn hard	Increased enthusiasm for learning	Active participation
Increased willingness to participate in class		
Learning and studying how to operate Gather Town through YouTube or the Internet		
Trying not to harm group members		
Finding myself more motivated		
Request professor for help	Cooperative interaction	
Request other classmates for help		
Request group member for help		
Sharing ideas with group members		
Brainstorming ideas with group members		
Trying to figure out the operation method with the group members		
Explaining how to operate Gather Town when group members ask		

Table 5
Results of intervening conditions.

Concepts	Subcategories	Main categories
Plying games with group members in Gather Town space during break time	Interaction with group members	Relationship with group members
Diving and swimming with group members in the virtual pool during break time		
Racing with group members in the virtual racing room during break time		
Chatting with group members in Gather Town space during break time		
Group members who turn off the camera during class	Group members' learning attitudes	
Group members who turn off the microphone during class		
Group members who passively participate in class		
Group members who do not faithfully participate in teamwork		
Group members who actively participate in class		
Group members who actively participate in teamwork		
Increased interest in Gather Town	Interest in the metaverse	Change in awareness of the metaverse
Wanting to use other metaverse platforms such as Zepeto or Roblox		
Trendy metaverse	Importance of the metaverse	
Frequent access to newspaper articles about metaverse		

4.2.5. Intervening conditions

Intervening conditions describe conditions for the adoption of enabling or inhibiting actions/interactions (Corbin & Strauss, 2015). The analysis results of intervening conditions were "relationship with group members" and "change in awareness of the metaverse." "Relationship with group members" consists of the subcategories of "interaction with group members" and "group members' learning attitudes." "Change in awareness of the metaverse" has the subcategories of "interest in the metaverse" and "importance of the metaverse" (Table 5). Participants developed an interest in other metaverse platforms, such as Zepeto and Roblox, in addition to Gather Town. Their awareness was heightened by the fact that the metaverse is a trendy and significant topic in mass media. A change in awareness of the metaverse can affect participants' active participation in the metaverse-based PBL. Moreover, whether group members actively and faithfully participate in class and teamwork, and whether they interact closely with each other, can affect participants' learning attitudes. In other words, the better the group members' learning attitudes and the more closely they interact with one another, the more active the participants will be in class.

4.2.6. Consequences

Consequences represent the outcomes that arise from the actions/interactions of the phenomenon under study (Chen et al., 2022). In other words, consequences answer the questions about what happened as a result of "active participation" (Corbin & Strauss, 2015). The consequences found in this study cover "enhancement of learning effectiveness" and are made up of the subcategories "strengthen the quality of learning" and "sense of reality." In other words, participants' active participation during the classes resulted in enhanced learning effectiveness. Participants improved the quality of learning in the metaverse-based PBL by deviating from the theory-oriented class and instead applying the theories to practical situations. In the class, they experienced a greater sense of immersion, concentration, accomplishment, and satisfaction with their learning experience. Further, despite the class being held in a virtual space, participants were able to experience what it would be like to own and operate a restaurant business in the real world. A detailed analysis of the consequences of the study is shown in Table 6.

4.3. Selective coding

Selective coding was carried out in consideration of the relations between the core category and other categories. The core category serves to integrate most of the concepts related to the studied phenomenon, which leads to the development of the theory (Chen et al., 2022; Corbin & Strauss, 2015). The core category was derived as "enhancing learning effectiveness through active participation in changing educational environments." We found that participants perceived classes applying metaverse platforms as novel educational methods that they had never encountered before. Although participants, who were unacquainted with metaverse platforms, were fascinated by the attraction that the platform had new features and functions with the creation of virtual space, they faced difficulties using it due to linguistic and technical limitations in class. All of the instructions and advice were provided in English. The operation method was complicated, so it took quite a while to understand and adapt how to use it. However, the participants, who realized the interest and importance of the metaverse, worked with group members to solve the problems and actively participated in collaboration with group members as their willingness to learn grew. Even though the class was held in a virtual space, participants felt like they were in a real classroom. They not only communicated and cooperated with group members in a virtual space but also became

Table 6
Results of the consequences analysis.

Concepts	Subcategories	Main categories
Fun class	Strengthen the quality of learning	Enhancement of learning effectiveness
Interesting class		
Non-boring class		
Increased concentration		
Feeling like playing a game in class		
Lively class atmosphere		
Saving time		
Creative class		
Memorable class		
Increased sense of accomplishment		
Increased learning satisfaction		
Increased understanding of the content of the class		
Increased immersion in class		
Deviating from the theory-oriented class		
Applying what we learn from theory to practice		
Deviating from the burden of teamwork		
Deviating from the prejudice against teamwork		
Preference for teamwork through Gather Town		
Feeling like classrooms in the real world	Sense of reality.	
Feeling like a university in the real world		
Feeling like face-to-face classes despite non-face-to-face classes		
Feeling as if I myself was opening a foodservice business in the real world		
Feeling as if I myself was becoming a restaurant owner in the real world		

interested in the class, and ultimately experienced an increased learning effect.

