

**DESIGN, DEVELOPMENT, AND EVALUATION
OF THE TEACHER COMPETENCY
FRAMEWORK IN GAME-BASED LEARNING
(TCF-GBL) FOR SECONDARY SCHOOLS IN
CHINA**

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FRAMEWORK IN GAME-BASED LEARNING
(TCF-GBL) FOR SECONDARY SCHOOLS IN
CHINA**

by

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LIST OF ABBREVIATIONS

GBL	Game-Based Learning
TCF-GBL	Teacher Competency Framework in Game-Based Learning
DDR	Design and Development Research
FDM	Fuzzy Delphi Method
TPACK	Technological Pedagogical Content Knowledge
TEDS-M	Teacher Education and Development Study: Learning to Teach Mathematics
CK	Content Knowledge
PK	Pedagogical Knowledge
TK	Technological Knowledge
PCK	Pedagogical Content Knowledge
TCK	Technological Content Knowledge
TPK	Technological Pedagogical Knowledge
GPK	General Pedagogical Knowledge
ICT	Information and Communications Technology
STEM	Science, Technology, Engineering and Math
TPACK-G	Technological Pedagogical Content Knowledge-Games
GK	Game Knowledge
GPK	Game Pedagogical Knowledge
GPCK	Game Pedagogical Content Knowledge
GBP	Game-Based Pedagogy
CVI	Content Validity Index
SPSS	Statistical Package for the Social Sciences
EFA	Exploratory Factor Analysis
MRA	Multiple Regression Analysis

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**REKA BENTUK, PEMBANGUNAN, DAN PENILAIAN KERANGKA
KOMPETENSI GURU DALAM PEMBELAJARAN BERASASKAN
PERMAINAN (TCF-GBL) UNTUK SEKOLAH MENENGAH DI CHINA**

ABSTRAK

Kajian ini bertujuan membangunkan Kerangka Kompetensi Guru dalam Pembelajaran Berasaskan Permainan (TCF-GBL) bagi menyokong guru sekolah menengah dalam melaksanakan *game-based learning* (GBL) secara berkesan di China. Kerangka ini direka bentuk untuk mengenal pasti kompetensi guru yang penting bagi amalan GBL yang berjaya. Kajian ini menggunakan kaedah *Design and Development Research* (DDR) yang merangkumi tiga fasa: analisis keperluan, reka bentuk dan pembangunan, serta penilaian. Dalam fasa pertama, soal selidik kuantitatif melibatkan 326 orang guru sekolah menengah yang melaksanakan GBL telah dijalankan untuk meneliti amalan, halangan pelaksanaan, dan keperluan kompetensi bagi pelaksanaan GBL yang berkesan. Analisis statistik deskriptif mendedahkan pelbagai halangan yang menghalang pelaksanaan GBL serta memberikan pandangan tentang persepsi guru terhadap kompetensi yang diperlukan. Dapatan ini menjadi asas bagi mengenal pasti komponen dan elemen kompetensi dalam kerangka TCF-GBL. Berdasarkan hasil fasa analisis keperluan, TCF-GBL direka bentuk dengan mengintegrasikan penemuan kajian bersama asas teori daripada kerangka TPACK dan TEDS-M. Selepas reka bentuk awal, pengesahan berasaskan pakar dilaksanakan untuk mendapatkan konsensus pakar menggunakan *Fuzzy Delphi Method* (FDM). Dalam fasa ketiga,

kesahan dan kebolehpercayaan TCF-GBL dinilai melalui *Exploratory Factor Analysis* (EFA). Selain itu, *Multiple Regression Analysis* (MRA) melibatkan 308 guru sekolah menengah digunakan untuk mengenal pasti komponen yang berfungsi sebagai faktor ramalan terhadap tahap kompetensi guru dalam melaksanakan GBL. Kerangka TCF-GBL yang dimuktamadkan merangkumi lima komponen kompetensi—pengetahuan kandungan (CK), pengetahuan pedagogi (PK), pengetahuan teknologi (TK), kepercayaan dan sikap (BA), serta ciri peribadi (PC)—yang terdiri daripada 52 elemen kompetensi. Hasil kajian menunjukkan bahawa TCF-GBL adalah sah dan boleh dipercayai, dengan kelima-lima komponen berfungsi sebagai faktor ramalan terhadap tahap kompetensi guru dalam melaksanakan GBL.

