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RESEARCH ARTICLE

L2 learner experiences in a playful constructivist metaverse space

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Abstract

This study creates a virtual space for language learning using a user-customizable metaverse platform and explores its potential for EFL learning. To this end, a virtual learning space, grounded in constructivist learning principles – contextualized learning, active learning, and collaborative learning – was created on a 2D metaverse platform. The metaverse was designed as a simulated deserted island for enjoyable and playful learning, allowing the students to actively explore, discover, and interact as they look for clues to escape the island. For educational application, 29 Korean middle school students participated in a two-hour activity. Data included screen recordings of student activities, student surveys, and interviews with the students and teachers. The findings showed that, as an EFL learning space of playful constructivism, the metaverse had great potential to embed contextualized learning and served as a medium for active learning that positively affected student interest and motivation. The results confirmed that the team-based approach combined with a game-like metaverse fostered student collaboration. Overall, the study showcased how language instructors can make use of a customizable metaverse for L2 learning and how a virtual space may serve as an arena for learner-centered instruction.

Keywords: playful constructivism; user-customizable metaverse; learner perception; collaborative learning; active learning

1. Introduction

Constructivist learning environments have great potential for L2 learning, but the principles, such as learning in the context and the community, interactive and collaborative learning, and active learning (Chen, Chen & Dai, 2018; Lee & Park, 2020; Li, Lund, & Nordsteien, 2023; Marone, 2016), are not always easy to translate into practice in English-as-a-foreign-language (EFL) classrooms. For example, in Korea, as an EFL environment, the L2 context is often lacking, and large classrooms inhibit interactive and collaborative learning. With the advancement of the emerging technology of customizable metaverse platforms, a new opportunity to apply constructivist learning principles in EFL classrooms has been created. Prior studies have confirmed the positive influence of using virtual worlds in L2 learning from multiple perspectives. From the social perspective, it promotes interactive and collaborative learning in an authentic context. From the language learning perspective, it cultivates the acquisition of linguistic knowledge and positive attitudes toward language learning (Lin & Lan, 2015) and increases oral accuracy (Lan, Kan, Sung & Chang, 2016) and communicative skills (Wang, Lan, Tseng, Lin &

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Gupta, 2020). Most importantly, the metaverse space can serve as a context for L2 learning and provide an arena where learners can actively engage in tasks and interact with others. In sum, the technology can realize the key constructivist learning tenets: contextualized, active, and collaborative learning (Chen *et al*., 2018; Lee & Park, 2020; Li *et al*., 2023). In recent years, customizable metaverse platforms have become more available, and they allow the user to customize a space depending on their educational purposes and realize constructivist learning theory in the L2 classroom.

Drawing from game design and constructivism, Marone (2016) proposed "playful constructivism" as a conceptual framework and theoretical model for learning. According to him, playful constructivism is the intersection of playful design, design-oriented participation, and playful participation, and supports a playful, participatory, and situated learning environment where students are socially immersed, learn from more knowledgeable others, and find learning more engaging and meaningful. Therefore, a well-designed playful constructivist space allows students to make personally meaningful choices, solve interesting and creative problems in collaboration with peers or more knowledgeable others, and actively achieve the learning goal, which is well aligned with key elements of constructivism. We expected that the concept of playful constructivism could be effectively applied to an English classroom for EFL middle school students, alleviating the current problems faced by many Korean EFL classrooms, and we designed the space for a specific group of EFL students to enable them to actively explore, discover, and learn in the present study. We further investigated how Korean EFL middle school students interacted and collaborated in the customized space, as well as how they perceived their activity in the metaverse.

2. Literature review

One of the key principles of L2 learning in constructivism is contextualized learning. Contextualized learning provides a meaningful learning environment created for L2 acquisition (Chen *et al*., 2018; Lee & Park, 2020). From a cognitive perspective, contextualized learning allows students to activate mental schemata about the target language and acquire the language in a more natural way, thereby reducing cognitive load and language anxiety during learning (Lee & Park, 2020; Li *et al*., 2023). Associating the language with its meaning within the situation where the language is used helps activate the complex memory network and consequently increases retention and memory recall (Lee, 2023a). Hence, language learning in a situational context promotes EFL students' listening, speaking, and writing skills (Hwang, Chen, Shadiev, Huang & Chen, 2014; Hwang, Shih, Ma, Shadiev & Chen, 2016).

Active learning is another key principle of L2 learning. Active learning fosters students' autonomy of learning and helps generate their own knowledge and deeper learning (Er, Altunay & Yurdabakan, 2012; Foushee *et al*., 2023). Particularly in L2 learning, active learning helps students seize language learning opportunities and better acquire an L2 from language input (Foushee *et al*., 2023). Agbatogun (2014) argues that communicative tasks in an active learning environment increase students' willingness to speak and improve their communicative competence, as well as enhance engagement, enjoyment, and ownership of learning. The study also shows that an active learning environment, where the students take ownership and responsibility of their own learning, increases the participation level of less confident students. Active learners are no longer seen as passive recipients of knowledge but as active agents who can monitor their own learning progress toward the learning goal and make decisions about what and how to learn. The active learning approach promotes learner agency and independence as students are allowed to freely explore the given tasks with little teacher intervention (Göğüş, 2012). This type of discovery learning can be beneficial in promoting knowledge construction through self-reflection and meaningful social interaction between students. The active learning approach also fosters interaction, engagement,

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and motivation in L2 learning by giving students choice and control over their learning, thus promoting self-regulated learning (Li, Majumdar, Chen & Ogata, 2021).

In addition, collaborative learning can further assist L2 learning by facilitating learners to help each other in managing and completing L2 tasks through oral interaction (Bao & Du, 2015). When beginning EFL learners share the same L1, they may rely on their L1 to mediate their performance of the assigned task. However, using the L1 as a cognitive and social tool can facilitate learners in "establishing a joint goal, effectively moving the task along, and assisting each other in solving difficulties" (Bao & Du, 2015: 19). From the affective perspective, interaction and collaborative learning increases students' attention, interest, engagement, and enjoyment, thereby benefiting L2 learning (Berns, Isla-Montes, Palomo-Duarte & Dodero, 2016; Hwang *et al*., 2014; Lee & Park, 2020). Gomez, Wu and Passerini (2010) and Zhang *et al.* (2021) demonstrated that collaborative learning contributes to increased motivation, enjoyment, and learning outcomes and facilitates self- and socially shared regulation. Similarly, Saab, van Jooligen and van Hout-Wolters (2005) and Borthick and Jones (2000) reported that students participated more actively in a task when they worked collaboratively and proposed collaborative active learning. Marone (2016) also considered collaboration an important element of playful constructivism. According to him, a good learning design should provide an affinity space where learners can actively and playfully participate in learning and collaboratively share their ideas and learn from others.

