Diagnosing student acceptance and designing digital gamified learning: an integrated UTAUT and TPACK perspective

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General Introduction

1.1. Introduction

Digital gamified learning is a new teaching approach that can be potentially effective in increasing student motivation (Hamari et al., 2014). It might directly affect the motivational level of learners by integrating various game principles, such as points, badges, and leaderboards, in non-game learning settings (Deterding et al., 2011). In terms of extrinsic motivation, it can provide clear external incentives using well-defined objectives, instant feedback, and reward/punishment mechanisms. Regarding intrinsic motivation, carefully designed gamified experiences can develop students' intrinsic motivation by offering challenging tasks (competence), rights of choice (autonomy), and promoting teamwork (relatedness) (Sailer & Homner, 2020).

However, although digital gamified learning has been theoretically proven to enhance student motivation, its practical effectiveness in education is often limited by significant shortcomings in pre-class preparation. Teachers tend to pick digital gamified resources due to their personal experience or access to technology without considering students' desires, needs, and preferences, which may lead to a misfit between the game design and students (Bai et al., 2020). Oliveira and Bittencourt (2019) proved that particular game elements motivating students or not depended on individuals' characteristics and learning needs. For example, Huang et al. (2019) stated that some introverts experienced anxiety when competing with other players, so they were less likely to engage in such classroom exercises. Similarly, key determinants and challenges of conducting gamified classes were defined by Demirbilek et al. (2022) through interviews with teachers. It stressed that some students were not involved in the gamified learning process because it failed to meet their learning objectives successfully. As emphasized by Vygotsky's zone of proximal development theory, instructional interventions must be grounded in accurate assessments of learners' existing cognitive levels and interests to construct effective learning scaffolding (Denehere et al., 2013). The pre-class diagnosis and planning phase directly defines how classroom instruction can be used to elicit deep student involvement and consequently improve their performance. In particular, the pre-class stage of digital gamified learning should consist of two important dimensions, including the diagnosis of student acceptance and planning of the game design. First, students' acceptance of digital gamified learning is an essential prerequisite for designing classes. Because students are the principal actors in teaching and are central to the effects of in-class learning activities (Klemenčič, 2020), the implementation of digital gamified learning as pedagogic resources in the classroom depends greatly on their perceptions. To be effective, a successful learning application ought to be highly adopted by learners. Otherwise, it will have a temporary effect (Razami & Ibrahim, 2022). Second, if students accept the use of an instructional intervention in class, the next challenge for teachers is to understand how to design suitable class activities and content to satisfy students' expectations. According to Gagne et al. (2005), learning is an event governed by an internal information-processing process. External instruction must systematically support this internal process through deliberate design. This design serves as a key factor that connects learning objectives to outcomes. When it comes to specific contexts of digital gamified learning, the learning potential of it could be maximized only when class designers focus on both the students' learning needs and game elements (Krath et al., 2021).

Given the importance of the pre-class phase for digital gaming effectiveness on learner motivation, there is a pressing need for research specifically on this stage. To narrow this research gap and give directions for practical pre-class preparation for gamified learning, we simultaneously diagnose students' acceptance of gamified learning and examine how to design gamified classes in this dissertation. The remainder of the introduction begins with a description of the brief illustration of gamified learning for student motivation, followed by the theoretical background, and finally an overview and outline of the following chapters.

1.2. Definition of gamified learning

In educational contexts, game-based learning (GBL) and gamification are often discussed as different concepts. The former emphasizes using existing games with complete rules and objectives as primary instructional applications (e.g., business simulation software, educational video games) (Shi & Shih, 2015). The latter refers to embedding game elements (e.g., points, badges, leaderboards) within non-game contexts to change students' behavior and enhance their learning experience (Deterding et al., 2011). Although GBL and gamification are two different terms, their core roles lie in successfully stimulating and sustaining learners' intrinsic and extrinsic motivation. Both approaches are designed to address fundamental psychological needs such as autonomy, competence, and relatedness (Ryan & Deci, 2000), and then guide learners into a state of focused and pleasurable flow experience (Nakamura & Csikszentmihalyi, 2009). Due to these similarities, recent studies have increasingly tended to blur their definition boundaries or even to integrate both into practice. For example, Subhash and Cudney (2018) regarded gamification as the intentional use of games to fulfill learning objectives. Camacho-Sánchez et al. (2022) stated that these two concepts are different but compatible. In their studies, they integrated these two methodological approaches as a new teaching tool and found that it can promote student active learning, improve their performance, and keep their motivation at a high level.