**DESIGN, DEVELOPMENT, AND EVALUATION OF THE TEACHER
COMPETENCY FRAMEWORK IN GAME-BASED LEARNING (TCF-GBL)
FOR SECONDARY SCHOOLS IN CHINA**

ABSTRACT

This study aimed to develop a Teacher Competency Framework in Game-Based Learning (TCF-GBL) to support secondary school teachers in effectively implementing game-based learning (GBL) in China. The framework was designed to identify essential teacher competencies for successful GBL practices. The study employed the Design and Development Research (DDR) method, consisting of three phases: needs analysis, design and development, and evaluation. In the first phase, a quantitative questionnaire involving 326 secondary school teachers who implement GBL was conducted to investigate practices, barriers to adoption, and competency requirements for effective GBL implementation. Descriptive statistical analysis revealed various barriers hindering the adoption of GBL and provided insights into teachers' perceptions of necessary competencies. These findings served as the foundation for identifying the competency components and elements included in the TCF-GBL framework. Building on the results of the needs analysis phase, the TCF-GBL framework was designed by integrating the findings with theoretical foundations from the TPACK framework and the TEDS-M framework. Following the initial design, the researcher conducted an expert-based validation to get expert consensus using the Fuzzy Delphi Method (FDM). In the third phase, the validity and reliability of the

TCF-GBL framework were evaluated through Exploratory Factor Analysis (EFA). Additionally, Multiple Regression Analysis (MRA) involving 308 secondary school teachers was used to identify which components of the TCF-GBL framework served as predictive factors for the level of teachers' competencies in implementing GBL. The finalized TCF-GBL framework comprises five competency components—content knowledge (CK), pedagogical knowledge (PK), technological knowledge (TK), belief and attitude (BA), and personal characteristics (PC)—encompassing a total of 52 competency elements. The results show that the TCF-GBL framework is both valid and reliable, with all five components serving as predictive factors for the level of teachers' competencies in implementing GBL.

CHAPTER 1

INTRODUCTION

1.1 Introduction

The rapid advancement of digital technologies has transformed the educational landscape, enabling personalized instruction, interactive engagement, and data-driven decision-making (Nilsson, 2024). In response, governments worldwide have promoted teacher competency development through various initiatives and the establishment of competency standards, underscoring the central role of technology in modernizing pedagogy (Yang et al., 2023). Within this technological context, game-based learning (GBL) has emerged as a powerful pedagogical approach that leverages the immersive and motivational potential of games to foster active and experiential learning.

Games and new technologies are playing an increasingly important role in 21st-century education (Toh & Kirschner, 2020). Game-based learning is one of the upcoming global learning trends. Game-based learning refers to the use of games in educational settings to support learning or as educational tools (Pinedo et al., 2022). While GBL has been widely recognized as a valuable tool in fostering 21st-century skills, its adoption in Chinese secondary schools remains at an emerging stage. Researchers have recognized the potential of using game-based learning in the educational setting to improve student learning (Clark et al., 2016; Karakoç et al., 2022; Papanastasiou et al., 2017; Sung & Hwang, 2013).

Studies have showed that the connection between play and learning persists throughout life and is grounded in five key characteristics of play: pleasure,

meaningfulness, engagement, iterative processes, and social interaction (Zosh et al., 2017). Engaging storylines, visual aesthetics, game rules, healthy competition, badges and rewards, timely feedback, levels, and many other elements help students master learning topics quickly and in a fun way (Boller & Kapp, 2017). The immersive nature of games enables students to retain knowledge and apply it in real-life contexts. Integrating game-based learning (GBL) is an effective way to achieve this, but its success depends on providing teachers with adequate training and necessary competencies for effective classroom implementation (Hu & Sperling, 2022).

Despite the many benefits offered by implementing game-based learning in the classroom, research indicates that teachers are insufficiently prepared to effectively utilize games for teaching in the classroom (An et al., 2016; Becker, 2007; Denham et al., 2016). One of the most necessary areas of research is how teachers should be adequately trained to acquire the competence to use game-based learning effectively in the classroom (Denham et al., 2016; Ray & Coulter, 2010; Takeuchi & Vaala, 2014). It is critical that teachers undergo professional development aimed at enhancing students' academic performance in the classroom through the effective use of game-based learning.