In recent years, the metaverse has become a viable platform for L2 learning and has drawn attention from researchers and practitioners (Information Resources Management Association, 2019). According to Ng (2022), the metaverse is "a 3D digital virtual world that enables people to 'live' and 'learn' through their avatars in immersive learning environments" (p. 195). The metaverse has great potential as a space to implement constructivist learning principles and accomplish effective L2 learning. First, the metaverse promotes contextualized language learning by providing an authentic context and specific situations where students make sense of the content within a spatial environment. Second, the metaverse enables active learning as students explore the environment, manipulate objects, and interact with others in the metaverse (Thrasher, 2022; Xie, Chen & Ryder, 2021). Finally, the metaverse supports social interaction and collaboration among users. Interaction and collaboration in the metaverse, in turn, provide scaffolding and allow for negotiation of meaning (Xie *et al*., 2021).

In more recent years, a new type of customizable 2D metaverse platform has emerged. Compared to previous 3D metaverse platforms, it is not graphically attractive, but offers new functionalities that previous metaverse platforms did not provide, such as proximity chat (to interact with other users nearby), a private zone (to communicate only with members in the same zone), and multimodal communication channels, including video chat. More importantly, creating and customizing a space and objects is much easier on these 2D metaverse platforms, compared to 3D platforms, such as Second Life. Several studies have explored the effectiveness of using customizable metaverse platforms in learning and found that it enhanced collaborative learning (Jang, 2021; Najjar, Stubler, Ramaprasad, Lipford & Wilson, 2022), reduced L2 anxiety, and promoted self-directed and active learning (Hong, Lee & Ahn, 2022; Lee & Ahn, 2022). Such platforms also increased learner satisfaction and motivation to learn through convenience and fun, easy interaction (Jeong & Kim, 2022; Lee, 2023b). With a customizable platform, an instructor can create a whole new world according to their educational purposes. Hence, the current study created a learning space in the metaverse based on constructivist learning principles, which allowed EFL middle school students to explore, play, and learn the language by actively participating and interacting with others, and, in doing so, enhance their interest and motivation to learn. In short, we constructed an L2 learning space of playful constructivism (Marone, 2016) and examined its educational effectiveness in L2 learning. The present study addresses the following research questions:

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Figure 1. *Desert Island Survival* module on the app.

1. Did the user-customized metaverse space facilitate students' active participation and collaboration in L2 learning tasks?
2. What were the students' perceptions toward learning English in the user-created metaverse space?

3. Method

3.1 Project description

The L2 learning task of the current study was part of a larger educational project for underprivileged middle school students called *Dream Class*, funded by Samsung, Korea. *Dream Class* developed an English learning app that featured eight modules. The students completed each module independently over six weeks. To enhance their app-based learning, various activities were provided during and after studying each module, including both online and offline gatherings with the instructors who designed the tasks. The task included in the present study was one of the facilitating activities after completing the module titled *Desert Island Survival* (Figure 1). This module consisted of six different locations based on the storyline, in which the learner and their friends went for an excursion in the sea, encountered a storm, and ended up on a deserted island. The module presented information about the island and survival skills in English, and the students learned English vocabulary and expressions and applied all four skills in English to complete the tasks included in the module.

After the students completed the tasks in the module, we created a similar space in the metaverse, Gather.town, to further consolidate student learning in a contextualized virtual environment (Figures 2 and 3). As the wrap-up session for the module, we used the same locations and the storyline, which framed the context of the task and provided students with a purpose and a goal. Since the space was a nonlinear open world, the students needed to actively explore the island and discover clues to accomplish their goal. The various locations were connected through portals, and in each place, objects were hidden to provide tips about survival. The platform's object-embedding function and avatars were particularly useful for active learning.

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Figure 2. Screenshot of the deserted island.

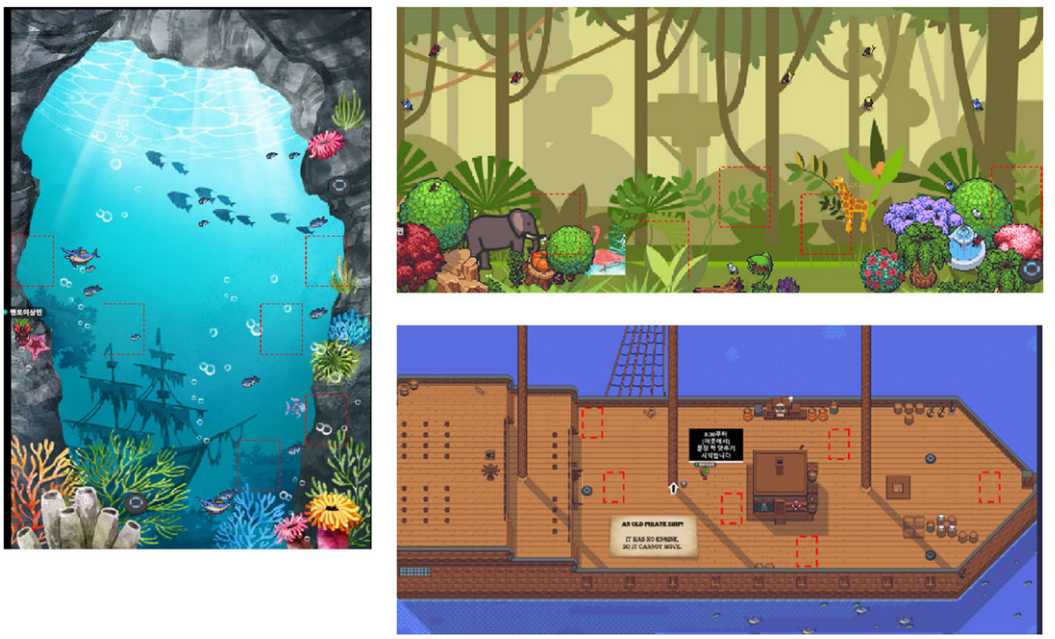


Figure 3. Inside the portals: Under the sea, the jungle, the pirate ship.
Note. The numbered circles mark portals to different places: to the cave (1), under the sea (2), the pirate ship (3), the jungle (4), and the river (5); the squares: interactive items; ovals: the students' avatars; black squares on the top of the screen: the students' videos.

