# Challenges and opportunities in using digital pedagogy for game-based architecture education: a case in China

**Abstract.** Digital pedagogy (DP) has received increasing attention from different disciplines to study the dedicated use of contemporary digital technologies (e.g., virtual learning environments and digital media platforms) for inclusive and personalized learning and teaching. Applying DP appropriately can help teachers to shift from traditional instruction methods towards more interactive and engaging approaches for high-quality education. Under the umbrella of DP, digital game-based learning (DGBL) represents a pedagogical approach that utilizes interactive and immersive digital games to nourish the development of critical thinking and problem-solving skills for student-centred active learning. However, how teachers can apply DGBL effectively in architecture education is still being determined. We conducted a qualitative case study to explore student engagement after implementing the DGBL pedagogy supported by H5P escape room learning activities in an architecture course with 121 university students. Our study found that the game elements and the characteristics of architecture education influenced students' learning engagement in four aspects (behavioural, emotional, cognitive and social). The main research findings contribute to digital pedagogy by extending people's understanding of the DGBL's impact on learner engagement with rich empirical data. Limitations and practical implications were discussed for future development.

**Keywords:** Architectural Education, Escape room, Digital game-based learning, H5P, Engagement

## 1 Introduction and literature review

In recent years, the field of education has witnessed a significant transformation fuelled by the rapid advancement of digital technologies. Several studies and research explore how to integrate digital and immersive tools to enhance the existing workflow of students and teachers by highlighting advantages and disadvantages in education and practice and pursuing different goals [6]. One of the main aims of implementing this new approach in Architecture education is to bridge the gap between theoretical concepts and real-world applications. However, successfully integrating these two methods in the Architecture realm remains a complex endeavour, often presenting numerous challenges and untapped opportunities.

H5P is an open-source technology that provides a versatile platform for creating and delivering interactive content that can be seamlessly integrated into learning management systems and web-based applications. Therefore, this study explores mainly the following research question: In what ways the use of H5P-assisted DGBL in curriculum design improves learning engagement?

### 1.1 Digital game-based learning and architecture education

Digital Game-Based Learning was first coined by [18] as "the coming together of serious learning and interactive entertainment into a newly emerging and fascinating medium". Over the past two decades, the inclination towards DGBL has gained momentum in the educational context, particularly online and blended educational contexts. DGBL is seen as a tool that can benefit architecture education. From the original French École des Beaux-Arts movement to the giant leap of Bauhaus ideas to our present-day emphasis on interdisciplinary instructional methods, the long history of architecture education has evolved around the project-based praxis and the student-centred constructive approach [24]. The professional practice, as a significant and yet influential segment of education in the study of architecture, helps in many ways; it allows students to understand the theoretical knowledge at a practical level, get acquainted with current trends in domestic or foreign professional practice, develop teamwork and problem-solving skills [19].

This lays the foundation for the application of DGBL in architecture education. Firstly, DGBL effectively promotes the development of students' problem-solving skills [2, 11], harmonising architecture education's educational purpose. Furthermore, DGBL experts believe that the true power of digital games lies in using real-world context and authentic tasks [15, 23]. This allows learners to apply what is learned by solving real problems from the field and activate relevant prior knowledge, aligning with architecture education's main focus. Another benefit of DGBL is the self-oriented trial and error process. In architecture education, students employ various techniques, including modelling and sketching, to generate personal expressions [24]. Similarly, DGBL creates a safe environment for the learners to try without fear of failure [15].

### 1.2 Impact of digital game-based learning on student engagement.

Engagement refers to "psychological investment in and effort directed toward learning, understanding, or mastering the knowledge, skills, or crafts that academic work is intended to promote" [17]. It is a meta-construct that includes different dimensions and indicators. The models of engagement proposed by different researchers have consistently addressed three common sub-constructs that include a) cognitive engagement, which involves the mental effort investment in learning and the idea of self-regulation or the use of cognitive strategy; b) behavioural engagement, which is related to observable behaviours of active participation, such as effort, concentration, attendance to classes, asking questions, and contributing to class, commonly understood as time "on task"; and c) emotional engagement, which refers to feelings and emotional reactions, such as interest, enjoyment, enthusiasm, feelings of belonging, and value of learning [8, 9, 10, 14].