The teacher serves as the mediator, bridging game-based learning with the curriculum (Foster & Shah, 2020). Teachers play an important role in achieving the educational goals of game-based learning (Jong et al., 2017; Tokarieva et al., 2019). Teacher perceptions are vital, as teachers play a key role in selecting, implementing, and assessing educational games for their students (Huizenga et al., 2017). Game-

based learning enabled the teacher to move beyond the traditional lecture-based class structure, allowing more time for independent exploration and critical thinking; however, this needs to be supported by teachers with more comprehensive competencies (Deng et al., 2020). Teachers' competencies play a pivotal role in influencing their behavioral performance across various teaching actions, as well as in regulating and impacting student learning outcomes and academic levels (Foster & Shah, 2020).

Early research has shown that having relevant teacher competencies is important for the successful implementation of game-based learning (Barab et al., 2010; Hamari & Nousiainen, 2015; Shah & Foster, 2015). In addition, studies have shown that experienced teacher instruction is able to enhance the impact of games on student learning (Eastwood & Sadler, 2013; Hayak & Avidov-Ungar, 2020; Silseth, 2012). However, this needs a comprehensive approach to maintain teachers' interest in games and develop their competence to implement game-based learning (Li, 2013).

Competencies are considered to be one of the most valuable resources for individuals, organizations, and societies. Education is usually recognized as a process of developing knowledge, skills, and attitudes (Lee et al., 2018). In terms of understanding the concept of competencies, Tigelaar et al. (2004) argue that competencies are the comprehensive individual characteristics formed by people who mobilize various traits to judge their own action goals, plan action strategies, regulate their behaviors, and produce effective action results in practical activities based on the goals, tasks, and conditions to be realized.

In the field of education, the competencies possessed by teachers have a considerable effect on the effectiveness of teaching and learning. Teachers' competencies include a wide range of skills, knowledge, and attributes that are essential for creating optimal learning environments and fostering student growth. These competencies go far beyond subject matter expertise and include pedagogical skills, interpersonal skills, and a deep understanding of diverse learning needs (Nousiainen et al., 2018). Teacher competencies form a multifaceted framework that underpins effective teaching and student learning outcomes.

1.2 Background of the Study

In recent years, China has made significant efforts to promote technology integration in education, particularly at the secondary school level. Today's educational field has focused on the great potential of combining games and education, and there is considerable interest in games to inspire and involve students in learning (Hussein et al., 2022). Secondary school teachers, both at the junior and senior levels, are increasingly encouraged to adopt GBL pedagogical strategies; however, many lack the competencies necessary to implement GBL effectively. Game-based learning has accumulated various research findings, but limited attention has been paid to the impact of teachers' competence to implement game-based learning on student learning outcomes when targeted at enhancing student learning. Therefore, it is important to arouse teachers' awareness of games and improve their competence to integrate game-based learning in the classroom (Nousiainen et al., 2018).

Teaching is a complex practice that demands a blend of specialized knowledge (Koehler & Mishra, 2009). Teachers need to continuously adapt their instructional methods and enhance their grasp of teaching practices. Consequently, effective teaching hinges on the flexible assimilation of comprehensive, well-structured, and interconnected knowledge from diverse domains (Shulman, 1986). While certain studies (Chen et al., 2020; Eastwood & Sadler, 2013; Hämäläinen & Oksanen, 2014; Kangas et al., 2016; Nousiainen et al., 2018; Shah & Foster, 2015) have explored teachers' competencies in game-based learning, further research is needed to fully comprehend the role of teachers across various contexts of game-based learning. The development of teachers' competence in game-based learning can further promote the effective evolution of this pedagogical approach.

Competency frameworks have been emphasized as systematic business management tools (Benayoune, 2024; Elsayah et al., 2023; Megahed et al., 2012) and have been recognized as personal assessment tools in psychology and education (Falloon, 2020; Kasser et al., 2013; Sharma et al., 2024). Many frameworks are available to assist teachers in developing the necessary competencies they need to acquire. One of the most significant and impactful conceptual developments in the fields of technology and teacher education in the 21st century has been the development of the Technological Pedagogical Content Knowledge (TPACK) framework, which outlines the knowledge and skills necessary for teachers to effectively integrate educational technology into the classroom (Santos & Castro, 2021).

The TPACK framework is both significant and practical, as it highlights the crucial role of technological knowledge (Wang, 2019). It is not only about how to use it but also how to integrate it with pedagogical and content (Marcelo & Yot-Domínguez, 2019). Current TPACK research tends to take a generic approach to technology (Setiawan et al., 2019). This generic approach to technology may not provide sufficient guidance to improve teacher preparation for implementing game-based learning. Consequently, it is essential to provide teachers with a clear, structured framework that defines the essential competencies for implementing game-based learning in the secondary school context.