1.3. Gamified learning in the digital era: the evolution and status quo

In recent years, gamified learning has been increasingly digitized since such environments align well with the preferences and learning habits of this generation of students. It can provide interactive and exploratory digital environments that enable learners to investigate, experiment, and progressively construct both cognitive understanding and emotional engagement (Boyle et al., 2011). According to Hong et al. (2024), gamified classes these days have mostly relied on different digital systems. Consequently, this dissertation will focus specifically on the design of digital gamified learning environments.

Digital gamified learning, especially when used in in-class settings, has developed dramatically over the last few years. From the introduction of simple educational games or gamification to more advanced and engaging learning activities, teachers' awareness of its effect on improving learner engagement, motivation and learning achievement has grown gradually. In particular, digital gamified learning development has gone through three major stages. The first stage was at the beginning of the 2000s when educational digital games or gamification was created, mainly offering game-based experiences using one game mechanic such as stories, rewards, or punishment to teach fundamental learning contents (Gros, 2007; Moreno-Ger et al., 2009). The next stage was, in the early 2010s, when the immersive and interactive gaming setting became the predominant tendency due to the significant development of human-computer interaction (HCI), virtual reality (VR) and augmented reality (AR) (e.g., Laine et al., 2016; Kurniawati et al., 2019). At this stage, digital games were seen to be useful pedagogical resources and were applied in different learning contexts. For example, ClassDojo introduced game-like elements for behavior management, while Minecraft Education Edition allowed students to develop creative problem-solving skills within an open-world environment. The latest iteration of in-class digital gamified learning focuses on personalized learning and the use of adaptive learning technologies (2020s). Its feature guarantees that the students are involved and make progress at the pace appropriate to their learning needs (Klock et al., 2020; Hong et al., 2024). For example, educational games that are made in conjunction with artificial intelligence (AI) can offer real-time feedback and adjust content depending on the users' progress and thus, every gamified session is unique to the learner (e.g., Zhao et al., 2025). Moreover, game platforms have built-in data analytics that allow teachers to track student action traces, detect their learning pain points, and tailor learning tasks accordingly.

1.4. Learner motivation

Motivation involves the synthesis of both one's attitude and desire to exert effort towards attaining a specific aim (Lai, 2011). In educational settings, learner motivation may equip students with the required drive to boost their enthusiasm, and consequently, develop high levels of personal satisfaction and improve their learning outcomes (Coetzee, 2011). According to Kaveh (2010), it has a significant role in the learning process and accomplishment. As was already demonstrated in previous studies, there exists a strong relationship between learners' motivation and their academic performance. For example, the meta-analysis study conducted by Richardson et al. (2012) showed that there was a steady positive correlation between motivation and grade point average (GPA). Similarly, a survey by Zlate and Cucui (2015) also found motivation to be a significant predictor of academic success. Motivation can be further classified into intrinsic and extrinsic motivation. Intrinsic motivation occurs when learners participate in a behavior caused by interest, curiosity, or pleasure in the learning task itself (Ryan & Deci, 2000). The extrinsic motivation concerns getting certain rewards, earning good grades or escaping punishment (Coetzee, 2011). In spite of the fact that intrinsic motivation is one of the most important factors that can trigger the development of creativity and promote effective learning, extrinsic motivation also occupies an irreplaceable position in multifaceted learning environments because many activities are not intrinsically motivating (Buzdar et al., 2017). More importantly, it is critical to note that external motivation can become internalized and eventually converted into internal motivation over time once students have met their psychological requirements (Ryan & Deci, 2000). This transition is important to maintain long-term engagement in learning. In specific, based on self-determined theory, when educational design can stimulate students' autonomy (feeling that actions are voluntary), competence (feeling capable of mastery), and relatedness (feeling connected to others), they are more likely to integrate external rules and values into their sense of self, moving them from 'I must learn' to 'I want to learn' (Deci & Ryan, 2012). Therefore, to enhance student learning performance, the potential instructional intervention needs to not only activate students' intrinsic motivation but also design and utilize extrinsic motivation and create necessary conditions for its internalization.