5. Discussion and conclusion

5.1. Theoretical contributions

With the development of technology, the metaverse has expanded beyond everyday life to the field of education. Despite the growing importance of metaverse as a medium for PBL, hospitality students' experiences have yet to be examined in depth. Thus, this research explored the pedagogical effectiveness of metaverse-based education in the PBL context to improve the direction of education in the hospitality field. This study contributes to the accumulating evidence that metaverse platforms are an effective medium for sustainable education for PBL. The findings showed that metaverse platforms are suitable and effective tools for PBL courses that require collaborative learning activities. Participants preferred the metaverse-based PBL class because it enables participants to create a comfortable learning environment with a sense of reality, improve peer socialization, increase fluid interactions, and facilitate learning. By helping each other and sharing ideas with group members in virtual space without time or space constraints, participants tried to reach a common goal, producing positive outcomes. In other words, metaverse platforms in the PBL curriculum can encourage students to engage in blue-sky thinking and brainstorming. Our findings are in line with other studies (Barry et al., 2009, p. 6066; Choi, 2021; Jovanović & Milosavljević, 2022; Latulipe & De Jaeger, 2022; Nunes et al., 2017; Pellas & Peroutseas, 2016), which observe the role and functions of metaverse platforms in PBL contexts.

In the process of the metaverse-based PBL class, participants faced difficulties using metaverse platforms due to linguistic and technical limitations as in previous research (Barry et al., 2009, p. 6066; Latulipe & De Jaeger, 2022). However, they also attempted to overcome difficulties by using a wide range of learning strategies. By asking professors, classmates, and group members or searching YouTube or the Internet, they learned how to navigate the metaverse platform. Participants also worked together with group members to overcome difficulties. Hence, the findings indicated that metaverse-based PBL is an effective learning method that helps students not only become self-directed learners by improving learning motivation but likewise improve collaboration skills, and the finding is echoed by research (Hmelo-Silver, 2004; Kivela & Kivela, 2005; Nadda et al., 2022). The findings further support that metaverse-based PBL creates an immersive learning environment as if participants were in actual space and situations (Fitria, 2021; Tlili et al., 2022). In the metaverse, the participants felt as if they were in classrooms and restaurants in the real world. It was as if they had opened a restaurant and become owners in the real world. In this vein, metaverse-based PBL can create a learning space where students can immerse themselves in classes even though they are virtual spaces.

Furthermore, this study applied qualitative methodology using grounded theory to understand students' metaverse-based PBL learning experiences. While grounded theory is a valuable method for understanding learning processes (Castanelli et al., 2022; Deepa et al., 2022; Miles, 2018; Zhang et al., 2022), its application has been lacking within the context of metaverse-based PBL. The research provides an in-depth understating of students' learning experiences of metaverse-based PBL. More specifically, this research identified not only students' learning outcomes but also their cognitive and affective experiences in the metaverse-based PBL learning process.

5.2. Practical implications

This study also provides relevant practical implications for improving learning environments for hospitality students from an educational standpoint. First of all, our research results indicate that students perceived various positive learning effects from PBL classes that used metaverse platforms such as Gather Town. In a comfortable education environment, metaverse platforms can encourage more dynamic and cooperative learning. Using the metaverse makes students feel as if they are in a real classroom and keeps them engaged. Classes conducted on metaverse platforms can lead to self-directed learning because students are more active and comfortable sharing ideas and asking questions in a virtual classroom. Students also tend to get closer to their group members more easily and quickly in virtual classes through playing games, diving, swimming, racing, and chatting in virtual spaces together. As students' enjoyment and social connectedness increase in classrooms, their participation and learning improve (Patton, Renn, Guido, & Quaye, 2016). Therefore, there is a need to develop various PBL curriculums using metaverse platforms in universities.

Second, metaverse-based PBL is effective for teaching and training students as professionals. In particular, participants enjoyed activities in virtual restaurants. Despite being virtual, participants felt like they were running a restaurant business through the process of selecting their own menus, decorating furniture, and kitchen appliances. Hospitality is an academic field that requires a highly integrated learning environment that actively connects theory and practice for improving operational and managerial competence, so it requires experiential learning such as internships or field trips (Rosenkranz, 2022). However, since experiential learning is generally conducted outside the classroom, there are cost- and time-consuming limitations (Croy, 2009). The metaverse can play a role as a medium of sustainable education to mitigate the inherent shortcomings and limitations of experiential learning for hospitality students. Metaverse-based PBL can train and educate restaurant operation and management professionals by applying learned theories to practice without the constraints of time and space. Therefore, higher education institutions should establish a sustainable educational environment by developing a metaverse-based PBL curriculum that can realize experiential learning so that hospitality students can grow into professionals who contribute to the future hospitality industry.

Lastly, participants experienced difficulties with the operation of Gather Town. As the operational methods of Gather Town are complicated and the manuals were written in English, participants had difficulties understanding how to operate Gather Town. There may be limitations to using Gather Town for users who lack English competence. Thus, educators need to teach detailed operational methods to students to ensure sustainable learning environments. Furthermore, educational managers should promote training and

coaching on the need for and use of metaverse platforms for educators.

5.3. Limitations and future research

Despite its significant theoretical and practical implications, this research has some limitations. First, as this study focused on Korean students to understand hospitality students' experiences of the metaverse-based PBL curriculum, the findings are not generalizable to hospitality students as a whole. Thus, future research needs to be conducted on hospitality students from various cultural backgrounds. Second, this research explored Gather Town as a metaverse platform. For this reason, the analysis results can be different if research examines students' learning experiences with other metaverse platforms, such as Zepeto, Roblox, or Fortnite. Lastly, this research explored students' perspectives. Thus, a deeper understanding of the metaverse-based PBL curriculum by users would require the consideration of educators' perspectives such as professors and lecturers.

Authorship contributions

Please indicate the specific contributions made by each author.

Namhee Lee: Analysis and interpretation of data; Drafting the manuscript; Revising the manuscript critically for important intellectual content; Approval of the version of the manuscript to be published.

Mina Jo: Conception and design of study; Acquisition of data; Funding acquisition; Investigation; Methodology; Approval of the version of the manuscript to be published.

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Declaration of competing interest

The authors of the manuscript have no Conflict of Interest.

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