Although the critical role of teachers has often been overlooked in discussions of game-based learning and is just getting started (Shah & Foster, 2015), recent efforts suggest that research is beginning to focus on ways to empower teachers in the classroom through tools or frameworks that facilitate the meaningful integration of technology and education. Several frameworks have been developed for teachers to emphasize the knowledge needed for game-based learning instruction. Shah and Foster (2015) developed GaNA (Game Network Analysis), a framework aimed at empowering teachers by helping them enhance their competencies, skills, and knowledge in game-based learning. Hsu et al. (2013) introduced the TPACK-G framework aimed at evaluating teachers' understanding of digital games specifically rather than technology in general.

The issue of the ability to use technology has been at the forefront of discussion in China (Bai & Yan, 2023). At the secondary school level, teachers have introduced

a game-based learning pedagogy (Wang & Zheng, 2021). Students at the secondary level are very fond of playing games, and by embedding games into the curriculum, teachers are more likely to get the students' attention, which means they may be interested in learning more compared to a very dull teaching environment. Finding better ways to implement game-based learning is a challenge that tests the strengths and competencies of game-based learning pedagogy educators. Teachers are expected to find the best pedagogical approach to solving learning problems in order to implement game-based learning pedagogy more effectively (Foster & Shah, 2020). Therefore, it is important to understand the competencies required for cultivating proficient secondary school teachers in game-based learning pedagogy.

1.3 Problem Statement

Since "game-based learning" appeared in the Horizon Report (Higher Education Edition) in 2009, after more than ten years of development, game-based learning has achieved fruitful results, but there are still some problems. Teachers face persistent difficulties in integrating games into classroom practices, which hinder the systematic adoption of GBL. A key challenge lies in teachers' competencies in GBL. Many teachers report difficulty in aligning games with instructional objectives and statutory curriculum requirements, and in assessing the accuracy and pedagogical suitability of game content (Deng et al., 2020). Teachers also struggle with technological knowledge and pedagogical knowledge, especially when attempting to design or adapt games to meet subject-specific learning goals (Liao et al., 2019; Hébert

et al., 2021). Teachers encounter difficulties in integrating game-based learning into their classrooms due to a lack of access to the requisite training required for successful implementation of this innovative approach (Denham et al., 2016). Currently, there is a lack of comprehensive understanding regarding the optimal methods for supporting teachers in integrating educational games into their teaching strategies (Callaghan et al., 2018). Teachers felt underprepared to integrate digital games into their curriculum (Mutch-Jones et al., 2018). Even teachers who integrate games into their classrooms acknowledge that selecting appropriate games and incorporating them into the curriculum can be challenging (Chen et al., 2020).

Implementing game-based learning in the classroom is difficult to control in terms of teaching progress, time, and classroom dynamics. The combination of large class sizes, time constraints, and the energy required, the teacher was unable to support every student and provide prompt feedback (Deng et al., 2020). Teachers often lack professional development opportunities, especially during pre-service training, to acquire competencies such as classroom management in game-based environments, assessment of learning outcomes, and adaptation of GBL to diverse learners (Deng et al., 2020; Khalil et al., 2022). Teachers' competence to plan and execute games is weakened in the absence of in-depth knowledge of games (Kaimara et al., 2021), in addition to leading to a lower perceived value of the educational opportunities provided by games (Martín del Pozo et al., 2017). In game-based learning, availability and constraints in learning environments (e.g., schools and classrooms) continue to influence teachers' decisions regarding the integration and analysis of games (Shah &

Foster, 2014). For example, structural constraints such as fixed class schedules can limit the ability to facilitate discussions about games (Sanchez-Mena & Marti-Parreño, 2017). According to many teachers with less teaching experience, the biggest concern about using game-based learning in the classroom comes from the management of classroom discipline (Kaimara et al., 2021; Kellinger, 2020). Kellinger (2020) emphasized the importance of classroom rules when employing game-based learning in the educational setting. Teachers with less teaching experience need to improve their classroom management skills, and the addition of games increases the difficulty of classroom management (Manesis, 2020).