1.5. Digital gamified learning for learner motivation and learning outcomes

Digital gamified learning has been regarded as one of the most effective and prominent teaching approaches for enhancing learner motivation and engagement (Jackson & McNamara, 2013; Millis et al., 2017). To be more specific, it could increase the fun of learning activities and create a relaxed atmosphere (Wichadee & Pattanapichet, 2018), eliciting students to express their feelings, emotions and articulate their perspectives (Kenali et al., 2019). In addition, digital game-based learning is a student-centered method, which allows students to engage themselves in what they learn (Wichadee & Pattanapichet, 2018). Motivation is a key determinant of class effectiveness (Heaslip et al., 2014). Enhanced learner motivation leads to the development of various abilities, such as problem-solving, skills, independence, and self-confidence throughout the educational process, thereby improving students' achievements (Kenali et al., 2019).

Although the beneficial impacts of digital games or gamification on learning performance have been pointed out by not a few studies, their negative effects should be taken into consideration as well. For example, Abadi et al. (2022) have conducted a literature review to investigate the advantages and disadvantages of gamification in education. They illustrated eight drawbacks of gamified classes, such as the high cost of applying and developing digital gamification systems, the disengagement due to the misuse of game elements, and the diminished value over time. Besides, the increased cognitive load is another concern (Turan et al., 2016). Turan et al. (2016) studied students' cognitive load and achievement in gamified classes using a quasi-experimental design. The results showed that the experimental group had an increased cognitive load compared with the control group. The possible reason might be that students have to deal with the gamified tasks apart from the learning content, which would result in their redundancy effects (Sweller et al., 1998).

1.6. Theoretical framework

In order to fulfill students' expectations and minimize the potential negative impact on students resulting from insufficient pre-class preparation, this dissertation is grounded in a dual-focus theoretical framework that integrates technology acceptance theory (UTAUT) with the Technological Pedagogical Content Knowledge (TPACK) model for instructional design. This integrated approach allows for a systematic investigation into not only whether students are willing to engage with gamified learning technologies (acceptance), but also how such technologies can be pedagogically and effectively embedded into course design to scaffold pre-class preparation (TPACK-based design). Consequently, this section will elaborate on this combined framework, detailing how it guides the investigation of student acceptance and the key design factors of supportive gamified classes.

1.6.1. Pre-class phase diagnosis: Determinants of students' acceptance of digital gamified learning

To fully understand the mechanism for integrating gamified tools in class, many conceptual models to guide educational research and practice have been developed and validated about the factors influencing students' technology acceptance.

Theory of Reasoned Action (TRA) is a basic model, which theorizes 'attitudes' and 'perceived subjective norms' as powerful determinants of predicting behaviors and acceptance of technological tools (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). TRA assumes that people perform one behavior only when they intend to do it (Kreijns et al., 2013). While this model is pioneering, its simplicity limits its explanatory power, particularly in situations where individuals face external constraints or require specific skills to perform behaviors. Rooted in the principle of TRA, the Technology Acceptance Model (TAM) proposes that users' readiness and willingness to use information systems (IS) depend on their 'perceived usefulness' and 'ease of use' of these technological tools (Davis, 1989). Although TAM has played a significant role in explaining technology application, there are still certain concerns to consider. In general, TAM mainly focuses on the functional features of technology without regard to the internal psychological determinants of student perception of technology. These factors are particularly important because, besides the mere usability of technology tools, the student would also be motivated by personal interests or more complicated cognitive objectives (e.g., critical thinking, problem-solving). Besides, theory of Planned Behavior (TPB) builds on the model of TRA, adding self-efficacy (Ajzen, 1991). However, even though TPB is used widely, its application in forecasting the usage of technology, including digital games in education, can be limited. Similar to TRA, it also neglects environmental constraint effects and cannot adequately consider the changes between different predictors in various settings. IMBP, derived from the Theory of Reasoned Action (TRA; Fishbein & Ajzen, 1975) and the Theory of Planned Behavior (TPB; Ajzen, 1991), provides a path to investigating factors influencing a particular behavior in a given population (Admiraal et al., 2013).

