DIGITAL COMPETENCY MODEL DEVELOPMENT FOR COLLEGE TEACHERS IN INNER MONGOLIA, CHINA

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Thesis Title Digital Competency Model Development for College Teachers in Inner Mongolia, China

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ABSTRACT

Inner Mongolia is an underdevelopment area in north China, with relatively backward education level and uneven digital competency of college teachers. Assessing the digital competency of college teachers and the aspects of low ability will help teachers improve digital competency in a targeted manner.

The objectives of this research are: 1) to study the current problems and resolution for improvement on digital competency of college teachers in Inner Mongolia, China 2) to design a digital competency development model for college teachers in Inner Mongolia, China. 3) to evaluate the digital competency development model. The research instruments include: 1) questionnaire, 2) structured interview, and 3) evaluation form, data analysis by using mean, median (Md), mode (Mo) and interquartile range (IQR).

The results were found that:

The current problems with digital competency of college teachers in Inner Mongolia mainly included: limited digital awareness, inadequate knowledge and skills in technology integration, and difficulties in designing and implementing effective digital teaching strategies. They struggle with personalizing instruction and conducting reliable academic evaluations, while issues with privacy protection remain. Additionally, their professional development is hindered by difficulties in resource updating and a lack of innovative thinking in teaching practices.

A digital competency development model for college teachers in Inner Mongolia was constructed, referred to the ICT-CFT framework, refined through a Two-Round expert survey. The model comprises five dimensions, three levels, and 51 competency descriptions, outlining varying levels of digital competency. It identified "knowledge acquisition" as essential for all teachers, "knowledge application" as the general competency necessary for advancing digital education, and "knowledge creation" as a higher-level competency that distinguishes excellent teachers.

Five experienced associate professors in education evaluated the digital competency model's effectiveness, rationality, and practicality, focusing on its design, hierarchical structure, and competency descriptions. All 51 descriptions received majority support, though some were deemed in need of improvement. Overall, experts recognized the model as aligned with current educational technology trends, meeting teachers' needs and providing valuable guidance to enhance professional development and student learning experiences.

Keywords: Digital Competency, Development Model, College Teachers, ICT-CFT Framework, Inner Mongolia

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Wang Xiao

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Introduction

Rationale

The advent of the digital age has promoted many changes in the field of education. Digitalization and informatization of education have become an irreversible trend of the times. The direction of teachers' professional development should adapt to the changes of the times. Research in the field of higher education is increasingly focusing on digital competency. The development of teachers' digital competency stems from the requirements for students' digital competency in the digital age. Inner Mongolia is an underdevelopment area in north China, with relatively backward education level and uneven digital competency of college teachers. Assessing the digital competency of college teachers and the areas of low ability will help teachers improve digital competency in a targeted manner.

In Inner Mongolia, college teachers often lack sufficient digital citizenship skills. Many are 'digital immigrants' and may not be more proficient in digital technology than their students. Teachers often fail to fully integrate digital tools into their teaching, primarily due to two reasons: either they lack the necessary skills or the external environment does not support such integration. Additionally, many teachers lack experience in addressing issues like cyberbullying, personal data breaches, online public opinion, and digital fraud. In addition, many teachers also have inadequate digital teaching skills. Those who graduated from education programs often did not receive training in digital literacy, while those from non-education backgrounds generally lacked systematic teaching theory training. As a result, they struggle to incorporate digital technology into teaching design effectively.

Based on the explorations made by scholars in the research of teachers' digital competency, frameworks or models at the national and regional organizational level have also been introduced one after another. Digital competency is a dynamic concept. With the development of technology, evaluation methods need to be constantly adjusted and updated. When measuring and evaluating digital competency, the

characteristics of different subjects, different teaching stages and different teaching objectives should be considered comprehensively. College teachers undertake various responsibilities such as teaching, researching, education, and social services, and their job requirements is significantly different from that of K12 teachers.

Research Questions

How to evaluate and improve the digital competency of college teachers in Inner Mongolia, China?

Objectives

1. To study the current problems and resolution for improvement on digital competency of college teachers in Inner Mongolia, China.

2. To design a digital competency development model for college teachers in Inner Mongolia, China.

3. To evaluate the digital competency development model.

Scope of the Research

The Variable

Independent Variable

Digital Awareness, Knowledge and Skills of Digital Technology, Digital Applications, Digital Social Responsibility, Professional Development

Dependent Variable

College Teachers' Digital Competency

Study Content

Referring to the 'ICT Competency Framework for Teachers (ICT-CFT)' issued by UNESCO, and based on the 'Digital Literacy of Teachers' enacted by Ministry of Education of China, constructing a digital competency development model for college teachers in Inner Mongolia, China. The constructed digital competency development model will be a competency matrix consisting of five dimensions and three levels.

Time

This study conducted a systematic literature review from June to July 2024, expert interviews for research objective 1 in August, an expert survey for research objective 2 in September, and expert interviews for research objective 3 in October.

Advantages

1. Constructing a digital competency development model can evaluate the level of college teachers' digital competency.

2. Constructing a digital competency development model for college teachers can help teachers reflect on their own teaching, continuously improve their digital competency, and adapt to the requirements of the new era.

3. Constructing a digital competency development model can help college administrators formulate teacher training plans and design training projects.

Definition of Terms

College teachers in this study refers to full-time teachers and administrators of ordinary undergraduate universities, excluding vocational colleges, as well as externally hired and temporarily hired teachers.

DC refers to digital competency, which is defined as the ability of citizens in the digital age to use various digital technologies reasonably, legally, healthily and safely to study, work and live on the premise of conforming to moral norms.

DCDM refers to digital competency development model, which is designed to help individuals and organizations assess and improve digital skills and capabilities.

DigCompEdu refers to "European Framework for the Digital Competence of Educators" issued by European Commission in 2017, which is oriented to all educators in various fields.

ICT refers to information and communication technology, including various technologies and tools used to process and transmit information, such as computers, the Internet, communication equipment and software. The core function of ICT is to support the creation, storage, sharing and dissemination of information.

ICT-CFT refers to ICT Competency Framework for Teachers (Version 3) published by UNESCO. It aims to guide teachers to effectively integrate ICT in education. The main goal of the framework is to improve teachers' digital literacy and promote the improvement of teaching quality.

TPACK refers to technological pedagogical content knowledge, which is a framework for understanding and integrating the types of knowledge teachers need in teaching, emphasizing the intersection of content, pedagogy and technology.

TPD refers to teachers' professional development, which is the process by which teachers continuously improve their professional knowledge, teaching skills and educational literacy through various forms of learning and practice during their careers.

Research Framework

Starting from the current problems existing in the digital competency of college teachers in Inner Mongolia, and comparing with the relevant indicators of 'Digital Literacy of Teacher' enacted by Ministry of Education of China, a model for improving the digital competency of college teachers is constructed.

Referring to the structure of ICT-CFT (UNESCO, 2018), taking into account the social and cultural factors of China and the reality of higher education in Inner Mongolia, the model will distinguish the different development stages of teachers' digital competency and provide guiding suggestions.