More recently, a MOOC (Massive Open Online Courses) engagement scale further distinguished social engagement, centred on learner-instructor and learner-learner interactions, from behavioural engagement as the fourth dimension of learner engagement in MOOCs [5]. All the dynamically interrelated dimensions of engagement are essential mediators of interest in game-based learning [8]. In this line of reasoning, high engagement entails heightened concentration, enjoyment, commitment, effort, and positive affect toward the activity, showing a significant positive footprint on learning and

teaching [12]. This study focuses on the four components of learner engagement: behavioural, cognitive, emotional, and social while examining the relationship between learner engagement and a DGBL intervention in an architecture course.

## 2 Research methodology

### 2.1 Research setting

The four-year full-time BEng-Architecture at the Department of Architecture at REDACT FOR PEER REVIEW in REDACT FOR PEER REVIEW for the academic year 22/23 has started to experiment in that sense using the H5P tool by choosing a 5-credit taught module. The selected module is named REDACT FOR PEER REVIEW, which introduces students to the role and responsibility of the architect as a professional and in the construction industry, together with exposing them to concepts about the management of an architecture practice. During the previous academic years, this module has recorded low levels of engagement and interest by students that have become evident throughout the collection of low attendance rates and discontinuous levels of engagement and interaction with the teaching team.

In light of these special conditions and the additional learning and teaching issues faced during the last three years of the Covid-19 pandemic, during the second half of the academic year 22-23, the REDACT FOR PEER REVIEW module included among its contents an additional support section to help students consolidate and internalize the knowledge and learning outcomes provided by the module consciously and maturely. Specifically, the activity selected by the various package of options included in the H5P tool was that of interactive videos linked to a system of escape rooms. A series of three short videos (maximum 5 minutes each) related to the fundamental topics of the module were made, referring to the essential part of the final assignment requested for completing the module successfully. The main aim of the activity was that students watched these videos answering questions on the main topic embedded in them. To continue watching the video and especially the following ones, the students had to provide the correct answer; otherwise, they would get stuck on the video watched. In this way, students could resolve doubts and strengthen the essential concepts to complete their final submission and achieve the fundamental module's learning outcomes. In this research, the main strategy relied on a previous study [25] employing a new digital technology, HTML 5 Package (H5P), to design and deliver learning in a professional practice class within the architecture curriculum through online digital escape rooms on the Moodle-based virtual learning environment, namely the learning mall. The primary motivation of the Module Coordinator for introducing the online digital escape room supported by the H5P technology was to improve students' learning experience and performance. Providing a highly engaging activity can help students achieve the learning outcomes in the authentic content of DGBL and increase the course participation rate that in these last years registered a quite low attendance percentage and a discontinuous level of engagement.

### 2.2 Participants, data collection and analysis.

The non-probability sampling technique was employed in this study to obtain feedback faster, simpler, and more practically [26]. 10 senior undergraduate students, 6 females and 4 males, who attended the escape room in the architecture professional practice course, voluntarily participated in the one-on-one interviews. Before data collection, all participants received an explanation of the project to ensure that they were fully aware of the research aims. The consent form and participant information sheet were provided and signed in advance. Qualitative data collection methods were employed with semi-structured individual interviews to examine different dimensions of learner engagement in the course and key drivers of engagement created by the features embedded within the DGBL activity. Qualitative research facilitates a deeper understanding of the causality between people's beliefs and understandings, their behaviour, and the context of the intervention being implemented [16]. Additionally, the interview has been the mainstay of qualitative research to give a "voice" to persons for authentic experiences that are important to the present study's research questions [4, 22]. The one-on-one interviews lasted 20 to 30 minutes each. All interviews were audio-recorded. Two researchers conducted the interviews via online meeting, transcribed the audio recordings into text, translated the Chinese text into English if the interview was conducted in Chinese, and manually cross-checked the auto-transcription and translation results before analysing the data.