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While the students studied with the app, they worked alone without any interaction or collaboration with others; however, in the metaverse, they could interact with others and collaboratively work on tasks in context. Therefore, we designed the space based on the framework of playful constructivism (Marone, 2016), where the students could actively engage in learning tasks, interact with others, and collaborate on these tasks. Specifically, we embedded various tasks designed to develop students' English reading, writing, listening, and speaking skills on the deserted island. Interactive activities were implemented to provide the students with opportunities to interact with teachers and peers, such as "Find Martin and Talk" (talking about wanted items with the native English-speaking teacher) and "Match the Sentence" (each pair talks to other pairs to find the rest of the sentences). To further promote collaborative learning, the students completed the tasks in teams. The principles and their realization in the metaverse are summarized in Appendix A (see supplementary material).

3.2 Participants

3.2.1 The students

A group of 29 Korean middle school students applied to participate in the metaverse activity. The students were from different schools and did not know each other. They explored the space and completed the tasks over the course of two hours. Only two of them had used Gather.town prior to the deserted island task. At the beginning, the students were given a speaking test, in which they introduced themselves for one minute to assess their language proficiency. Two raters, the researchers of the present study (professors of English education), evaluated their English-speaking ability, and their English proficiency was determined to be at a beginner level (CEFL A1). After an orientation about the activity and the platform, the students explored the island in teams (nine teams in total). Each team shared an answer sheet in the form of a Google document (see Appendix B in the supplementary material).

3.2.2 The teachers

Three teachers participated in the activity; a Korean English teacher and a native English teacher participated in the speaking tasks as the speaking partners of the students. Another Korean English teacher assisted the students as a facilitator by answering their questions during the activity. The students communicated in English with the native English teacher, in Korean with their partners, and used both languages with the Korean teachers.

3.3 Data collection and analysis

In the present study, we employed a mixed-methods approach, incorporating both qualitative (screen recordings and post-interviews) and quantitative data (a post-questionnaire). Specifically, we utilized the sequential transformative method, collecting qualitative data first, followed by quantitative data, and then integrating the findings in the interpretation phase (Creswell, 2003). Screen recordings of the student activities from four randomly selected teams were collected, totaling approximately six hours. All three teachers and three students participated in one-on-one, semi-structured interviews. The student interviews were conducted in the metaverse space immediately after the activity, whereas the teacher interviews took place within a couple of weeks after the project. Each interview lasted 10 minutes. In the interviews, students were asked about what they found most enjoyable and useful in learning English in the metaverse, as well as any difficulties they encountered while completing the tasks. The teachers were asked about their observations of student behaviors and reactions during the activity, their perceptions of the self-exploratory learning environment, and suggestions for improving task design and the virtual space for L2 learning. After completing the exploration, the students submitted their answer sheets and

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the post-questionnaire. The post-questionnaire included 17 questions, two of which were open-ended questions. The questions focused on the students' interest in the tasks and teamwork, as well as the usefulness of the tasks for learning English. The open-ended questions asked for reasons why they liked or disliked the deserted island activity.

The videos were analyzed by two coders (the researchers of the present study) to extract segments relevant to the two core topics: active learning and collaborative learning. Active learning sequences were identified as those showing students making intentional choices about where to go, what to do, and how to perform the tasks (Mercer, 2011). Collaborative learning episodes were identified as those demonstrating peer support and assistance for learning (Ohta, 2001). After comparing the critical moments each coder selected, differences were discussed until consensus was reached. The chosen sequences were then transcribed and translated for closer analysis. The interviews were first open-coded and then thematically coded according to emerging themes. Initial codes were identified to reflect recurring responses across the teachers and students. For example, issues such as a lack of time to explore the entire metaverse space, difficulties in locating and completing all the tasks, and confusion caused by the nonlinear nature of the activity were repeatedly mentioned in the interviews. These codes were grouped into a broader theme of "challenges related to non-teacher-directed, self-exploratory learning" and triangulated with the results of the recording analysis under the topic of active learning. The post-questionnaire was analyzed using SPSS 28 for descriptive statistics.

4. Results

4.1 Interview and video recording

4.1.1 Active learning

In the metaverse, the students were given freedom to explore the virtual world in any direction. Thus, each team's learning path was determined by their chosen route of navigation based on negotiation and decision-making among the team members. The following example shows how the task design generated socially oriented learner agency as the students engaged in self-exploratory learning during the activity. The conversation took place when a pair of students had just finished a task and were about to move on to another one:

(1) [In a private zone on the abandoned ship: Group 3]

1 S7: *jinjja mwo haji? eodi gaji? eodi galkka?*
Really, what do we do? Where should we go? Where do you wanna go?
((2 lines omitted))
4 S6: *uh … o-beon, o-beon-do* ***Jack*** *aniya?*
Um, isn't the answer for number 5 *Jack*, too?
5 S7: *eo,* ***Caribbean****-ui haejeok geugeo ani-eot-seo?*
Yeah, wasn't that "The Pirates of the *Caribbean*"?
((4 lines omitted))
10 S7: *yukbeon-eun nae-ga akka jeone gatdawat-geodeun.*
I've been to the place for number six a while ago, you know
11 *geu kkott-hante meokhimyeonseo.*
when I was eaten by that flower.
12 S6: *eung.*
Yeah.
13 S7: *kokkiri-rang girin-irang geu daeume mwo-deora?*
An elephant and a giraffe and do you remember what was next?
((3 lines omitted))

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17 S7: *kkot-irang hana deo isseot-neunde.*
A flower and there was one more.
18 S6: ***flower**-hago* . . .
Flower and . . .
19 S7: *ah, igeo gieok an nanda. gatdaoja.*
Oh, I don't remember this. Let's make a run and come back.
20 S6: *gatdaolkka? kkot itneun-de.*
Should we go back to the place where the flower is and come back?
21 S7: *eung, kkot itneun-de.*
Yeah, where the flower is.
22 S6: *geurae.*
Okay.

The interaction begins as S7 asks her partner what they should do next. Instead of responding to her question, S6 brings her attention to one of the task questions they had already completed (lines 4–5). After exchanging a few turns to check each other's answers, S7 talks about an activity they found when they were transported through a portal hidden in a flower (lines 10–11). In the following lines, the pair tries to remember the last item they failed to locate while doing the vocabulary scavenger hunt there (lines 13–18). Before moving to a new task, S7 suggests that they go back and look again for the last item, and S6 agrees (lines 19–22).

The dialogue demonstrates how learner autonomy operated as the students exercised control over their learning through self-reflection and collaborative interdependence. Although a couple of teachers were standing nearby when the conversation took place, the students did not seek help from them; instead, they exercised their agency to make an intentional choice to return to the place they had already visited. By empowering the students to take control over the sequence and pace of learning, they were given the opportunity to play an active role and take responsibility for their own learning.