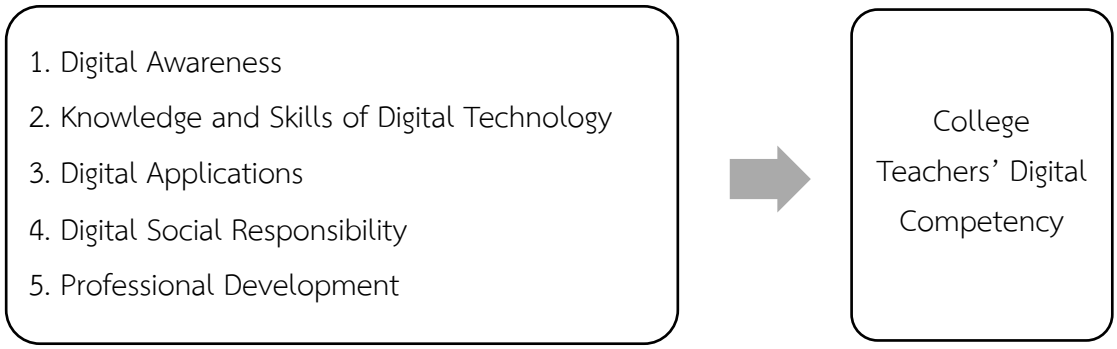

Figure 1.1 Research Framework

Chapter 2

Literature Review

The formation of the information society and the widespread use of digital technology have greatly changed people's social patterns, work and life content, knowledge structure, information acquisition methods, behavior patterns, and thinking habits. With the advent of the digital era and the global large-scale online teaching caused by the COVID-19, the connotation of teachers' competency is very different from that in the past.

As a result, research on teachers' digital competency is increasingly gaining attention, leading to a continuous evolution of how digital skills are perceived and developed among educators. Various countries and international organizations have introduced a series of digital competency frameworks, models, and standards aimed at guiding and enhancing teachers' abilities in this vital area.

The progression from “skills” to “literacy”, and then to “competency”, highlights a broader understanding of digital competency. This concept now extends beyond mere technical skills to encompass a comprehensive range of knowledge, critical thinking abilities, and the integration of various attributes such as attitude, personality, mindset, and values.

This section will summarize the relevant research in this field.

1. Current problems and resolution on college teachers’ DC
2. Existing digital competency models for teachers
3. How to evaluate digital competency models

The details are as follows

Current Problems and Resolution on College Teachers' DC

'Digital Competency' or 'Digital Literacy'?

In 1997, Paul Gilster (Paul Gilster, 1997) first proposed the term 'digital literacy' in his book 'Digital Literacy'. In 2012, the American Library Association (ALA) defined 'digital literacy' as "the ability to retrieve, understand, evaluate, create and exchange digital information by using information and communication technology, which requires cognitive and professional skills". International research on 'digital literacy' and 'digital competency' had already formed a certain scale in 2006.

Defining literacy as the knowledge and ability that should be possessed in some categories narrowed the richness of teachers' practical wisdom. Therefore, the research on digital competency developed rapidly and gradually replaced digital literacy.

In 2012, Ferrari et al. (Ferrari et al., 2012) defined Digital Competency as "set of knowledge, skills, attitudes, abilities, strategies and awareness that is required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; behave in an ethical and responsible way; collaborate; create and share content and knowledge for work, leisure, participation, learning, socializing, empowerment and consumerism."

There was a close connection between them, yet they were sometimes referred to together and used to underpin each other, despite having different meanings. This overlap often occurred because both concepts address similar themes or objectives within a particular context. However, it was crucial to recognize their distinct nuances. Digital literacy typically emphasized the skills required to locate, evaluate, and use information, whereas digital competency encompassed a broader range of abilities, including critical thinking, ethical considerations, and adaptability in various digital environments. Understanding these differences not only clarifies discussions but also aids in developing targeted strategies for education and training. By acknowledging both the interrelation and the divergence of these concepts, educators and policymakers can create more comprehensive frameworks that support individuals in navigating the complexities of the digital world.

There are regional differences in referring those concepts, that studies concerning digital competency are often conducted in European countries outside the

UK, while those on digital literacy in English speaking counties (Anusca Ferrari, n.d.; Carretero et al., n.d.; Esteve-Mon et al., 2020; Falloon, 2020; E. J. Instefjord & Munthe, 2017; Redecker & Punie, 2017; Sillat et al., 2021) . However, in some countries, for some reasons such as translation, the distinction between digital competency and digital literacy are blurred (Hinrichsen & Coombs, 2013; Madsen et al., 2018). There is still some controversy over the concept expression and its connotation.

Table 2.1 Comparison between Digital Competency and Digital Literacy

	Digital Literacy	**Digital Competency**
Proposed time	1997	2006
Main regions	UK, USA, Asia, China	Europe, South America
Main goal	Practice or teaching changes, development of educational systems	Developing teacher and student competencies
Concept connotation	Digital technology and common-sense abilities	Comprehensive and competitive abilities
Application areas	Education Policy and Practice	Educational Research

The research on teachers' digital competency has significantly increased since 2018. It can be seen that digital competency has gradually become a key ability for future teachers to adapt to the development of the digital age, and researchers are more concerned about the diverse and comprehensive abilities of teachers or pre-service teachers.

In China, there is no statement about 'digital competency' in official documents. With the deepening development of digital education, the keyword 'digital competency of teachers' first appeared in 2019. In 2022, Ministry of Education of China enacted professional standards for teachers, which used 'digital literacy' rather than 'digital competency'.

Table 2.2 Teachers' Professional Capability Standards by Ministry of Education of China

Time	Teachers involved	Terms used	Basic Literacy	Promote Students' Development	Promote Teachers' Development
2004	Primary and secondary schools	Educational technology capability	Educational technology knowledge and Skills	Information technology application and innovation	Informatization awareness and attitude; Informatization research and development
2014	Primary and secondary schools	Information technology capability	Technological Literacy	Planning and Preparation; Organization and management; Assessment and diagnosis	Learning and development
2018	Pre-servise teachers	ICT Teaching competency	Basic ICT literacy	ICT support teaching	ICT support learning
2020	Vocational education	Information technology capability	Information technology knowledge and skills	Information technology application and innovation	Informatization awareness and attitude; Informatization research and development
2021	K-12 teachers	Information literacy	Information literacy	Learning guidance; Teaching evaluation; Class management; Home-school communication	Self-directed learning; Communication

Table 2.2 (Continued)

Time	Teachers involved	Terms used	Basic Literacy	Promote Students' Development	Promote Teachers' Development
2022	K-12 and Higher Education teachers	Digital Literacy	Digital Technology and Skills	Digital Applications	Digital Awareness; Digital Social Responsibility; Professional development

The high-frequency keywords for foreign researches on teachers' digital competency include 'ICT', 'technology education', 'digital literacy', 'belief', 'teacher education', 'pre-service teacher', 'digital competency', 'professional development', 'TPACK', etc.

In China, the high-frequency keywords include 'information literacy', 'information teaching ability' (ITA), 'ICT in education', 'primary and secondary school teachers', 'information technology', 'teachers' professional development', 'pre-service teachers', 'improvement strategies', 'TPACK', etc.