Based on these theoretical frameworks, the Unified Theory of Acceptance and Use of Technology (UTAUT) synthesizes the strengths of these models, allowing for a more comprehensive exploration of students' behavioral intentions and acceptance, and has been widely applied in existing research (Venkatesh et al, 2003). As stated by Marchewka and Kostiwa (2007), UTAUT accounted for approximately 70% of the variance in behavioral intention and acceptance to use a technology. It was a fairly good prediction compared with TAM for predicting learner usage. Some prior studies that have modified the UTAUT model to explore students' acceptance of digital games or gamification, failed to integrate game-specific variables (e.g., Kuang et al., 2024). (e.g., Kuang et al., 2024). The research contexts where behaviors are performed or not should be sufficiently specific (Kreijns et al., 2013), particularly within game-based learning environments, due to the inherent complexity of digital game design. Therefore, in this dissertation, building upon the existing UTAUT framework and elaborating on relevant contextual aspects related to 'gamified learning', various factors that are likely to influence the integration of gamified tools in education would be investigated.

1.6.2. Pre-class phase planning: key factors for gamified class design based on TPACK theory

Mishra and Koehler (2006) argued that the effective technology-integrated teaching approach requires teachers to develop convergent knowledge that synthesizes technology, pedagogy, and subject-specific content. Different dimensions of knowledge described in the TPACK model provide teachers with a critical tool to analyze the varying levels of technology integration observed in instructional practice (Koehler & Mishra, 2009). Among them, the three principal dimensions of knowledge are pedagogical knowledge, technological knowledge and content knowledge. Pedagogical knowledge (PK) is the knowledge about teaching and learning processes among teachers, including approaches to instruction, as well as more global educational aims, principles, and objectives (Graham, 2011). Technological knowledge (TK) can be defined as teachers' familiarity with technology, ranging from traditional instructional technologies such as textbooks and digital resources, to the Internet and multimedia tools (Mishra & Koehler, 2006). According to Baran and Uygun (2016), content knowledge (CK) is described as teachers' understanding of the teaching content they are responsible for. In addition, the systematic combination of these three knowledge types leads to the emergence of the other three knowledge dimensions, namely, pedagogical-content knowledge (PCK), technological-content knowledge (TCK), and technological-pedagogical knowledge (TPK). TPACK highlights how these types of knowledge are significant for class design because their incorporation can release the potential of technological tools.

The previous studies have shown that adopting TPACK model in the class design stage may lead to meaningful and engaging learning experiences (Koh, 2019), increased lesson coherence, and active involvement of the students (Chai, 2019). It may be due to the fact that when paying attention to the interactions of content, pedagogy, and technologies, it is easier to choose suitable technological instruments that will fit into teaching goals and strategies (Koehler & Mishra, 2009). For example, Harris and Hofer (2011) built a TPACK-based learning activity type taxonomy to help teachers in planning instruction. They showed that starting with content and pedagogical goals, instead of choosing a specific technological application, produced more robust design decisions. Recent findings also suggest that TPACK can improve teachers' confidence in technology integration, leading to more innovative classroom practices and higher levels of student motivation and learning outcomes (e.g., Martin et al., 2024). As a result, TPACK has been widely supported as an effective theoretical and practical framework for guiding technology-integrated class design.

1.7. Overview and outline of the dissertation

Although online games and gamification are very promising towards improving motivation among students, their real practical value may be compromised by poor preparation during the pre-class stage. Prior research has highlighted the need to diagnose student acceptance and to plan instructional design grounded in learner characteristics (e.g., Krath et al., 2021). However, there is limited research on a framework that systematically integrates the diagnosis of learner acceptance with the principles of effective, learner-centered class design planning. To address this gap, this dissertation first examined students' acceptance to understand the determinants of students' willingness to use digital games or gamification in class, relying on an extended UTAUT model. Then we attempted to explore key issues for designing a suitable digital game-based/gamified class using the TPACK framework. Since effective classes should encourage students' active participation and respond to what students require, the study of the pre-class design phase in this dissertation would mainly focus on tailoring gamified teaching, aiming to respect students' characteristics and fulfill their needs and expectations. Furthermore, it is worth noting that, due to the similar principles and mechanics of game and gamification, this dissertation will not strictly distinguish between them but will mainly focus on their shared pedagogical effectiveness. Instead, they will be collectively termed 'gamified learning' and defined as any teaching method that systematically employs game design thinking, game mechanics, or game-like experiences to enhance teaching effectiveness and learning motivation. The terms, including gamification and game, mentioned in this research would be discussed under this unified definition.