It is difficult and ineffective to implement game-based learning instructional design in the classroom. Many teachers claim that the true benefits of game-based learning are rarely achieved and that it is difficult to sustain students' enthusiasm in class when only one type of game is used frequently (Ranieri et al., 2021; Watson & Yang, 2016). Game-based learning instructional design poses a great test of teachers' lesson design skills. Teachers often grapple with the task of designing or finding appropriate games, and sometimes students may not show interest in games introduced by teachers. Teachers' concerns about uncontrollable classroom discipline and pace after using games are also partially influenced by the design of game-based learning instruction. Teachers acknowledge the difficulties in implementing game-based learning, including designing content and instruction for games (Liao et al., 2019). Another challenge is facilitating the implementation of complex games (Foster & Shah, 2020). Teachers' lack of expertise in analyzing and designing games reduces the

possibility of teaching with games (An, 2018; Hébert et al., 2021; Megagianni & Kakana, 2021). Denham et al. (2016) noted that there is a significant research gap in identifying the context and conditions required to adequately prepare teachers for the instructional, content, and technology training necessary to effectively integrate GBL into their instructional practices.

A significant barrier to technology integration in general and the use of game-based learning in particular is negative teacher attitudes (Huizenga et al., 2017). Teachers' attitudes toward implementing game-based learning are influenced by internal factors such as individual interests and attitudes (Fokides & Kostas, 2020). It is found that although many teachers hold a positive attitude towards using technology in the classroom, the willingness to implement GBL consistently is constrained due to their insufficient preparation in technology, pedagogy, and professional knowledge (Spiteri & Chang Rundgren, 2020; Zhu & Wang, 2018). Hämäläinen and Oksanen (2014) and Nousiainen et al. (2018) emphasize that the significance of teachers is often overlooked in the literature on game-based learning, and there is a scarcity of comprehensive examinations of teachers' competencies in game-based learning. The competence of teachers in implementing GBL has become a significant factor influencing the advancement of game-based learning (Pan et al., 2021).

Currently, there is a scarcity of direct guiding theories with high relevance to GBL, and few pedagogical models are available for teachers interested in adopting game-based learning (Denham, 2019). The absence of a proper framework contributes to teachers' uncertainty about which competencies are essential for GBL, how to

implement GBL effectively, and how to evaluate its pedagogical impact (Pan et al., 2021). The lack of a clear GBL framework within the curriculum further compounds these challenges, as it hinders teachers' ability to effectively utilize games in teaching and influences their perceptions of teaching with games (Allsop & Jessel, 2015). Several studies have emphasized the critical importance of offering teachers relevant theoretical guidance and instructional support (Chen et al., 2020; Denham et al., 2016).

Therefore, this study needed to be done to identify the specific competencies required for secondary school teachers in China to implement GBL effectively by developing and validating a comprehensive framework. Such a framework will not only strengthen teacher training and professional development but also enhance the quality and sustainability of GBL practices in Chinese secondary schools.

1.4 Research Objectives

This research was conducted to design, develop, and evaluate a teacher competency framework in game-based learning (TCF-GBL) for Chinese secondary schools. The study was conducted using Design and Development Research (DDR) (Richey & Klein, 2007). This approach is a form of research that is based on the design of needs for problem solving. This study aimed to achieve the following objectives:

Phase One: Needs Analysis Phase

RO1) To investigate the practices of Chinese secondary school teachers in implementing game-based learning.

RO2) To investigate the barriers faced by Chinese secondary school teachers in implementing game-based learning.

RO3) To investigate the competencies needed by Chinese secondary school teachers in implementing game-based learning.

Phase Two: Design and Development Phase

RO4) To determine the components and elements of the TCF-GBL framework based on experts' consensus.

RO5) To determine the priority of the components and elements of the TCF-GBL framework based on experts' consensus.

Phase Three: Evaluation Phase

RO6) To evaluate the validity and reliability of the TCF-GBL framework.

RO7) To identify which components of the TCF-GBL framework—content knowledge, pedagogical knowledge, technological knowledge, belief and attitude, and personal characteristics—are the predictive factors for the level of teachers' competencies in implementing game-based learning.

1.5 Research Questions

Based on the three phases of design and development research, several research questions were developed.

Phase One: Needs Analysis Phase

RQ1) What are the practices of Chinese secondary school teachers in implementing game-based learning?

RQ2) What are the barriers faced by Chinese secondary school teachers in implementing game-based learning?

RQ3) What are the competencies needed by Chinese secondary school teachers in implementing game-based learning?

Phase Two: Design and Development Phase

RQ4) What are the components and elements of the TCF-GBL framework based on experts' consensus?