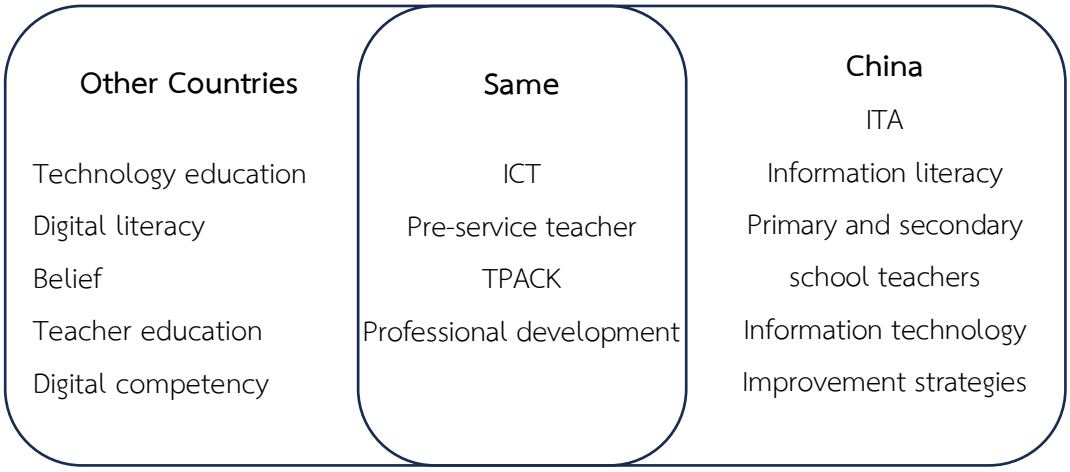

Figure 2.1 High-frequency Keywords on Teachers' DC

Although many studies have offered various perspectives on understanding digital competency, it remains challenging to obtain a comprehensive picture of teachers' digital competency in the context of higher education. This difficulty arises from several factors, including the diverse definitions and frameworks used to define digital competency across different institutions and disciplines. Additionally, the rapidly evolving nature of technology means that digital competencies are continually changing, making it hard to establish a fixed standard for what constitutes effective digital proficiency.

In China, the research achievements of teachers' digital competency mainly include a review of the research on the digital competency framework for teachers, an introduction to the European Commission digital competency framework for teachers, an investigation of the Norwegian professional digital competency framework for teachers, and an analysis of international experiences related to teachers' digital competency frameworks. However, most of the research objects are primary and secondary school teachers and pre-service teachers, there is a relatively lack of research on the digital competency of in-service college teachers.

Current Problems of Teachers' DC

Compared with K12 teachers, the number of related studies on the digital competency of college teachers is relatively small. Scholars' researches mainly focus on the participants' perception on digital competency, the level of digital competency, and influencing factors.

Guillén-Gámez et al. (2020) investigated various factors that could influence digital competence among educators, highlighting the complexity of this competency in modern educational settings. Similarly, García-Esteban (2017) analyzed the role of video as a learning tool, specifically examining its impact on the digital competence development of both teachers and students. This research aimed to determine whether incorporating video into the curriculum could enhance this essential skill in higher education.

In addition, Kunda et al. (2018) explored the factors affecting the attitudes of university teaching staff in Educational Sciences towards the integration of ICT in their teaching practices. Their study shed light on the motivations and barriers that educators

face when adopting new technologies, which can significantly impact the effectiveness of digital competency development.

Together, these studies underscore the multifaceted nature of digital competence and the various elements that contribute to its cultivation within higher education. By examining these different aspects, researchers aim to create a more comprehensive understanding of how digital competencies can be effectively fostered among educators and learners alike.

Before 2021, documents on teachers' digital competency enacted by the Ministry of Education of China were all aimed at K12 teachers and normal college students. The research on digital competency of college or university teachers lacked guiding indicators and mainly focused on the TPACK model.

From 2011 to 2022, the research hotspots of TPACK in China mainly focused on teacher education issues such as the status quo and development paths of information-based teaching capabilities of normal students, pre-service teachers or teachers in various disciplines under the information environment. The ultimate goal is to improve the level of TPACK in teaching, and promote teachers' professional development. (Huang Cuimei et al.,2022)

In the work of Xiao Fengyan et al. (Xiao Feng-yan & Guo Zhi-feng, 2023), "the overall TPACK level of college and university teachers in Inner Mongolia is relatively low, and TK, TPK, TCK are weaker than other TPACK elements."

After 'Digital Literacy of Teachers' was enacted, Chinese scholars began to use this indicator system to study the issue of teachers' digital competency. The number of published literatures is relatively small. Searching for relevant studies from CNKI, there are only 5 articles involving higher education.

Table 2.3 The Main Problems of Teachers' DC during 2020~2023

	Digital knowledge and skills	**Digital application in teaching**	**Digital belief/ awareness**	**TPD**	**Empower -ing learners**	**Environment/Management system**	**Internet security**
Artacho et al., 2020	√	√	√	√			
Demeshkant et al., 2020	√	√					
Dias-Trindade et al., 2020		√			√		
Ryhtä et al., 2020a		√			√		
Sumardi et al., 2020	√	√	√		√		
Sailer et al., 2021	√	√					
Fernández-Batanero et al., 2021	√	√		√			
Zhao et al., 2021		√					√
Scherer et al., 2021		√	√	√		√	
Rubach & Lazarides, 2021			√				
Pongsakdi et al., 2021			√				
Antonietti et al., 2022			√				

Table 2.3 (Continued)

	Digital knowledge and skills	**Digital application in teaching**	**Digital belief/ awareness**	**TPD**	**Empower-ing learners**	**Environment/Management system**	**Internet security**
Zimmer & Matthews, 2022		√		√	√		
García-Vandewalle García et al., 2023	√						√
Song Lingqing, 2023	√	√					
HU Jiehui & ZHANG Tiefu, 2023		√	√				
Li Gaoxiang et al. 2023	√	√		√			
Chen Fengdan et al. 2023			√			√	
Total	**8**	**13**	**8**	**5**	**4**	**2**	**2**

From existing research, the main problems with teachers' digital competency included weak digital application ability in teaching (Artacho et al., 2020; Demeshkant et al., 2020; Dias-Trindade et al., 2020; Ryhtä et al., 2020a; Sumardi et al., 2020; Sailer et al., 2021; Fernández-Batanero et al., 2021; Zhao et al., 2021; Zimmer & Matthews,2022; Scherer et al., 2021; Song Lingqing, 2023; HU Jiehui & ZHANG Tiefu, 2023; Li Gaoxiang et al. 2023), insufficient digital knowledge and skills (Artacho et al., 2020; Demeshkant et al., 2020; Sumardi et al., 2020; Sailer et al., 2021; Fernández-Batanero et al., 2021; García-Vandewalle García et al., 2023; Song Lingqing, 2023; Li

Gaoxiang et al. 2023), and lack of digital awareness (Artacho et al., 2020; Sumardi et al., 2020; Scherer et al., 2021; Rubach & Lazarides, 2021; Pongsakdi et al., 2021; Antonietti et al., 2022; HU Jiehui & ZHANG Tiefu, 2023; Li Gaoxiang et al. 2023).