Accordingly, four studies are presented from diagnosing learner acceptance to detailing the 'what to learn', 'whom to teach', 'with what technological tool', and 'how to use technological tool' of design, seeking to provide teachers with an evidence-based path from pre-class diagnosis to actionable design (Figure 1.1). Starting with Chapter 2, we investigated key factors influencing students' acceptance of gamified learning as the prerequisite for instructional design.

Building upon this, Chapters 3 to 5 (Figure 1.2) shift to the instructional design itself, providing an in-depth analysis of one or more core knowledge dimensions of the TPACK framework, respectively (Figure 1.2). Specifically, Chapter 3 *(what to learn)* focuses on the content knowledge (CK) grounded in a comprehensive analysis of learning needs from three aspects, necessity, lacks and wants (Hutchinson & Waters, 1987). Furthermore, this study attempted to examine the fit between game elements and learning needs for building the technological content knowledge (TCK). Then, according to Shulman (1987), pedagogical content knowledge (PCK) is conceptualized as the integrative knowledge that synthesizes three key aspects: what to teach (CK), how to teach it (PK), and whom to teach (knowledge of learners). In the specific context of designing gamified classrooms, the development of a teacher's PCK is based on a structured understanding of the learners. To systematically cultivate this understanding during the instructional design phase, Chapter 4 collects different types of learner information for creating user profiles *(whom to teach)*. In the dimension of technological knowledge (TK) and pedagogical knowledge (PK), Chapter 5 *(with what technological tool & how to use technological tool)* explores the types of game elements used in tailored gamified contexts (TK). As pedagogical knowledge (PK), and emphasizes different tailored approaches for personalizing the gamified applications to align with students' individual characteristics (PK). In addition, this study further investigates the relationship between game elements and tailoring approaches to develop technological pedagogical knowledge (TPK). Therefore, this adapted framework provides a valuable insight into analyzing what to teach (CK), whom to teach (user profile/PCK), with what tools (TK), and how to teach (PK/TPK) and develop a practical TPACK system for effective gamified class design.