RQ5) What are the priorities for the components and elements of the TCF-GBL framework based on experts' consensus?

Phase Three: Evaluation Phase

RQ6) What is the validity and reliability of the TCF-GBL framework?

RQ7) Which components of the TCF-GBL framework—content knowledge, pedagogical knowledge, technological knowledge, belief and attitude, and personal characteristics—are the predictive factors for the level of teachers' competencies in implementing game-based learning?

1.6 Significance of the Study

This study is of significance for various groups in the field of game-based learning, particularly in framework design and development. The results of this study provide valuable insights for researchers to compare and enhance concepts, definitions, and theories related to game-based learning, particularly concerning teachers' competence in this domain. Its findings contribute to enriching the body of research

on game-based learning pedagogical theories. Moreover, it identifies necessary competencies for teachers and emphasizes their pivotal role in the implementation of game-based learning.

The findings of this research are significant for teachers. Firstly, it provides guidance to facilitate further development of teachers' competencies and skills in the area of gamified learning. The results of this research can help improve the structure of the knowledge system required for teaching and establish a competence system to meet future teaching tasks. Additionally, it serves as a valuable guide for self-assessment during game-based learning practices, helping teachers identify the competencies and skills they need to improve and strategically plan their teaching approaches. By analyzing their own experiences against the framework, teachers can gain insights into quality requirements and enhance their teaching effectiveness. Furthermore, the framework provides a standardized framework and evaluation perspective, aiding teachers in achieving engaging and effective game-based learning instruction. This competency framework contributes to enhancing the quality of teacher training and advancing teachers' competencies in game-based learning.

The findings of this study hold significant implications for schools, educational administration, and policymakers involved in implementing game-based learning pedagogy in secondary schools. The research provides clear, scientifically defined competency indicators, which can guide administrators in developing targeted training programs and strategies to address teachers' developmental needs in GBL. Additionally, these findings offer a framework for assessing teachers' skills, helping

administrators provide appropriate support and resources to foster their growth. Furthermore, policymakers can also leverage these insights to inform future policy decisions, aiming to balance traditional methods with more innovative, student-centered approaches. By highlighting the potential benefits and addressing potential barriers, this study can assist policymakers in creating strategic plans to scale GBL implementation in schools, ensuring that it aligns with national educational goals and standards. This research offers both immediate and long-term value in shaping the future of education in China.

This study is vital since it analyzes teachers' knowledge and skills, enhances existing competency assessment tools, and externalizes teachers' competence in game-based learning pedagogy through measurable evaluation criteria, ultimately empowering teachers to excel in game-based learning. The findings of this study offer practical guidance and support for stakeholders involved in promoting game-based learning in secondary education settings.

1.7 Limitation of the Study

The goal of this research is to design and develop a competency framework for teachers who use a game-based learning pedagogy. However, several notable limitations can be identified, as outlined below.

The findings of this study may not be applied as a basis for generalization to other educational levels because it only focuses on teacher competencies in game-based learning at the secondary school level.

This study is limited to the secondary schools in the eastern region of China, including Shanghai and Jiangsu. Therefore, the applicability of implementation in other schools across the country is vague, as some of the findings may not be applicable for generalization. The samples and participants in this study are only teachers who implemented a game-based learning pedagogy. However, it is not limited to any gender, race, or even religion.

To protect the rights of research participants, individuals are permitted to withdraw from the study at any time. Participants are encouraged to inform the researcher of their intention to withdraw and provide reasons if necessary. Conversely, the researcher reserves the right to terminate a participant's involvement in the study if the participant is found to be intentionally providing false information or failing to adhere to study protocols. This measure ensures the reliability and integrity of the research data.

1.8 Operational Definitions

The terms used in this research may be interpreted differently in different contexts. The following are definitions and explanations of some of the terms used in this research according to the research needs.

1.8.1 Competency

Oubibi and Zhao (2019) define competency as the knowledge, skills, attitudes, values, motivations, and beliefs people need to succeed in work. In this study, competency refers to the set of personal characteristics, knowledge, skills, beliefs, and

attitudes required for effective implementation of game-based learning throughout the teaching and learning process.

1.8.2 Game-Based Learning

Game-based learning (GBL) is the use of existing games or specially developed serious games to acquire knowledge or achieve a specific learning outcome (Kirriemuir & Mcfarlane, 2004). In this study, game-based learning refers to an instructional mode that integrates games into the classroom.