While most students seemed to have enjoyed taking different paths to participate in the activities, not all students appreciated the high degree of freedom they experienced. When asked for suggestions to enhance their learning experience in the metaverse, some students responded that they would like more structure and guidance in terms of task order. Being more accustomed to participating in language tasks with a prescribed order, these students felt overwhelmed by the high degree of freedom they were given. S1, in particular, mentioned that "I wish it had a route to follow, like showing us a way to go. And I hope it shows an order, like which direction to go."

Teacher 2 mentioned that the nonlinear nature of the task design resulted in varying levels of participation, especially at the beginning of the activity. While students with a strong sense of agency and curiosity seemed to enjoy the freedom of interacting with various objects without a teacher's interference, those who were more careful and cautious showed hesitation when invited to wander around and approach the tasks in the order they preferred:

> I asked one of the students, "What was fun?", and he said finding and solving the tasks was fun. He was a kind of student who enjoyed learning through discovery. I could tell he enjoyed the activities 100%. But the others, who were rather quiet and passive, would hesitate and wonder at first, "Is it okay to walk in here?" In the end, even those students said they'd like to experience more activities like this in the future. (T2)

Student interviews also revealed that they needed more time to discover all the hidden tasks. Although they were not required to complete all the tasks, many reported that they wished they had more time to find the tasks. For example, S14 said, "There were too many (tasks) and the map was so big. Well, maybe not so big, but there was too much to do in the time given." One of the

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teachers also pointed out the need to limit the number of tasks. Based on his observation, the native speaker teacher expressed concern that some students would easily give up on difficult tasks and look for less challenging ones. With many tasks to choose from, some students focused only on tasks that required less time and effort:

> They just went to the first thing that caught their eye. Anything that appeared to be a little bit more challenging, they would just skip over it and go to the next thing 'cuz there were so many next things. (T3)

The analysis of student dialogue revealed that the open-world design of the activity has the potential to support active learning and reinforce the students' sense of agency. By performing the tasks in the paths they chose, they were able to engage in meaningful learning. Some students, however, did not feel comfortable having such freedom and control over their own learning process, as they asked for more specific guidance. Others needed some time to get used to the idea of self-exploration, although they enjoyed the new type of learning experience in the end. The data also showed that the design of nonlinear tasks needed more careful consideration regarding the impact of time and the number of tasks required.

4.1.2 Collaborative learning

The students moved around as a team to solve the tasks embedded in a variety of simulated settings, including a jungle, a cave, a river, a beach, and a pirate ship. In the cave, there were two ghost avatars explaining the task and several images of cave paintings numbered in order. Here, the students had to find the correct image based on the listening and describe the action in the paintings in writing. The following example shows how student interaction unfolded in this simulated setting:

(2) [In the cave: Group 1]

1 S1: *il-beon yuryeong-eun, e-beon-in geot gatji?*
   It seems like the answer for number 1 ghost is number 2, right?
2 *geugeon geoui hwaksil-hande*
   I'm almost certain about that but
3 *munje-neun sam-beon saram-i mwo hago isseossdeon geolkka?*
   what do you think the person in number 3 was doing?
4 S2: *bul piu-go isseossdeon geo aniya?*
   Wasn't he building a fire?
5 S1: *eo?*
   Huh?
6 S2: *bul piu-go issneun geo gatseupnida.*
   I think he was building a fire.
7 S3: *ah, geuraeseo* ***making a fire****.*
   Oh, so the answer is *making a fire*.
8 S1: *nan mwo galgo itneun geon jul aratne.* ***He is making fire.***
   I thought he's grinding something. *He is making a fire.*

In this example, S2 helps S1 figure out what the person in the cave painting is doing (lines 1–6). As S2 describes his observation in Korean, S3 offers an English translation of the expression "*making a fire*" (line 7). After realizing that his initial understanding of the image was wrong, S1 puts the expression in a complete sentence ("He is making fire") as the final answer to the task (line 8). Example (2) shows how collaborative interaction enables the students to perform tasks that they

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could not have undertaken alone. In this form of interaction, they managed to establish and maintain intersubjectivity by taking responsibility for giving and receiving assistance.

Similar collaboration took place in other parts of the deserted island. At the river, when the students' avatars walked up to a raft, an embedded website for solving the quiz "How to make a raft" opened. Here, the task was to rearrange five sentences in the correct order to describe the steps for building a raft:

(3) [At the beach: Group 1]

1 S1: *Ildan yeoseot-gae-reul chatgo bwayadoeji anheulkka?*
Shouldn't we look for six (logs) first?
2 S3: *eung.*
Yeah.
3 S2: *geureonikka chatgo naseo*
So after looking for (six logs)
4 *mur-e tteu-neunji hwaginha-go mukk-go tto mukk-go*
check if they float on water and then tie them and tie again
5 *geurigo ije namutip ollyeono-eumyeon dwae.*
and then you need to put the leaf on top.
6 S3: *eung.*
Yeah.
7 S1: *geureonikka chat-go hwaginha-go mukk-go*
So find and check and tie and
8 *wichiha-go arae-e mukkgo?*
place it and tie under?
9 S2: *geureonikka* ***find six dry tree logs****-ga cheotbeonjjae.*
so *find* six *dry tree logs* is the first.

In example (3), S1 initiates the discussion by sharing his choice of the first sentence and asking for the team members' opinions (line 1). As S3 expresses her agreement (line 2), S2 gives suggestions for the subsequent steps in raft-building (lines 3–5). In doing so, he translates only part of each sentence into L1 to convey his meaning. S3 expresses her understanding and responds positively (line 6), while S1 asks for confirmation of his understanding (lines 7–8). In the following sequence, S2 responds by elaborating on his opinion about the answer.

Unlike in example (2), the students could not see each other's avatars while talking because they had to perform the task on a website outside the deserted island. Nevertheless, they were able to create a shared context while developing useful strategies for effective communication. Being aware that his team members were looking at the same set of sentences, S2 relied on partial translation of the sentences in his interaction (lines 3–5). Following S2, S1 used a similar communication strategy to check his understanding of S2's remark (lines 7–8). As both students actively sought a more efficient way to get their meanings across, they were able to achieve intersubjectivity.