The recorded interview transcriptions were coded with NVivo 12 qualitative analysis software. Data analysis adhered to the thematic analysis approach [21], with a hybrid approach incorporating deductive and inductive coding [7]. A predetermined code manual was developed based on the research questions and literature review. The final version of the code manual consisted of two parts. First, the four dimensions of learner engagement (behavioural, cognitive, emotional and social) were divided into 11 subcategories. Second, the coding scheme focused on identifying factors that enhance learner engagement in the DGBL setting. Data analysis was conducted separately, which allowed the independent coder to gain familiarity with the coding scheme. After confirming and consolidating the identified coding categories, the researchers met online to compare their analysis and classify results. The two independent coders discussed all disparities until an agreement was reached. Before the thematic analysis was finished, two rounds of coding comparisons were examined together with a literature search. Overall dimensions relevant to the research questions were identified and further analysed.

## 3 Results

### 3.1 Student engagement

To identify students' performance on academic engagement following the use of H5P, the researchers gained insights from the literature and empirical data (interviews and open-ended survey questions). This study conceptualized academic engagement in an

explanatory matrix across four dimensions: (1) behavioural engagement, (2) emotional engagement, (3) cognitive engagement (4) social engagement.

*Behavioural engagement*. The behavioural engagement dimension concerns students' observable actions and their participation and involvement in educational activities. It entails time on task, students' behaviours regarding rules and expectations, and student participation in learning activities, including effort, persistence, concentration, attention, asking questions, and contributing to the discussion. Student state excerpt examples:

Student A: "I may use it for a long time".

Student B: "I will follow its order, take notes while watching the video, and then answer the questions".

Student C: "When I use the H5P, I will ask questions if there's something I don't understand".

*Emotional engagement*. Emotional engagement refers to students' affective reactions in the classroom, including interest, boredom, happiness, sadness, and anxiety. Some conceptualize it as identification with school, belonging (a feeling of being essential to the school), and value (an appreciation of success in school-related outcomes). Student state excerpt examples:

Student D: "I think H5P is a fun learning activity that makes it a bit easier to learn, you don't have to memories, and you can remember the knowledge more easily."

Student E: "I think it's one of the more emerging learning experiences that I've been exposed to, so I'm just interested in it, and that would then lead me to be very willing to learn about it and continue to watch these related learning videos."

*Cognitive engagement*. Cognitive engagement defines as the levels of processing theory, including the idea of deep versus shallow engagement. Deep engagement involves actively using prior knowledge and intentionally creating more complex knowledge structures by integrating new information with prior knowledge. Shal-low engagement involves rote processing and other intentional cognitive actions that are more mechanical than thoughtful. Student state excerpt examples:

Student F: "Because I use it at the end of the course to help with revision, and because many of our exams are taken at the end of the course, H5P provides an active learning and independent exploration process that allows students to work independently to review their knowledge, which can help improve performance and aid our learning."

Student G: "I think it's good to take notes while watching the video because you might miss a section in the process, so you can go back and watch it again."

*Social engagement*. Social engagement is centred on learner-instructor and learner-learner interactions. It highlights the importance of collaboration, social learning, interaction and communication patterns in online discussion and motivation for attending offline meetings. Student state excerpt examples:

Student H: "The most helpful thing is that I can use it to communicate with my teachers later, which has helped me a lot."

Student I: "Because each group of students may have different ideas when reading the same material, you can use this platform to see different perspectives on the same knowledge point and generate some collisions of ideas. The teacher will also better

understand each student's ideas because usually no one answers or interacts in class, but in this way, the teacher will better understand the students' ideas and give better feedback."