In addition, some researchers also mentioned TPD (Artacho et al., 2020; Fernández-Batanero et al., 2021; Scherer et al., 2021; Zimmer & Matthews,2022; Li Gaoxiang et al. 2023), empowering learners (Dias-Trindade et al., 2020; Ryhtä et al., 2020a; Sumardi et al., 2020; Zimmer & Matthews,2022), environment or management system (Scherer et al., 2021; Chen Fengdan et al. 2023), and Internet security (Zhao et al., 2021; García-Vandewalle García et al., 2023).

Measurement of College Teachers' Digital Competency

Although considerable research has been conducted on digital competency in educational contexts, there remains a notable confusion and inconsistency between the digital competencies required by the general public and those needed by specific educational professionals, such as teachers and school leaders. Some research suggested that the digital competencies required by educators are more complex compared to those needed in other societal sectors (E. Instefjord & Munthe, 2016; Krumsvik, 2014) This complexity arises because educators operate within intricate organizational systems and rich educational traditions, which adds layers of complexity to the application of digital competencies in educational settings (Krumsvik, 2008).

In addition, Yang Shuang et al. (Yang Shuang & Zhou Zhiqiang, 2019) developed a comprehensive evaluation index system for assessing university teachers' digital literacy. This system encompasses several key areas: the use of digital technology, management of digital information, creation of digital content, construction of digital communities, and capabilities in digital security.

In the work of He Chang et al. (He Chang & Guan Yuqiao, 2023), college teachers' digital competency is composed of four elements: 'morality and consciousness', 'education and learning', 'individual professionalization' and 'digital empowerment', which influence each other. Among them, the order of influence from large to small are: 'education and learning', 'morality and consciousness', 'individual professionalization', and 'digital empowerment'.

Overall, the levels of digital competency among teachers vary significantly across different studies. Ryhtä et al. (Ryhtä et al., 2020b) found that participants generally exhibited only a basic level of digital competency and often encountered limitations when using technological tools. Many educators struggled with integrating digital technology into their teaching practices. In contrast, other studies have reported that teachers displayed an intermediate level of digital competency and were considered proficient in certain aspects (Guillén-Gámez & Mayorga-Fernández, 2020a López-Belmonte et al., 2019). Sales et al. (Sales et al., 2020) found that the majority of faculty participants felt confident in their digital skills and considered themselves proficient in digital competency.

Furthermore, Gallego-Arrufat et al. (Gallego-Arrufat et al., 2019) specifically investigated digital competency in the area of digital security among future teachers. Their findings highlighted a critical need for further development in this area, as most participants had not received prior training in digital security. Only about one-third of the participants had achieved a medium level of competency in this crucial aspect of digital literacy. This underscores the importance of enhancing digital security training to better prepare educators for the challenges of the digital environment.

Research Methods

Systematic Literature Review (SLR)

SLR is a research method used to comprehensively and systematically identify, evaluate, and synthesize existing literature on a particular topic or research question. It goes beyond a traditional literature review by following a structured and rigorous process to ensure objectivity and minimize bias. Petticrew and Roberts (Petticrew, M. & Roberts, H., 2006) detailed the definition and methods of SLR in their book “Systematic Reviews in the Social Sciences: A Practical Guide”, which provided a framework for subsequent research.

SLR is widely used in various academic disciplines to provide an evidence-based overview of the state of knowledge on a particular subject. They offer a structured approach that enhances the credibility and transparency of the review process, making it easier for researchers and practitioners to access reliable and relevant information for decision-making, theory development, and further research.

SLR is a necessary tool for accurately and reliably summarizing research evidence. A systematic literature review attempts to sort out all empirical research evidence that meets predetermined criteria to answer a specific research question. Its key features include:

a. Clear objectives, clear and repeatable methods;

b. Systematic search, striving to obtain all literature resources that meet the qualification criteria;

c. Evaluate the effectiveness of the included research results;

d. Systematic introduction and comprehensive analysis of the features and findings included in the study.

Sillat et al. (2021) conducted a systematic literature review that analyzed existing proposals and conceptions related to the assessment processes and methods for digital competency in higher education. Their comprehensive examination aimed to identify best practices and gaps in current assessment frameworks, ultimately providing insights into how educational institutions can effectively evaluate and enhance digital competencies among faculty and students.

Similarly, Esteve-Mon et al. (2020) performed a systematic literature review focusing specifically on the digital teaching competencies of university educators, utilizing data from the Web of Science and Scopus scientific databases. Their research sought to synthesize findings across various studies to better understand the specific digital skills and competencies required for effective teaching in higher education.

Expert Opinion Survey

Most research studies in this field have employed surveys as their primary research instrument. For example, Janssen et al. (2013) conducted a Delphi study to explore experts' perspectives on what it means to be digitally competent. This approach is particularly valuable, as the Delphi method facilitates the collection of qualitative insights from a panel of experts, allowing for a deeper understanding of the nuanced definitions of digital competence.

It is important to highlight that Janssen et al. used a quantitative methodology to investigate content related to digital competence, with data collection conducted through structured questionnaires. This combination of qualitative and quantitative

methods provides a comprehensive view of the experts' opinions while ensuring that the findings are grounded in measurable data.

Similarly, Mengual-Andrés et al. (2016) developed and validated a questionnaire focused on digital competencies in higher education based on their investigative findings. Their work illustrates the process of constructing reliable assessment tools that can effectively measure the digital competencies required by educators and students alike.

The use of expert surveys, such as the Delphi method, not only enhances the reliability of research findings but also contributes to the ongoing discourse on digital competency frameworks. By synthesizing expert opinions and validating assessment instruments, these studies play a crucial role in shaping educational policies and practices that respond to the evolving digital landscape.

Existing Digital Competency Models for Teachers

The Development of the Concept of Teachers' Digital Competency

In 1973, American psychologist and Harvard University professor McClelland (McClelland, 1973) published an article titled "Testing for Competence Rather Than for 'Intelligence'" in the American Psychologist, which became the birth of 'competence movement'. The concept of competency is often metaphorically described as an iceberg. According to McClelland, the visible tip of the iceberg represents a person's knowledge and skills, while the larger, hidden portion beneath the waterline encompasses enduring personal characteristics, self-concepts, traits, and motives such as self-confidence, initiative, empathy, and achievement orientation.

The term "competency" gained prominence in business terminology largely due to Richard E. Boyatzis, who introduced it in his influential book The Competent *Manager* (1982). Boyatzis defined competency as "an underlying characteristic of a person which results in effective and/or superior performance in a job." This underlying characteristic can include a motive, trait, skill, aspect of self-image, social role, or a body of knowledge.

Building on Boyatzis's work, Spencer further refined the definition of competency. According to Spencer (Spencer & Spencer, 1993), competency is "an

underlying characteristic of an individual that is causally related to criterion-referenced effective and/or superior performance in a job or situation."

In summary, competencies are underlying characteristics that reflect ways of behaving or thinking, generalizing across various situations and enduring over time. They encompass a broad range of attributes that contribute to effective and superior performance in diverse roles and contexts.

As education and teaching reforms continue to evolve, the competency movement has gradually transitioned from the realm of business management into the field of education. Initially, the focus of competency research within education centered on the exploration of educational learning theories. This foundational work laid the groundwork for understanding the essential skills and knowledge required for effective teaching and learning.