In the interview, the teachers expressed satisfaction with the level of student collaboration that occurred during the activities. Teacher 1 particularly found the metaverse experience effective in supporting the co-construction of task-oriented conversations. Based on the fact that the students managed to create a joint environment for collaboration even in their first encounter with their

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team members (or partners), she viewed the metaverse as a potential arena for learner-centered instruction:

> [When you study online], you do things by yourself. You post a message on the bulletin board by yourself, connect to Zoom by yourself, watch YouTube by yourself. But this, the metaverse makes you come in and work together on the tasks with others, which naturally leads to collaboration, even when the students don't know each other. I think the educational effect of it is really great. (T1)

Teacher 2 mentioned that the students showed enjoyment and excitement when they actively participated in collaborative interactions, which may have led to the creation of a low-stress environment for language learning. She said, "They actively shared their ideas with each other and laughed a lot, and they focused on what their team members were doing and paid attention to each other's actions." As active participants in the learning process, the students demonstrated highly learner-centered interaction in their attempts to complete the tasks. The data suggest that they were not only motivated to meet the task requirements but also willing to support each other as a team. Teachers' comments also indicated that the pedagogical design of the tasks and the learning environment fostered collaborative learning experiences among students. The metaverse served as a promising tool for creating a positive and supportive environment conducive to achieving shared understanding among students.

4.2 Questionnaire

After the completion of the activity, a questionnaire was administered to assess the students' attitudes toward the tasks and teamwork, as well as the usefulness of the activity for English learning. Table 1 shows the mean scores of the students' responses to the 15 statements on the questionnaire. The answers are arranged on a 5-point Likert scale from 1 = *totally disagree* to 5 = *strongly agree*.

The quantitative results show that the student participants had a positive perception toward the learning experience in the metaverse (see Table 1). The majority of the students reported that they enjoyed the activity. Although their level of task completion was not as high as their overall satisfaction, the questionnaire revealed that the students found most of the tasks fun and interesting, especially those that required more hands-on involvement (e.g. games, scavenger hunt). The students also expressed satisfaction with working as a team. More importantly, they reported that the learning experience in the metaverse helped them improve their English, as it made it easier and more interesting to learn, which seems to explain their strong desire to engage in similar activities in the future.

In line with their responses to the multiple-choice items, the students' answers to the open-ended questions confirmed that they enjoyed team-based learning ($n = 9$). Similarly, their preference for tasks that encouraged them to "learn by doing" was also evident in their responses ($n = 6$). In addition, some of them perceived their learning experience as game-like, which made learning more engaging and stimulating ($n = 5$). What made the activity more attractive was that it was something that they had never seen or done before ($n = 5$). On the other hand, the main complaint of the students was the lack of time to complete all the tasks ($n = 7$). Some students indicated that they struggled to get used to the autonomy-supportive environment, especially at the beginning of the activity ($n = 5$).

5. Discussion

The main concern of this study was to explore the pedagogical potential of the metaverse in language learning by investigating (1) whether the user-customized metaverse space facilitated

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Table 1. Students' reaction to the learning experience in the metaverse ($N = 29$)

Statement	*M*	*SD*
Attitudes toward the language tasks		
I enjoyed the learning activity on the deserted island.	4.38	1.049
I was able to finish most of the tasks.	3.45	1.152
I enjoyed the matching sentences task.	3.72	1.192
I enjoyed interacting with the teachers through the speaking activities.	4.17	1.071
I enjoyed the puzzle games (i.e. jigsaw puzzle, crossword puzzle).	4.24	1.057
I enjoyed watching movies for task completion.	3.97	1.210
I enjoyed the scavenger hunt (i.e. find the words).	4.24	1.057
Perception of teamwork		
I enjoyed working with a friend as a team.	4.24	1.215
My team member(s) helped me with dealing with the tasks.	4.34	1.203
Usefulness of the activity for learning English		
The activity was useful in improving my English.	4.45	0.736
The activity was useful for acquiring English vocabulary.	4.41	0.867
The activity was useful for learning English expressions.	4.38	0.942
The activity made learning English much easier.	4.48	0.829
The activity made my interest in learning English much stronger.	4.38	0.942
I wish to participate in a similar type of English learning activity in the future.	4.59	0.780

students' active participation and collaboration in L2 learning tasks and (2) students' perceptions of the learning experience. The pedagogical value of the metaverse and the activity design were assessed by analyzing students' talk-in-interaction during the activity, conducting interviews with the students and teachers, and examining students' perceptions of their learning experience. The analysis of student interaction showed that the customized 2D metaverse platform encouraged Korean middle school students to engage in active and collaborative learning. In the post-questionnaire, the students expressed great satisfaction with the learning activity and believed that it helped them improve their L2 skills, but analysis of the interview revealed that their reactions to the high degree of freedom in the metaverse were mixed, with some students thriving on the opportunity to explore while others preferred more structured guidance.

The current study demonstrated how the metaverse space design and technological affordances can help realize playful constructivism. Most importantly, the customizability of Gather.town allowed us to design the space, a deserted island, for our own pedagogical purposes. The functions of the platform, such as multimodal communication channels, private zones, and avatars, also promoted student interaction and collaboration. The high customizability of the platform allowed for the creation of an imaginary world in which the students could enjoy immersing themselves in the context and approaching L2 tasks in a playful way. Throughout the activity, the students were constantly on the move to find the hidden missions and in constant interaction with the environment, suggesting that the adoption of game-like features in the metaverse can facilitate risk-taking and productive failure among language learners (Shatz, 2015). The results also showed that having students work in teams promoted active and collaborative learning, as evidenced by the analysis of the verbal interactions of the collaborative groups. Despite the fact that the students had never met each other prior to the activity, they were able to immediately engage in on-task

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conversations based on a shared experience (i.e. completing the desert island module in the English learning app). The avatar-based nature of the interaction may also have contributed to the high level of collaboration among the students by creating an atmosphere for friendly, relaxed conversation and encouraging spontaneity, as reported in previous research (Hirata, 2023). Most importantly, the incorporation of fantasy-like themes that increase immersion (Cornillie & Desmet, 2013) and adventure-style tasks that tap into students' desire for achievement seem to have made learning in the metaverse particularly playful and participatory. While a novelty effect may have influenced their self-reported gains and positive views of the virtual learning environment, the adventure-style context and storyline seemed to increase their motivation and interest in learning English, leading to a strong desire for additional learning opportunities in the metaverse. Although 3D or fully immersive VR is more visually attractive to learners and can lead to a higher level of immersion and presence – a sense of being personally situated in the virtual space (Lin & Lan, 2015; Makransky & Petersen, 2021) – the findings indicate that a customizable 2D platform also has great potential to serve as a medium for constructivist learning in EFL settings, corroborating previous studies on L2 learning in the virtual world (Wu, Zhang & Wang, 2022; Yang, Lo, Hsieh & Wu, 2020).