1.8.3 Content Knowledge

Content knowledge is knowledge about the actual topic to be learned or taught (Absari et al., 2020). In this study, content knowledge refers to a teacher's knowledge in a specific subject using game-based learning.

1.8.4 Pedagogical Knowledge

Pedagogical knowledge refers to a generic form of knowledge encompassing classroom techniques and methods, an understanding of the characteristics of the target audience, and strategies for assessing student comprehension (Nopriyeni et al., 2019). In this study, pedagogical knowledge refers to a teacher's knowledge to effectively utilize game-based learning, incorporating various pedagogical features into the teaching and learning process.

1.8.5 Technological Knowledge

Technological knowledge is a person's ability to use computer technology, including software and hardware, to produce desired results (Schmid et al., 2021). In

this study, technological knowledge refers to a teacher's ability to effectively understand, select, and utilize technologies to enhance the teaching and learning process in game-based learning contexts.

1.8.6 Belief and Attitude

Goodenough (1963) defines beliefs as propositions considered true, which serve as guides for assessing the future, supporting decisions, or evaluating the actions of others. Rokeach (1968) defines attitude as a relatively stable organization of beliefs centered on an object or situation, influencing one's predisposition to respond in a particular manner. In this study, belief refers to the perceptions or convictions that a teacher holds regarding the effectiveness, value, or practicality of game-based learning. Attitude refers to a teacher's overall evaluation, perspective, or predisposition toward game-based learning and influences their willingness to adopt this approach in teaching.

1.8.7 Personal Characteristics

Personal characteristics refer to the distinctive qualities, traits, attributes, or features that make an individual unique (Haslam et al., 2005). In this study, personal characteristics refer to a teacher's personality traits that will facilitate the use of game-based learning.

1.9 Summary

Chapter one provides an initial overview of the study, outlining its primary parts, which include the design, development, and evaluation of the Teacher

Competency Framework in Game-Based Learning (TCF-GBL). This competency framework is designed with a focus on the Chinese secondary school, emphasizing teacher competence in integrating game-based learning. The study was prompted by the discovery of several major problems, such as challenges in integrating games with teaching objectives and teachers' limited expertise in analyzing and designing games. Several key objectives are highlighted as essential to proving the study's effectiveness. Developing this framework holds significant implications for the field of education, particularly in enhancing teaching practices related to game-based learning pedagogy among teachers.

The purpose of this study is to fill the identified gaps in research and seek solutions to enhance teachers' readiness for the successful application of game-based learning in the classroom. Consequently, the study will center on the "design, development, and evaluation of a framework of teachers' competencies for game-based learning." Its objective is to identify the specific competencies that teachers require to proficiently integrate game-based learning into their instructional strategies.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews and consolidates the relevant background for this study. This chapter highlights a theoretical overview of constructing a competency framework for teachers implementing game-based learning. The final goal of this study is to enhance the integration of games in the classroom by investigating the needs and competencies of teachers for professional development in game-based learning.

This chapter conducts a comprehensive review of the research on game-based learning and teacher competencies. Firstly, a brief overview of the definitions and advantages of game-based learning is presented. Subsequently, this chapter explores existing competency frameworks and the research concepts that pertain to teacher preparation and expertise across various domains. Next, it delves into a detailed discussion of the research variables, theoretical framework, and conceptual framework to be employed in this study, emphasizing their application and relevance to the study's subject matter.

Several major topics will be discussed in this chapter, including game-based learning, the analysis of teacher competency frameworks, teacher preparation, research variables, the theoretical framework, and the conceptual framework. Each review will establish a robust conceptual foundation that will serve as the primary support and guidance for the overall research.

2.2 Game-Based Learning

2.2.1 Pedagogical Benefits and Characteristics of Game-Based Learning

The use of technology in the 21st century has expanded in ways that were not possible 20 years ago. Technology is now integrated into nearly every aspect of daily life, including entertainment, employment, and education. Members of 21st-century society must be prepared not only to interact with technology but also to create, innovate, and articulate it (Mirra & Garcia, 2021; Yadav et al., 2016). At the same time, game-based learning has emerged as an innovative teaching strategy that aims to use the motivation and engagement of computer games to enhance the learning process (Prensky, 2013).