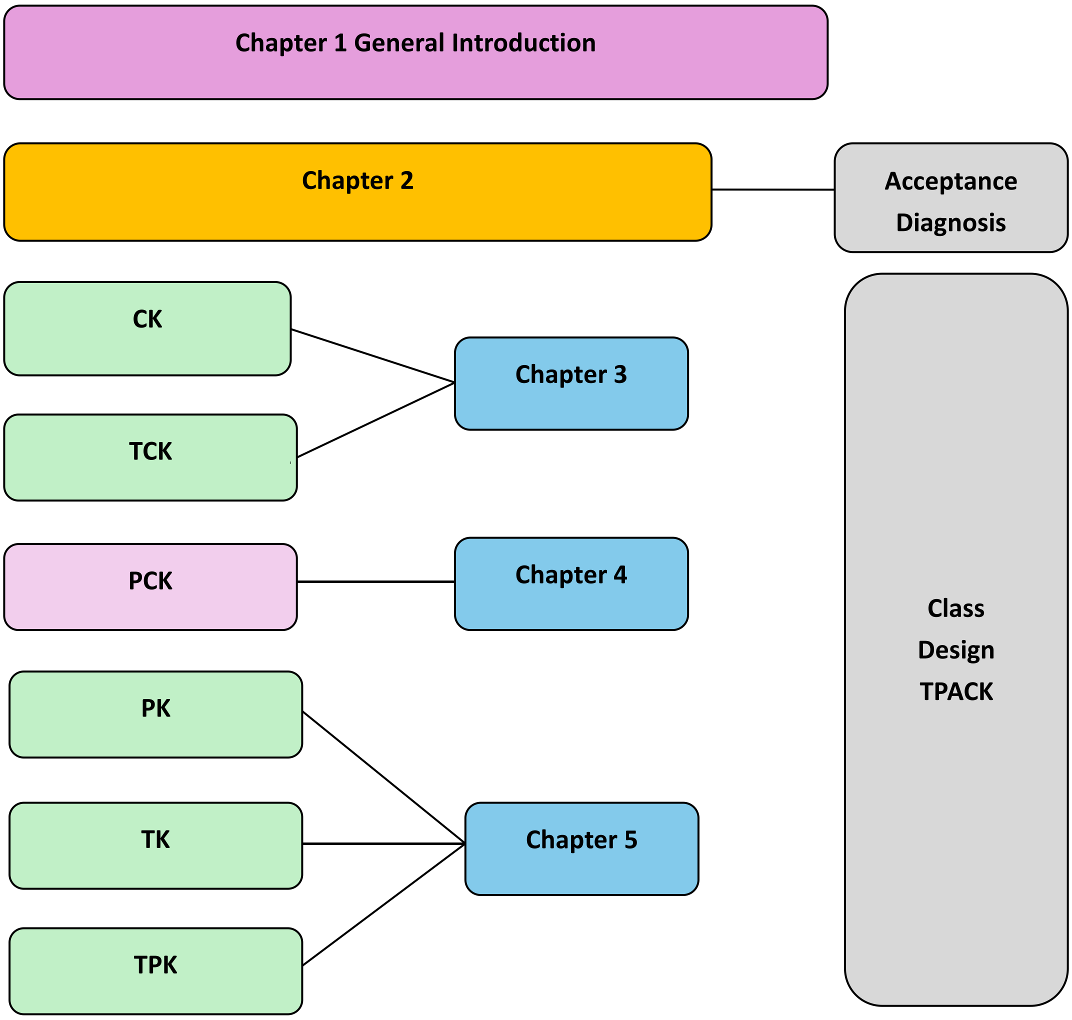

Fig.1.1. Dissertation outline

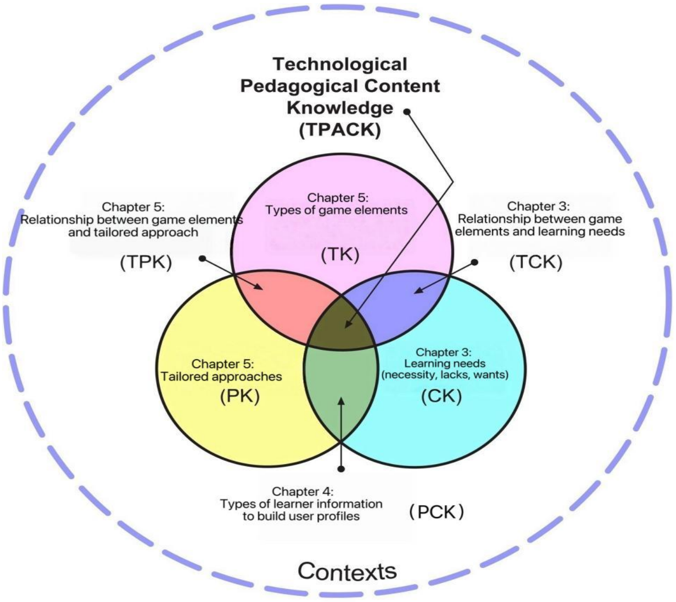

Fig.1.2. TPACK dimensions in gamified learning contexts

Specifically, four studies (Table 1.1) were performed in which:

1) Unpacking students' acceptance of digital gamified learning through an extended UTAUT model (Chapter 2)
2) Research on students' game element preferences and learning needs: Implications for the instructional design of the digital gamified class (Chapter 3)
3) A systematic literature review study on student information in user profiles for tailored gamified learning (Chapter 4)
4) A systematic literature review study on the approaches and game elements used to tailor gamified learning (Chapter 5)

Chapter 2 describes a mixed-method study investigating the factors that influence students' acceptance of the use of digital gamified learning. It serves as a prerequisite for teachers designing and implementing games or gamification in class. We first examine the relationship between the independent variables (i.e., performance expectancy, effort expectancy, social influence, facilitating conditions, learning motivation, preferences for game types and game design principles, learning compatibility, age, gender, and prior experience) and the dependent variable (technology acceptance). Additionally, to gain a comprehensive understanding, qualitative insights from student interviews are integrated to identify other potential influencing factors beyond the modified UTAUT framework. The following sub-questions were formulated: (1) How are the independent variables included in the modified UTAUT model related to university students' technology acceptance of using digital games for learning in class, and what additional factors have emerged from student perspectives? (2) How do variables on prior experience moderate the relationship between the other independent variables included in the modified UTAUT model and the dependent variable, technology acceptance? Quantitative data from 610 students and qualitative data from 10 interviewees from Chinese universities were collected and analyzed using a structural equation modeling approach and thematic analysis, respectively.