Despite the lack of social bonding, analysis of the interactional dialogues showed that students were able to effectively regulate joint activities with their teammates to complete the task in a relatively short period of time, sometimes using communicative strategies that promoted intersubjectivity. It is likely that communicating through avatars, without having to reveal their true identities, facilitated students' collaboration by reducing their anxiety and shyness (Chen & Kent, 2020). Another possible explanation for the high level of collaboration is that by being in a game-like, fantasy-style metaverse, students may have perceived themselves as participants in a team-based online game, who typically have to find their own ways to instantly collaborate with strangers (Kou & Gui, 2014) rather than as L2 learners. Studies on game-based online learning have reported that when a team-based approach is combined with gamification, it increases team cohesion (Zhao, Srite, Kim & Lee, 2021), mutual support for task performance (Far & Taghizadeh, 2022), and team flow (Admiraal, Huizenga, Akkerman & ten Dam, 2011), all of which can make the team function at its best. While the virtual space serves as an effective context for students to collaborate (Jeon, Lee & Choe, 2022), in addition, the metaverse space with a fantasy backbone story in the current study also created an affinity space where students worked collaboratively and playfully on the tasks and learned from their peers. With the recent pedagogical paradigm shifts from instructor-centered to student-centered learning supported by technological advances (Li & Lan, 2022), creating a virtual space of playful constructivism for L2 learning may further contribute to fostering students' collaborative knowledge construction.

Rather than following traditional, teacher-directed instruction, the metaverse showed potential for transforming L2 learning into a more active and self-directed learning experience. With the teacher's role limited to encouraging learner agency and providing guidance when needed, learners had to work within their teams toward self-directed solutions when they encountered a problem. Such an autonomy-supportive environment appears to have elicited levels of satisfaction, motivation, and interest among students that is similar to findings in other VR-based studies (Ardito & Czerkawski, 2021; Scholz, Komornicka & Moore, 2021). The fact that the tasks were developed as a review of language content that they had individually studied using an English learning app may also have had a positive effect on their active participation in self-directed learning in the metaverse. Had the task content been completely new to the students, there might have been some confusion and frustration, but having been exposed to the L2 linguistic content and having some awareness of it, the students seemed to exercise their learner agency more effectively.

However, analysis of the interview and post-questionnaire suggests that integrating such an open-world component may require more scaffolding for beginning L2 learners and careful consideration of student workload and estimated time for task completion. Although the majority

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of participants seemed to enjoy the sense of control and increased ownership of learning, some students were unable to complete all tasks within the allotted time. There were also problems with students choosing the least challenging tasks and complaining about the lack of teacher guidance. Several factors may have contributed to the partial success in promoting active learning among students. First, Korean middle school students are generally accustomed to teacher-centered instruction, which lacks opportunities for student self-exploration and decision-making (Park, 2020). Research has shown that the high level of collectivism in Korea leads teachers to adopt a controlling rather than an autonomy-supportive teaching style (Reeve *et al.*, 2014). If students are accustomed to such a classroom climate in which their initiatives and perspectives are not desired, encouraging student agency alone may not guarantee their active engagement in the metaverse. To successfully implement an open-world design, more opportunities for student-led activities must be provided in the classroom so that students can develop autonomous learning strategies and take a trial-and-error approach to learning without fear of making mistakes. Second, the teaching practices of middle school English classes in Korea largely involve close-ended tasks that focus on narrowly defined skills. In these classes, students' performance is usually evaluated based on the number of correct answers rather than their overall learning progress, which may lead students to avoid challenging tasks and focus on easier ones. This finding suggests that when designing a self-exploratory learning environment, it is important to accurately predict the level of difficulty of each task and provide scaffolding through hints or clues so that students do not easily give up on solving difficult tasks on their own. Third, some participants may have felt uncomfortable with the high level of freedom during the activity. Yoon and Rönnlund (2021) reported a case in which Korean middle school students voluntarily gave up their agency in student-centered lessons in order to conform to the school's strict evaluation system. Although the participants were not evaluated on their performance in the metaverse, their preference for more structured instruction in the classroom may have led to an expectation of explicit teacher guidance and control (Lee & Boo, 2022). Given that the creation of a playful metaverse space alone may not automatically facilitate self-exploratory learning for all learners (Kozlova, 2018), further research is needed to develop design and instructional strategies that can effectively foster Korean students' agency in an autonomy-supportive learning environment.

6. Conclusion

To address the limitations of EFL classrooms, which still focus on teacher-led lectures and drill and practice, the present study created a virtual space grounded in constructivist learning principles and demonstrated how contextualized, active, and collaborative learning can be successfully integrated and realized in a virtual environment for playful constructivism. However, this study has several limitations. First, the experiment was conducted in a single session with a small group of students. To further examine the long-term effect of the activity on L2 learning, immediate and delayed tests should be conducted. In particular, as L2 learning cannot occur in a short period of time, it is recommended that the learning period be extended. Future studies should also explore L2 learning in the metaverse with more diverse groups of students in terms of affective, cognitive, and social aspects. Additionally, the students in the present study often used their L1 during the task, which limited their L2 learning opportunities. Creating mixed groups with different L1 backgrounds could provide greater benefits in terms of language learning and intercultural awareness. While creating mixed groups is not feasible in the in-person English classroom in Korea, the metaverse makes this possible; therefore, future studies should explore this potential. Further exploration of students' oral interactions in the metaverse may shed light on how collaborative learning is realized and enacted in practice (Kim, 2021), especially given the paucity of existing literature that examines learners' spoken discourse in the metaverse. Additional research is needed to further investigate the effect of incorporating game-based features in a

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virtual space and its impact on learner collaboration for language learning. The inclusion of learners' self-exploration components (i.e. open-world design) remains another area that could benefit from additional research. It is suggested that future research could provide valuable insights into how instructors can utilize customizable metaverse platforms for L2 learning.

Supplementary material. To view supplementary material referred to in this article, please visit https://doi.org/10.1017/S0958344024000235

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References

Admiraal, W., Huizenga, J., Akkerman, S. & ten Dam, G. (2011) The concept of flow in collaborative game-based learning. *Computers in Human Behavior*, 27(3): 1185–1194. https://doi.org/10.1016/j.chb.2010.12.013

Agbatogun, A. O. (2014) Developing learners' second language communicative competence through active learning: Clickers or communicative approach? *Journal of Educational Technology & Society*, 17(2): 257–269. https://www.jstor.org/stable/jeductechsoci.17.2.257

Ardito, G. & Czerkawski, B. (2021) The development of autonomous student learning networks: Patterns of interactions in an open world learning environment for teachers exploring teaching with and through computer science. *Sustainability*, 13(16): Article 8696. https://doi.org/10.3390/su13168696

Bao, R. & Du, X. (2015) Learners' L1 use in a task-based classroom: Learning Chinese as a foreign language from a sociocultural perspective. *Journal of Language Teaching and Research*, 6(1): 12–20. https://doi.org/10.17507/jltr.0601.02