Over time, the scope of competency research expanded to encompass the competencies needed by teachers and educational leaders. This shift reflects a growing recognition of the importance of equipping educators with the skills necessary to navigate the complexities of modern educational environments. Today, research in this area not only examines the competencies of educators but also explores how these competencies can be assessed, developed, and applied to enhance teaching effectiveness and improve student outcomes.

This evolution highlights the critical role that competencies play in shaping educational practices and policies, ultimately contributing to the overall improvement of the education system. As the landscape of education continues to change, ongoing research into competencies will be essential for ensuring that teachers and educational managers are prepared to meet the challenges of the future.

The most valuable competencies of teachers should change with the development of the times. In the 1950s, teachers' competency mainly emphasized the mastery of mathematics and scientific knowledge, forming the Competency Based Teacher Education (CBTE) concept, which focuses on what abilities teachers should possess. However, the education community quickly discovered that the requirement for teachers is not just to master knowledge of a subject.

The 1960s to 1970s were the period of ‘human potential’, and the demand for teacher competency shifted towards emotional skills. The concept of Human-Based Teacher Education (HBTE) emerged, which was different from competency-based teacher education. Human based teacher education emphasized the independence and dignity of teachers. Similarly, academics have found that even the most caring teachers cannot achieve success without an understanding of what to teach and how to teach it.

After the 1980s, with the development of ‘constructivism’, the concept of education and teaching shifted from ‘teacher-oriented’ to ‘student-oriented’, which put forward new requirements for teachers’ competency. Students are seen as active, self-regulated learners who create meaning in meaningful ways from their own experiences. The role of teachers is considered to stimulate powerful knowledge construction, rather than explicitly providing knowledge and information.

In the early stages of competency development, scholars typically define it as a range of measurable characteristics essential for individuals to achieve performance. These characteristics encompass various aspects, including professional skills, knowledge, attitudes, and values. The elements of teachers’ competency are closely related to the successful implementation of teaching, as they not only influence the effectiveness of instruction but also impact students' learning experiences and outcomes. Therefore, a comprehensive understanding and cultivation of teacher competencies are crucial for enhancing the quality of education.

For example, D.M, Medley (Medley & Crook, 1980) referred to teacher competency as “any particular knowledge, skill, or attitude, or any set or combination of them, that we may choose to specify”. Kelchtermans (Kelchtermans & Vandenberghe, 1994) conducted a more in-depth study of teacher professional competency, believing that teacher professional competence consists of six parts: self-image, self-esteem, job motivation, job satisfaction, task-perception, and future perspective.

D. Kember (Kember, 1997) believes that a very important difference in modern teaching methods is the shift from ‘teacher centered/content-oriented’ to ‘student centered /leaning-oriented’.

Teachers' competencies are commonly categorized into three main areas: field competencies, pedagogical competencies, and cultural competencies. Field competencies pertain to the subject matter knowledge and technical skills required for teaching specific content. Pedagogical competencies involve the strategies and methods used to facilitate learning effectively. Cultural competencies relate to understanding and respecting diverse cultural contexts and ensuring inclusive education. However, teachers' professional competencies may encompass additional dimensions beyond these three primary areas (Bridges et al., 1993; Bulajeva & Tatjana, 2003; Hansen & Sevn-Erik, 1998; Stoffels & Newton Trevor, 2005).

Calvani et al. (Calvani et al., 2008) expanded the notion of competency by defining digital competency as the ability to navigate and adapt to new technological situations with flexibility. This includes analyzing, selecting, and critically evaluating data and information, leveraging technological tools to solve problems, and constructing shared, collaborative knowledge. Moreover, it emphasizes the importance of being aware of personal responsibilities and respecting reciprocal rights and obligations in a digital context. To assess digital competencies, Calvani and his team developed a comprehensive framework known as the Digital Competence Assessment (DCA). This framework provides a structured approach to evaluating digital competency, ensuring that individuals are well-equipped to navigate the complexities of the digital age.

Types of Teachers' DC Model / Framework

There are more than 100 existing digital literacy models and frameworks (Mark Brown, 2018), and there are different opinions on their expression and definition. Some studies take ability as the core of literacy, while others try to expand the scope of definition, covering knowledge, ability, attitude, emotion, morality, ethics, practice and so on.

Based on current researches, teachers' digital competency models or frameworks can be divided into conceptual models and content models, and the latter can be further divided into list models and development models.

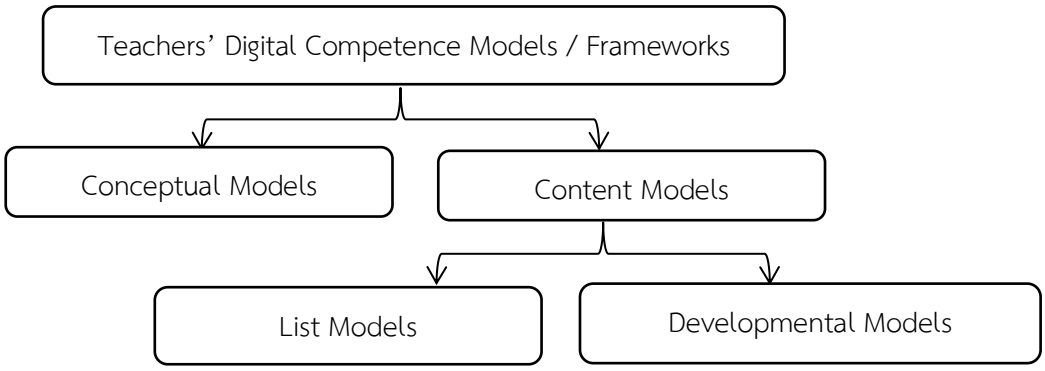

Figure 2.2 Types of Models / Frameworks

Conceptual Models

The conceptual models focus on analyzing the connotation, elements and their interrelationship from the perspective of conceptual cognition, such as SAMR, Technology Integration Matrix (TIM), TPACK, DECK, Teacher Education Information Literacy (TEIL), PICRAT etc.

Table 2.4 Representative Conceptual Models

Time	Name of Models	Competency Dimension
2006	SAMR	Substitution, Augmentation, Modification, Redefinition
2005	TPACK	Content knowledge (CK), Pedagogy knowledge (PK), Technology knowledge (TK), TPK, PCK (pedagogic content knowledge), TCK
2012	DECK	Distributed thinking and knowing, Engagement, Community and communication, Knowledge building
2019	TIM 3.0	Active, Collaborative, Constructive, Authentic, Goal oriented
2020	PICRAT	RAT (replace, amplify, transform), PIC (passive, interactive, creative)

List Models

The content-based models emphasize the orientation of educational practice. Among them, the list models focus on clearly listing the serialization

standards, indicators, stages and strategies of teachers' digital competency, such as International Society for Technology in Education (ISTE), Teacher Educator Technology Competencies (TETCs) and US International Training Performance and Teaching Standards Council (IBSTPI) standards, Association for Educational Communication and Technology (AECT) standards, and Digital Literacy of Teacher.