### 3.2 Factors that may influence students' engagement

The game elements have been divided into four relevant elements that address cognitive and affective aspects: (a) motivational elements (i.e. elements that influence players' thoughts, actions and reactions regarding meaningful play and learning); (b) interactive elements (i.e. elements that provide players with opportunities to engage and participate in gameplay activities); (c) fun elements (i.e. elements that provide players with a sense of fun and excitement); and (d) multimedia elements (i.e. elements that engage players through physical and/or multi-sensory interaction) [13]. Students perceived H5P as a gamified approach to learning similar to a breakout game, which would provide more fun and game rewards and a more experiential feel through multimedia technologies such as video interaction. Students are, therefore, motivated to use H5P for learning. Architectural education can be broken down through play, and the quality of education improves with this process, making nonformal education more suitable for lifelong learning than formal education in terms of operational flexibility and student attitudes to education. Students can experience first-hand the fundamental principles of architecture, 'the creation of events' and 'the construction of environments', through the 'environmental and spatial transformations' that characterise informal education. Student state excerpt examples:

Student J: "H5P is building a full aspect scenario based on knowledge, we can get a more practical feel for how it works, and it feels very interactive, so I like it."

Student I: "I think it's a breakout-like format, which is quite interesting."

Student E: "As this course is mainly about how to build a building, H5P uses this interactive approach to learn a lot about building construction, such as some safety hazards and what we need to be aware of during the actual operation."

Student F: "The course itself is a vocational education-related course, which will help you to understand the real industry."

## 4 Discussion and conclusions

Thanks to the results obtained through this research study, it is possible to affirm how the introduction of DGBL, specifically-the H5P tool, stimulates positive reactions by students and tutors. This approach is supported by the existing body of recent literature demonstrating the potential benefits of embedding these game technologies for improving the learning experience's quality-and enhancing student engagement.

In this case, students will not feel uncomfortable about their possible failure during the first attempts. Otherwise, students will feel more motivated to re-do the activity to enhance their final results and, as an essential consequence, improve the quality of the knowledge acquired, understanding previous mistakes and possible misunderstandings. The feeling of inadequacy and performance anxiety that students generally experience attending classes or modules will be replaced by a positive sense of self-improvement

based on the principles of emotional engagement [8, 9, 10, 14]. The description above represents a clear example of how DGBL raises students' focus and active commitment since it facilitates learning engagingly and joyfully.

Furthermore, the qualitative data collected in the results reveal that the design and provision of DG pedagogy, through the H5P tool, in a lecture-based module of the architecture curriculum can effectively boost students' behavioural engagement. It is evident in the interview report how students changed their attitude regarding the interaction with tutors, peers, and the module's tasks. Understanding the positive benefits of utilizing gamified elements in their learning experience, they started to wish to be more active during the class session sharing doubts or considerations to clarify any possible misunderstanding.

DGBL has detractors and critics. For example, [3] explains that the introduction of games into the contemporary learning system has been abused by the Companies that produce the games themselves for profit, given the rampant popularity recorded in recent years. These analyses can generate mistrust about the effectiveness of implementing game design principles in education because they highlight an absence of profound design studies and research. On the other hand, it is also true that despite the weaknesses mentioned above by the misuse of gamification, its principles introduced in the educational field are promising to improve students' educational experience and spread complex concepts appealingly [1].

To conclude, this study made practical and theoretical contributions to improve students' engagement and learning experiences within and beyond architecture education. In addition, this research showcased an excellent practice of digital games as elements that provide a safe and friendly environment for students [20]. Overall, this paper contributes to the existing body of knowledge by shedding light on the challenges and opportunities associated with using digital pedagogy for game-based architecture education [1]. As a future enhancement plan, there is the intention to expand the planning of gaming activity to the whole module to involve students since the earlier stage of the course topics' dissemination.

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