Berns, A., Isla-Montes, J.-L., Palomo-Duarte, M. & Dodero, J.-M. (2016) Motivation, students' needs and learning outcomes: A hybrid game-based app for enhanced language learning. *SpringerPlus*, 5: Article 1305. https://doi.org/10.1186/s40064-016-2971-1

Borthick, A. F. & Jones, D. R. (2000) The motivation for collaborative discovery learning online and its application in an information systems assurance course. *Issues in Accounting Education*, 15(2): 181–210. https://doi.org/10.2308/iace.2000.15.2.181

Chen, J. C. & Kent, S. (2020) Task engagement, learner motivation and avatar identities of struggling English language learners in the 3D virtual world. *System*, 88: Article 102168. https://doi.org/10.1016/j.system.2019.102168

Chen, Z.-H., Chen, H. H.-J. & Dai, W.-J. (2018) Using narrative-based contextual games to enhance language learning: A case study. *Journal of Educational Technology & Society*, 21(3): 186–198. https://www.jstor.org/stable/26458517

Cornillie, F. & Desmet, P. (2013) Seeking out fun failure: How positive failure feedback could enhance the instructional effectiveness of CALL mini-games. *WorldCALL 2013: Global perspectives on computer-assisted language learning*. Northern Ireland: University of Ulster, 64–68.

Creswell, J. W. (2003) *Research design: Qualitative, quantitative, and mixed method approaches* (2nd ed.). Thousand Oaks: Sage Publications.

Er, M., Altunay, U. & Yurdabakan, İ. (2012) The effects of active learning on foreign language self-concept and reading comprehensive on achievement. *International Journal on New Trends in Education and Their Implications*, 3(4): 43–58.

Far, F. F. & Taghizadeh, M. (2022) Comparing the effects of digital and non-digital gamification on EFL learners' collocation knowledge, perceptions, and sense of flow. *Computer Assisted Language Learning*. Advance online publication. https://doi.org/10.1080/09588221.2022.2146724

Foushee, R., Srinivasan, M. & Xu, F. (2023) Active learning in language development. *Current Directions in Psychological Science*, 32(3): 250–257. https://doi.org/10.1177/09637214221123920

Göğüş, A. (2012) Active learning. In Norbert, M. S. (ed.), *Encyclopedia of the sciences of learning*. New York: Springer, 77–80. https://doi.org/10.1007/978-1-4419-1428-6_489

Gomez, E. A., Wu, D. & Passerini, K. (2010) Computer-supported team-based learning: The impact of motivation, enjoyment and team contributions on learning outcomes. *Computers & Education*, 55(1): 378–390. https://doi.org/10.1016/j.compedu.2010.02.003

Hirata, Y. (2023) Do avatar-assisted virtual classrooms work for students with low speaking confidence?: A qualitative study. *Interactive Technology and Smart Education*, 20(3): 335–349. https://doi.org/10.1108/ITSE-10-2022-0142

Hong, S., Lee, S. & Ahn, T. (2022) Exploring features facilitating learning in the metaverse. *Journal of Korean Game Society*, 22(3): 71–82. https://doi.org/10.7583/JKGS.2022.22.3.71

https://doi.org/10.1017/S0958344024000235 Published online by Cambridge University Press

Hwang, W.-Y., Chen, H. S. L., Shadiev, R., Huang, R. Y.-M. & Chen, C.-Y. (2014) Improving English as a foreign language writing in elementary schools using mobile devices in familiar situational contexts. *Computer Assisted Language Learning*, 27(5): 359–378. https://doi.org/10.1080/09588221.2012.733711

Hwang, W.-Y., Shih, T. K., Ma, Z.-H., Shadiev, R. & Chen, S.-Y. (2016) Evaluating listening and speaking skills in a mobile game-based learning environment with situational contexts. *Computer Assisted Language Learning*, 29(4): 639–657. https://doi.org/10.1080/09588221.2015.1016438

Information Resources Management Association. (ed.) (2019) *Virtual reality in education: Breakthroughs in research and practice*. Hershey: Information Science Reference.

Jang, J. (2021) A study on a Korean speaking class based on metaverse – Using Gather.town. *Journal of Korean Language Education*, 32(4): 279–301.

Jeon, J., Lee, S. & Choe, H. (2022) Enhancing EFL pre-service teachers' affordance noticing and utilizing with the synthesis of qualitative evidence strategies: An exploratory study of a customizable virtual environment platform. *Computers & Education*, 190: Article 104620. https://doi.org/10.1016/j.compedu.2022.104620

Jeong, G. & Kim, H. (2022) Elementary school students' perceptions of interaction in English learning using Gather Town. *Journal of Education & Culture*, 28(2): 345–368.

Kim, M. H. (2021) Effects of collaborative learning in a virtual environment on students' academic achievement and satisfaction. *Journal of Digital Convergence*, 19(4): 1–8.

Kou, Y. & Gui, X. (2014) Playing with strangers: Understanding temporary teams in League of Legends. In Nacke, L. E. (ed.), *CHI PLAY 2014: Proceedings of the First ACM SIGCHI Annual Symposium on Computer–Human Interaction in Play*. New York: Association for Computing Machinery, 161–169. https://doi.org/10.1145/2658537.2658538

Kozlova, I. (2018) Task-based language learning and learner autonomy in 3D virtual worlds. In Qian, Y. (ed.), *Integrating multi-user virtual environments in modern classrooms*. Hershey: IGI Global, 50–73. https://doi.org/10.4018/978-1-5225-3719-9.ch003

Lan, Y.-J., Kan, Y.-H., Sung, Y.-T. & Chang, K.-E. (2016) Oral-performance language tasks for CSL beginners in Second Life. *Language Learning & Technology*, 20(3): 60–79. https://doi.org/10125/44482

Lee, H. & Boo, E. (2022) The effects of teachers' instructional styles on students' interest in learning school subjects and academic achievement: Differences according to students' gender and prior interest. *Learning and Individual Differences*, 99: Article 102200. https://doi.org/10.1016/j.lindif.2022.102200

Lee, S. & Ahn, T. (2022) Middle school students' interactional behaviors and perception of English-speaking activities in metaverse. *Secondary English Education*, 15(3): 25–44. https://doi.org/10.20487/kasee.15.3.202208.25

Lee, S.-M. (2023a) Factors affecting incidental L2 vocabulary acquisition and retention in a game-enhanced learning environment. *ReCALL*, 35(3): 274–289. https://doi.org/10.1017/S0958344022000209

Lee, S.-M. (2023b) Second language learning through an emergent narrative in a narrative-rich customizable metaverse platform. *IEEE Transactions on Learning Technologies*, 16(6): 1071–1081. https://doi.org/10.1109/TLT.2023.3267563