Game-based learning encompasses the integration of games as a central activity, either as the primary focus or as a catalyst for other related educational endeavors, with learning outcomes as the intended or consequential result (Kirriemuir & Mcfarlane, 2004). Game-based learning includes various strategies for integrating games into teaching and learning, with a primary focus on learning games that incorporate "video and computer game features to create engaging learning experiences that achieve specific objectives, outcomes, and experiences" (de Freitas, 2006). Beyond professionally developed learning games with well-defined pedagogical goals, GBL also involves the use of commercial games adapted for educational purposes (Van Eck, 2006). The purpose of game development in educational contexts is to enhance student engagement, ultimately contributing to improved learning outcomes.

In addition, GBL adapts game elements and mechanics to non-game environments, such as the classroom environment (Ioana et al., 2019). The incorporation of non-game content in GBL empowers educators to tailor the learning experience to individual students rather than adhering to a one-size-fits-all approach (Ioana et al., 2019). Games are considered potentially powerful learning environments for several reasons (Oblinger, 2004, p. 8).

- a) They activate prior knowledge.
- b) They offer immediate feedback and assess progress.
- c) They necessitate the transfer of knowledge from other contexts.
- d) They naturally provide experiential learning opportunities.
- e) They frequently facilitate social interactions within communities of practice centered around the game.

Games serve as a medium for providing students with benefits not typically found in traditional curricula. To comprehend how games can be advantageous, it's important to recognize that not all games are solely intended for entertainment. Contrary to the negative connotations associated with games, their use in the classroom has not only proven to be effective in motivating and engaging students but also in delivering multiple learning outcomes and fostering higher-order thinking skills, along with 21st-century skills (Hewett et al., 2020; Qian & Clark, 2016). Game-based learning has proven to be an effective teaching strategy, thanks to the power of games to capture students' attention and inspire them to explore the boundaries of their abilities, skills, and knowledge (Karakoç et al., 2022; Megagianni & Kakana, 2021;

Sundaram & Ramesh, 2022). A comprehensive analysis of the game allows the teacher to document characteristics of the game that are relevant to the curriculum. However, when changes in teaching and learning processes occur, it becomes the responsibility of teachers to implement and integrate these changes into their practice (Kaimara et al., 2022).

2.2.2 Implementation of Game-Based Learning in Secondary Classrooms

In secondary schools, GBL is integrated into subject-specific curricula such as English, mathematics, and science. For example, vocabulary games and digital quizzes are frequently used in English language learning (Zhou, 2024).

In mathematics, game-based simulations and problem-solving activities allow students to visualize abstract concepts, strengthen logical reasoning, and practice problem-solving in an interactive environment. Research has shown that integrating mathematics games into the curriculum can improve students' motivation and support differentiated instruction by adapting challenges to learners' varying skill levels (Hui & Mahmud, 2023).

For science education, GBL has been used to replicate laboratory experiments and model scientific phenomena. Serious games and virtual labs provide students with experiential learning opportunities that would otherwise be difficult to achieve due to limited resources or safety concerns. Studies indicate that these approaches improve students' inquiry skills and conceptual understanding while increasing their interest in STEM-related careers (Ullah et al., 2022).

Importantly, the effectiveness of GBL in secondary classrooms depends on aligning the chosen games with syllabus goals and course structures. Research shows that teachers who intentionally link game activities to learning outcomes, formative assessments, and curricular standards are more likely to achieve meaningful learning gains (Wilson et al., 2018). GBL is increasingly being explored as a means to complement traditional pedagogy by providing interactive practice, problem-solving opportunities, and formative feedback while still addressing curriculum standards (Koehler et al., 2013). The alignment of GBL with curriculum and assessment frameworks is essential. Teachers are encouraged to analyze game characteristics relevant to curricular goals and link them with classroom practices to ensure meaningful integration (Wilson et al., 2018). Overall, the implementation of GBL in secondary classrooms demonstrates its adaptability across subjects and its potential to enrich conventional teaching methods.

2.2.3 The Role of Teachers in Game-Based Learning

The purpose of game integration is to merge this knowledge with the teacher's teaching and curriculum expertise (Wilson et al., 2018). Research on teachers' perceptions regarding the value and application of games in the classroom is growing quickly. Although game-based learning technologies appear to enhance learning (Siew, 2018; Tobias et al., 2014), teachers still encounter resistance when adopting these applications (Molin, 2017). This resistance is primarily caused by insufficient time and technological resources, as well as teachers' lack of competency and self-efficacy in utilizing GBL technology effectively (Boghian et al., 2019; Jong, 2016). The last