Table 2.5 Representative List Models

Time	Name of Models	Competency Dimension
2012	AECT 2012	Content Knowledge, Content Pedagogy, Learning Environments, Professional Knowledge and skills, Research
2017 2018	ISTE	Learner, Leader, Citizen, Collaborator, Designer, Facilitator, Analyst
2021	IBSTPI (Instructor)2021	Professional Foundations, Designing for Learning, Facilitating Learning, Evaluating Learning
2022	Digital Literacy of Teacher	Digital awareness, Digital technology and skills, Digital applications, Digital social responsibility, Professional development

Developmental Models

The developmental models are based on the list model and presents the development level and performance of teachers' digital competency in a matrix structure, such as ICT-CFT, ICT in school education maturity model (ICTE-MM), DigComEdu (Redecker & Punie, 2017) and critical digital literacy framework for teachers.

Table 2.6 Representative Developmental Models / Frameworks

Time	Name of Models	Competency Dimension
2011	AITSL	Professional Knowledge, Professional Practice, Professional Engagement
2013	ICTE-MM	Information criteria, ICT resources, and Leverage domains
2013	Critical Digital Literacy	Decoding, Meaning Making, Using, Analyzing, Persona
2017	DigComEdu	Professional Engagement, Digital Resources, Teaching and Learning, Assessment, Empowering Learners, Facilitating Learners' Digital Competence
2018	ICT-CFT	Understanding ICT In Education, Curriculum and Assessment, Pedagogy, Application of Digital Skills, Organization and Administration, Teacher Professional Learning

Different models rank the goals of promoting the development of students and teachers differently. American International Society for Technology in Education (ISTE) standards and teacher digital competency framework put teachers' development before students' development, emphasizing that teachers' development is the premise and foundation of promoting students' development. On the contrary, the Chinese 2014 standards, 2020 norms, 2021 standards and 'digital literacy of teacher' emphasize that teachers' development is the result of promoting students' development and that students are centered.

Table 2.7 Representative Models Classification

Model Name	Digital Application	Promote Students' Development	Promote Teachers' Development	Progress Levels
TPACK, DECK, IBSTPI 2003 Standard, AECT 2012 Standard			√	
SAMR	√			
PICRAT, TIM		√	√	
ISTE 2017/2018 Standards	√	√		
DidComEdu 2017, UNESCO ICT-CFT 2018	√		√	√
Digital Literacy of Teachers (China)	√	√	√	

Related Research Using the Representative Models in China

To assess the factors influencing higher education lecturers' attitudes towards ICT integration in research and teaching, several models can be effectively employed. One notable example is the Technology Acceptance Model (TAM), introduced by Davis in 1993, which explores how perceived ease of use and perceived usefulness affect users' acceptance of technology. Another widely used model is the DeLone and McLean Information Systems Success Model, developed in 2003, which evaluates the success of information systems based on factors such as system quality, information quality, and user satisfaction. These models provide valuable frameworks for understanding and improving lecturers' attitudes and behaviors towards the integration of ICT in their academic practices.

Currently, most research on teachers' educational programs in China adopts the TPACK model. Using the name of each model and 'teacher' as keywords searching on China National Knowledge Infrastructure (CNKI), a large number of TPACK model related studies have been obtained, but very few studies using other models. Searching

for the keyword ‘ICT-CFT’ in CNKI, there are only 5 articles, 4 of which are journal papers and 1 is a master's degree thesis. Two of the journal papers introduced this framework, while only two apply it.

Table 2.8 Research Using Different Models in China

Model	Time	Author	Title / Literature Type	Total
TPACK	2011~ 2024		Journal	92
			Thesis	29
TAM	2023	Sun Aijing, Fan Jiulun, Zhang Erfeng	An Empirical Study on the Willingness of College Teachers to Continuously Use Online Teaching in the Context of Digital Education: A Case Study of S Province	2
	2021	Qin Hong-xia, Zhou Jia-hua, Li Zheng	A Study on the Continuous Use Intendions Differences of Online Teaching between Teachers and Students	
ISTE	2019	Wang Yongjun	Research on the Construction of the Framework of Primary and Secondary School Teachers’ Information and Communication Technology Innovative Competency: From the Perspective of ISTE 2017 Standards for Educators	1
ICT-CFT	2021	Yang Juan, Diao Jun-feng	On the Role Attributes and Teaching Ability Enhancement Strategies of Vocational Education Teachers in the Information Age Based on the ICT-CFT Framework	2
	2016	Zhang Li-qin, Wang Meng-meng	Construction of a Curriculum System for Information Technology Application Ability of Vocational Teachers under the ICT-CFT Framework	

Table 2.8 (Continued)

Model	Time	Author	Title / Literature Type	Total
SAMR	2023	Zou Cui-ying, Gong WEi	An Exploration and Implementation of a Mobile-assisted College English Teaching Model based on the SAMR Model	2
	2022	Liu Yu-ping, OuZhi-gang	Localization, Diversification and Equalization: Explorations on Application of Artificial Intelligence in International Chinese Language Education	

TPACK

The TPACK model provides a standardized curriculum design guide for teacher training, greatly alleviating the disconnect between technical knowledge, professional knowledge, and educational knowledge. However, researchers have also found that the experimental results and intervention measures of the TPACK theoretical model may not be replicated in different educational contexts due to the specificity of the particular course. (Miguel-Revilla et al., 2006).

The most important thing is that the TPACK model is detached from current national standards and exists in the teacher educational system, which can easily lead to a disconnect between teachers' abilities and social needs. Until 2022, Ministry of Education of China enacted the ‘Digital Literacy of Teachers’, which clarified the awareness, ability, and responsibility of teachers to use digital technology for professional practice. However, the framework lacks capacity level classification and supporting implementation plans. It is still in practice stage in various regions, and systematic research has not yet appeared.

ICT-CFT

The definition and scope of ICT have evolved significantly in the 21st century. Today, ICT encompasses the use of digital technologies to generate, distribute, collect, and manage information, as well as to facilitate real-time communication through methods such as instant messaging, voice over IP (VOIP), and video conferencing (Sarkar, 2012). This transformation has made ICT an integral part of modern life,

becoming a standard component in daily activities due to its crucial role in enhancing the quality of living. Sarkar also highlighted the potential of ICT in skills development, a concept that is closely related to Information and Communication Technologies for Development (ICT4D). ICT4D focuses on leveraging ICT to foster international development, particularly by creating new opportunities for marginalized populations (Walsham, 2017).

Researchers have identified several areas where ICT has made substantial contributions, including banking, healthcare, education, transportation, poverty alleviation programs, and e-governance (Reddy et al., 2020). These advancements demonstrate the transformative impact of ICT on various sectors and its role in promoting socio-economic development.

As an international organization leading the reform and innovation of global education/vocational education, the UNESCO has developed the 'ICT Competency Framework for Teachers (ICT-CFT)' in 2008, which has been updated to the third edition in 2018. This framework aims to cultivate qualified citizens in the information age and the skills required for industrial digital upgrading through the improvement of teachers' information-based teaching capabilities.

The ICT Competency Framework for Teachers (ICT-CFT) outlines three distinct stages to enhance teachers' capabilities in applying information technology to support student learning: knowledge acquisition, knowledge deepening, and knowledge creation.