Lee, S.-M. & Park, M. (2020) Reconceptualization of the context in language learning with a location-based AR app. *Computer Assisted Language Learning*, 33(8): 936–959. https://doi.org/10.1080/09588221.2019.1602545

Li, H., Majumdar, R., Chen, M.-R. A. & Ogata, H. (2021) Goal-oriented active learning (GOAL) system to promote reading engagement, self-directed learning behavior, and motivation in extensive reading. *Computers & Education*, 171: Article 104239. https://doi.org/10.1016/j.compedu.2021.104239

Li, P. & Lan, Y.-J. (2022) Digital language learning (DLL): Insights from behavior, cognition, and the brain. *Bilingualism: Language and Cognition*, 25(3): 361–378. https://doi.org/10.1017/S1366728921000353

Li, R., Lund, A. & Nordsteien, A. (2023) The link between flipped and active learning: A scoping review. *Teaching in Higher Education*, 28(8): 1993–2027. https://doi.org/10.1080/13562517.2021.1943655

Lin, T.-J. & Lan, Y.-J. (2015) Language learning in virtual reality environments: Past, present, and future. *Journal of Educational Technology & Society*, 18(4): 486–497. http://www.jstor.org/stable/jeductechsoci.18.4.486

Makransky, G. & Petersen, G. B. (2021) The cognitive affective model of immersive learning (CAMIL): A theoretical research-based model of learning in immersive virtual reality. *Educational Psychology Review*, 33: 937–958. https://doi.org/10.1007/s10648-020-09586-2

Marone, V. (2016) Playful constructivism: Making sense of digital games for learning and creativity through play, design, and participation. *Journal of Virtual Worlds Research*, 9(3): 1–18. https://doi.org/10.4101/jvwr.v9i3.7244

Mercer, S. (2011) Understanding learner agency as a complex dynamic system. *System*, 39(4): 427–436. https://doi.org/10.1016/j.system.2011.08.001

Najjar, N., Stubler, A., Ramaprasad, H., Lipford, H. & Wilson, D. (2022) Evaluating students' perceptions of online learning with 2-D virtual spaces. In Merkle, L. & Doyle, M. (eds.), *SIGCSE 2022: Proceedings of the 53rd ACM Technical Symposium on Computer Science Education*. New York: Association for Computing Machinery, 112–118. https://doi.org/10.1145/3478431.3499396

Ng, D. T. K. (2022) What is the metaverse? Definitions, technologies and the community of inquiry. *Australasian Journal of Educational Technology*, 38(4): 190–205. https://doi.org/10.14742/ajet.7945

https://doi.org/10.1017/S0958344024000235 Published online by Cambridge University Press

Ohta, A. S. (2001) *Second language acquisition processes in the classroom: Learning Japanese*. Mahwah: Lawrence Erlbaum Associates. https://doi.org/10.4324/9781410604712

Park, I. (2020) Problem development for PBL-based English science classes in elementary schools. *Journal of the Korea Academia-Industrial Cooperation Society*, 21(4): 33–38.

Reeve, J., Vansteenkiste, M., Assor, A., Ahmad, I., Cheon, S. H., Jang, H., Kaplan, H., Moss, J. D., Olaussen, B. S. & Wang, C. K. J. (2014) The beliefs that underlie autonomy-supportive and controlling teaching: A multinational investigation. *Motivation and Emotion*, 38(1): 93–110. https://doi.org/10.1007/s11031-013-9367-0

Saab, N., van Jooligen, W. R. & van Hout-Wolters, B. H. A. M. (2005) Communication in collaborative discovery learning. *British Journal of Educational Psychology*, 75(4): 603–621. https://doi.org/10.1348/000709905X42905

Scholz, K. W., Komornicka, J. N. & Moore, A. (2021) Gamifying history: Designing and implementing a game-based learning course design framework. *Teaching & Learning Inquiry*, 9(1): 99–116. https://doi.org/10.20343/teachlearninqu.9.1.9

Shatz, I. (2015) Using gamification and gaming in order to promote risk taking in the language learning process. In *Proceedings of the 13th Annual MEITAL National Conference*. Haifa: Technion, 227–232.

Thrasher, T. (2022) The impact of virtual reality on L2 French learners' language anxiety and oral comprehensibility: An exploratory study. *CALICO Journal*, 39(2): 219–238. https://doi.org/10.1558/cj.42198

Wang, C., Lan, Y.-J., Tseng, W.-T., Lin, Y.-T. R. & Gupta, K. C.-L. (2020) On the effects of 3D virtual worlds in language learning – A meta-analysis. *Computer Assisted Language Learning*, 33(8): 891–915. https://doi.org/10.1080/09588221.2019.1598444

Wu, J. G., Zhang, D. & Wang, M. (2022) Game-based virtual reality for languaculture learning: An example of the forbidden city. In Dengel, A., Bourguet, M.-L., Pedrosa, D., Hutson, J., Erenli, K., Economou, D., Peña-Rios, A. & Richter, J. (eds.), *2022 8th International Conference of the Immersive Learning Research Network (iLRN)*. Piscataway: Institute of Electrical and Electronics Engineers, 1–5. https://doi.org/10.23919/iLRN55037.2022.9815946

Xie, Y., Chen, Y. & Ryder, L. H. (2021) Effects of using mobile-based virtual reality on Chinese L2 students' oral proficiency. *Computer Assisted Language Learning*, 34(3): 225–235. https://doi.org/10.1080/09588221.2019.1604551

Yang, F.-C. O., Lo, F.-Y. R., Hsieh, J. C. & Wu, W.-C. V. (2020) Facilitating communicative ability of EFL learners via high-immersion virtual reality. *Journal of Educational Technology & Society*, 23(1): 30–49. https://www.jstor.org/stable/26915405

Yoon, J. & Rönnlund, M. (2021) Control and agency in student–teacher relations: A cross–cultural perspective on Finnish and Korean comprehensive schools. *Education Inquiry*, 12(1): 54–72. https://doi.org/10.1080/20004508.2020.1744350

Zhang, S., Chen, H., Wen, Y., Deng, L., Cai, Z. & Sun, M. (2021) Exploring the influence of interactive network and collective knowledge construction mode on students' perceived collective agency. *Computers & Education*, 171: 104240. https://doi.org/10.1016/j.compedu.2021.104240

Zhao, Y. A., Srite, M., Kim, S. & Lee, J. (2021) Effect of team cohesion on flow: An empirical study of team-based gamification for enterprise resource planning systems in online classes. *Decision Sciences Journal of Innovative Education*, 19(3): 173–184. https://doi.org/10.1111/dsji.12240

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