After examining students' acceptance for gamified learning, the subsequent chapters would shift to the instructional design by explaining the interrelated questions of 'what to teach', 'whom to teach', 'with what technological tools', and 'how to use these tools'.

In **Chapter 3,** we employ a mixed-methods approach using questionnaires with both open and closed questions to establish a practical pathway for exploring both content knowledge (CK) and technological content knowledge (TCK) during the class design phase. Specifically, this study investigates students' gaming preferences, their specific learning needs, and the potential relationships between them, with university English writing classrooms as the application context. The findings aim to inform teachers on how to identify and integrate these factors to design effective and engaging gamified classes. Five research questions guide this study: (1) Which preferences do university students have concerning game elements? (2) Which game elements do university students mention as making their English writing homework effective? (3) What do university students need in learning to write in English? (4) What kinds of English writing homework do university students report as effective? (5) To what extent do university students' game element preferences relate to their English writing needs? The self-reported questionnaires from 505 language learners attending English writing classes at the tertiary level in China were collected. In order to answer these questions, descriptive analysis, structural equation modeling, and content analysis were employed.

After understanding what to learn, Chapter 4 further focuses on the aspects of learners to answer whom to teach. It firstly presented a selection of studies to provide an overview of empirical research on tailored gamified learning to classify types of student information and explain instruments for collecting them, which would be a key step to using tailored gamification in class, and allow teachers to broaden their pedagogical content knowledge (PCK) by building effective user profiles for students. 31 peer-reviewed studies were selected and systematically analyzed. The central research question in this study was: (1) What information in the user profiles can be used to differentiate students for tailored gamified learning? (2) How is this information about students' user profiles collected? This finding yields four types of student information, contributing to an evidence-based understanding of the 'learner' within the pedagogical content knowledge (PCK) framework for gamified learning. By systematically examining what student data matters (learner, player, personal, and contextual information) and how it can be collected, this review provides teachers with actionable user profiles, thereby making it possible to develop student-centered class design in gamified learning.

Based on the systematic mapping of student data (to whom it will be taught) introduced in the earlier chapters, Chapter 5 shifts its focus to the essential integration of technology-related tools (what technologies to apply), and their application (how to use these technologies). Though Chapters 3 and 4 provide teachers with insights regarding learners' needs and user profiles, there is a major gap, i.e., how teachers can convert them into workable class designs. This chapter, therefore, advances our TPACK exploration by focusing on the intersection of pedagogical knowledge (PK) and technological knowledge (TK) in the context of designing tailored gamified classrooms. Specifically, we explored two questions: (1) Which approaches are employed to tailor gamification in education? (2) Which game elements are used when using these tailored approaches? To answer these research questions, we employ a systematic literature review based on 43 peer-reviewed articles.

Chapter 6 offers a comprehensive overview of the research conducted in Chapters 2 to 5. It includes a summary of the key findings from the preceding chapters, a general discussion of the results, implications for practical application and future research directions, as well as an exploration of the limitations encountered in these studies.

Table 1.1. Introduction of the 4 included studies in this dissertation

Chapter	Objectives	Target Items	Methodology	Learning Context	Participants/Included articles
2	Unpacking students' acceptance of digital gamified learning through an extended UTAUT model	Acceptance diagnosis	Mixed (questionnaire & interview)	In-class learning activities	610 Chinese university students
3	Research on students' game element preferences and learning needs	TPACK-based design planning: (1) CK (2) TCK	Mixed (questionnaire with open & closed questions)	Out-of-class learning activities: English writing homework	505 Chinese university students
4	Research on student information in user profiles for tailored gamified learning	PCK	Systematic literature review	Tailored gamification	31 peer-reviewed articles
5	Research on approaches and game elements used to tailor gamified learning	(1) TK (2) PK (3) TPK	Systematic literature review	Tailored gamification	43 peer-reviewed articles