In the knowledge acquisition stage, teachers assist students in using information technology to effectively gather information and learn new concepts. This initial phase emphasizes the importance of developing foundational skills that enable students to navigate digital resources efficiently.

Moving to the knowledge deepening stage, teachers aim to integrate information technology more profoundly into their teaching practices. This integration not only facilitates a deeper understanding of the material but also helps students enhance their problem-solving skills in real-world scenarios. By employing various digital tools and resources, educators encourage learners to explore the complexities of the subject matter and apply their knowledge in practical contexts.

Finally, in the knowledge creation stage, teachers adopt a developmental perspective, fostering an environment where students can self-construct new knowledge relevant to contemporary society and its evolving demands. This stage emphasizes creativity and innovation, enabling students to engage in critical thinking and collaborative projects that address real-world challenges.

Together, these stages provide a comprehensive framework for educators to develop their information technology application capabilities, ultimately enriching the learning experience and preparing students for the demands of the modern world.

Related Research in Inner Mongolia

At present, no research has been found on the digital competency of college teachers in Inner Mongolia. Only three papers used the TPACK model, but one of them did not provide research methods and data, which lacked scientific rigor.

Siqintuya (Siqintuya, 2022) believed that the TPACK ability of college teachers in Inner Mongolia was generally at a medium level, with unevenness. College teachers had a solid grasp of subject knowledge and teaching knowledge, but lacked technical knowledge. Xiao Fengyan et al. (Xiao Feng-yan & Guo Zhi-feng, 2023) believed that the overall level of TPACK of college teachers in Inner Mongolia was relatively low, and technology-related TK, TPK, and TCK were weaker than other TPACK elements. Therefore, the conclusion of the existing research is that the digital competency of college teachers in Inner Mongolia are at a medium-low level.

Research Methods

Structural Equation Modeling (SEM)

SEM is a statistical technique designed to analyze the relationships between observed and latent variables within a complex theoretical framework. This method enables researchers to explore both direct and indirect effects of various variables on one another, offering valuable insights into underlying causal relationships and latent constructs. One of the key strengths of SEM lies in its ability to accommodate complex models that involve multiple interrelated variables, making it particularly useful in fields such as social sciences, psychology, and education.

Additionally, SEM allows for the testing of theoretical models against empirical data, facilitating the validation or refinement of existing theories. As a result, researchers

can draw meaningful conclusions about the dynamics within their study areas, leading to a deeper understanding of the factors that influence various outcomes.

SEM can be used for various purposes, including hypothesis testing, model validation, theory development, and confirming or refuting complex theoretical frameworks. It's widely used in fields like psychology, social sciences, economics, and business to analyze complex relationships among variables.

Some studies have employed Partial Least Squares Structural Equation Modeling (PLS-SEM) to maximize the explained variance of dependent variables while investigating the impact of digital competence on Digital Information Literacy (DIL). This focus on the relationship between digital competence and DIL represents a relatively new research area, aligning well with the exploratory nature of PLS-SEM (He et al., 2018).

Delphi Method

Delphi Method is a research method that involves collecting and synthesizing expert opinions through a series of iterative surveys or questionnaires. It is often used to gather insights, predictions, or judgments on complex or uncertain topics where there is no single definitive answer. The Delphi method aims to reach a consensus or convergence of opinions among a group of experts. The Delphi method often maintains participant anonymity to encourage honest and independent responses. Experts do not know who else is participating in the study, reducing the potential for biases or group dynamics.

Consensus achieved through the Delphi process is regarded as more reliable than the opinion of any single expert, as it harnesses the collective wisdom of a group of knowledgeable individuals while minimizing the impact of dominant personalities and the risk of groupthink. This method ensures a comprehensive range of perspectives and insights, which enhances the overall reliability of the findings. Consequently, expert consensus derived from the Delphi process is often considered valuable "evidence" that, when combined with other data sources, can provide more accurate predictions and inform effective decision-making.

Mengual-Andrés et al. (Mengual-Andrés et al., 2016) uses the Delphi method to validate the design of a questionnaire to determine the perceived importance of digital competence in higher education.

Scales

In the context of research and measurement, a ‘scale’ refers to a set of items or questions designed to measure a particular construct or variable. Scales are commonly used in surveys, questionnaires, and psychological assessments to quantify and evaluate characteristics, attitudes, behaviors, or traits of individuals. Some scholars developed scales to evaluate the digital competency level of teachers. Gümüş et al. (Gümüş & Kukul, 2023) developed the Teacher Digital Competence Scale.

The Likert Scale is a commonly used psychometric tool in research and surveys to measure individuals' attitudes, opinions, or perceptions on a particular subject. It was developed by Rensis Likert in 1932 and has since become a widely adopted method for collecting and analyzing data in various fields.

How to Evaluate Digital Competency Models

From a European perspective, digital competency is increasingly recognized across various domains as essential for thriving in a digitalized knowledge society (Hatlevik & Christophersen, 2013). One prominent area of focus is policy-related documents, where digital competency is often identified as a key driver of change and development in educational and workforce policies (Ala-Mutka, 2011; Hatlevik & Christophersen, 2013). Together, these areas underscore the multifaceted nature of digital competency, highlighting its critical role in shaping educational practices, informing policy decisions, and enhancing individuals' ability to navigate the complexities of the digital world.

Model Evaluation Methods

Known-groups Method

The known-groups method is a statistical technique used in psychometrics and social research to assess the validity of a measurement instrument, such as a survey or a test. This method involves comparing the scores of individuals from known groups to evaluate whether the instrument can accurately discriminate between these

groups. Known-groups validation is particularly relevant in situations where there are clear and distinct groups based on a certain characteristic or criterion. Cabero-Almenara et al. (Cabero-Almenara et al., 2020) employed known-groups method to measure the reliability and validity of the questionnaire DigCompEdu Check-In.

Expert Interview

Expert interview is a qualitative research method that involves engaging with individuals who possess specialized knowledge or expertise in a particular subject area. These interviews aim to gain in-depth insights, expert opinions, and a deeper understanding of complex topics. Expert interviews are commonly used in academic research, policy development, and areas where the expertise of individuals is crucial for decision-making or problem-solving.

Chapter 3
Research Methodology

The purpose of this chapter is to provide a detailed overview of the research methodology used in this study. This chapter outlines the approaches and strategies that were employed to address the research questions, ensuring the validity and reliability of the study's findings. This research focused on evaluating and improving the digital competencies of college teachers in Inner Mongolia, China. The chapter was organized into three sections, and the researcher followed the procedures below. (Figure 3.1)

1. To study the current problems and resolution for improvement on digital competency of college teachers in Inner Mongolia, China

2. To design a digital competency model development for college teachers in Inner Mongolia, China

3. To evaluate the digital competency development model

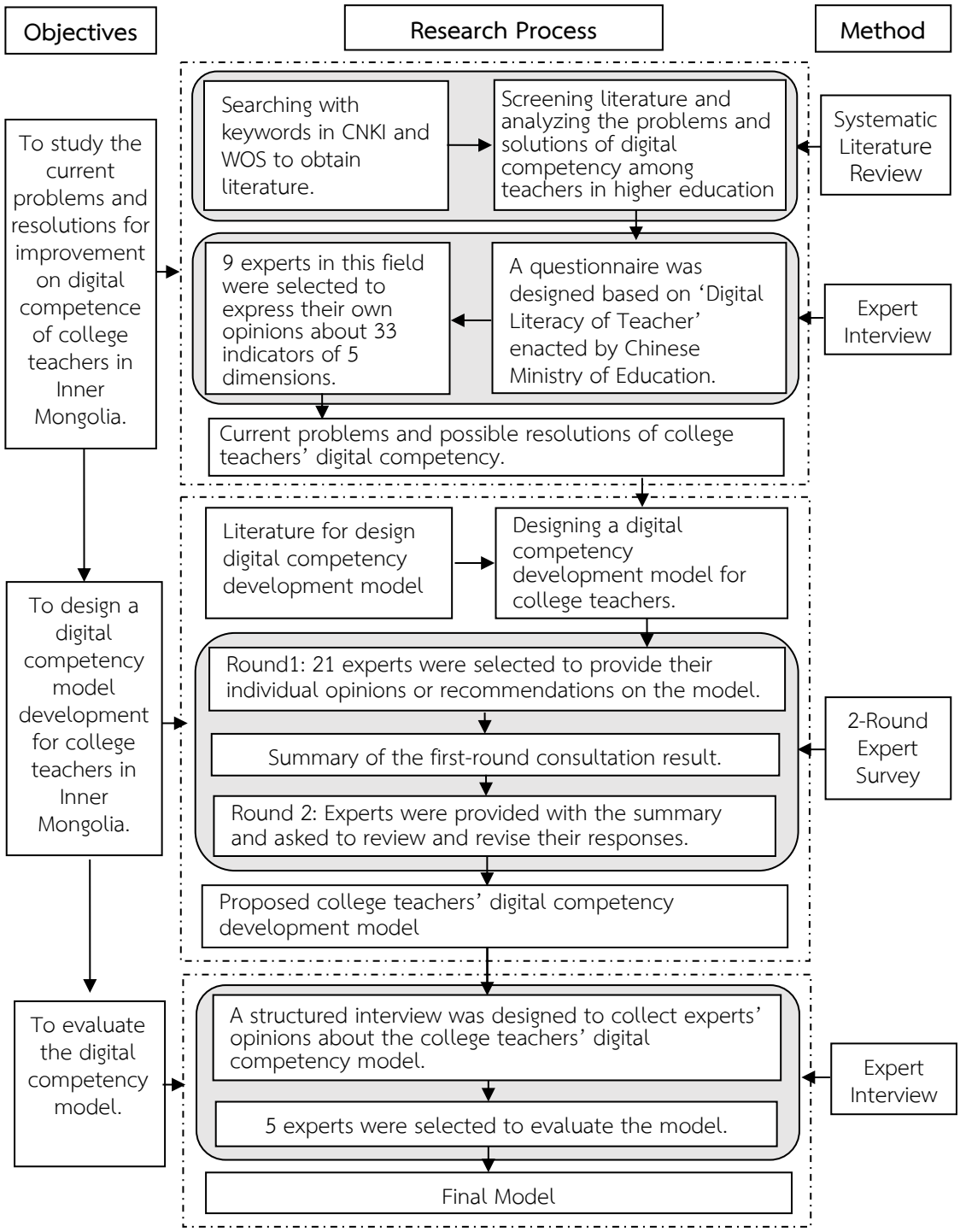

Figure 3.1 Research Methodology and Process

Objective 1: To study the current problems and resolution of college teachers' digital competency in Inner Mongolia.

The Population / Sample Group

The Population

Experts in the field of educational digital technology in Inner Mongolia, China.

The Sample Group

9 experts in the field of educational digital technology in Inner Mongolia, China. The qualifications of the experts are as follows:

1) at least 10 years of college work experience in Inner Mongolia,

2) have extensive experience in educational digital technology,

3) graduated with Master's degree or above,

4) academic title is associate professor or above.

Research Instrument

Interview Form

Expert Survey is a research method that collects insights, suggestions and evaluations by consulting professionals or experts in the field. It is usually used to rely on the knowledge and experience of experts to support decision-making or research when there are complex or ambiguous issues. This study would use a structured interview form to survey experts. The interview form would be designed based on 'Digital Literacy of Teacher' enacted by Ministry of Education of China, which includes 5 dimensions and 33 indicators (Appendix B). For each of the 33 indicators, experts were asked to say whether there were problems among college teachers in Inner Mongolia. If so, what suggestions would they make for solving the problems? If not, what was the basis for the experts' judgment?

Data Collection

The main process was as follows:

9 experts in this field were selected. The researchers interviewed nine experts individually and recorded each expert's answers, and then compiled the main opinions of the nine experts for each indicator. Based on the results of expert opinion survey, a summary of the current problems and possible resolutions in college teachers' digital competency in Inner Mongolia was provided.

Data Analysis

Based on the results of an expert opinion survey, this study analyzed and summarized the current problems of college teachers' digital competency in Inner Mongolia and provided a basis for constructing a model for the development of college teachers' digital competency.

Objective 2: To design a digital competency development model for college teachers in Inner Mongolia.

The population / Sample Group

The Population

Experts in the field of educational digital technology in Inner Mongolia, China.

The Sample Group

21 experts in the field of educational digital technology in Inner Mongolia. The qualifications of the experts are as follows:

1) at least 5 years of college work experience in Inner Mongolia,

2) have extensive experience in educational digital technology,

3) graduated with Master's degree or above.

Research Instruments

Questionnaire

According to the detailed description of 33 indicators in the "Digital Literacy of Teachers" issued by the Chinese Ministry of Education, the digital competencies of teachers are deconstructed into three levels from low to high, forming a preliminary

digital competency model for college teachers. A questionnaire would be designed to collect experts' opinion about the college teachers' digital competency development model.

The study would be performed through a two-round expert survey. The purpose of the two rounds survey was to ensure the scientific and rationality of the model in terms of concept, structure and application through repeated feedback and revision by experts.

The first round of questionnaires would be open-ended, aiming to collect experts' preliminary views and key factors on digital competency of college teachers. The answers of experts in this round would be analyzed, classified and summarized to provide a basis for the design of the second round of questionnaires.

The second round of questionnaires would be mainly closed-ended. Based on the core views summarized in the first round, experts would be invited to evaluate the specific model framework and key digital competency at different levels. In this way, the opinions of experts could be gradually gathered, and a more consistent digital competency development model could be formed. The questionnaire used a five-point Likert scale, 1 represented very unreasonable, 2 represented relatively unreasonable, 3 represented uncertainty, 4 represented relatively reasonable, and 5 represented very reasonable.

IOC Table

Index of Item-Objective Congruence (IOC) is a commonly used method for evaluating the content validity of questionnaires or measurement tools. This method helps researchers ensure that each item in the questionnaire accurately reflects the core concepts of the study by having experts evaluate the match between each question in the questionnaire and the research objectives. IOC validity testing is carried out through a scoring system, usually scored by multiple experts, and finally the IOC value of each question was calculated to determine its validity. The calculation formula of each item is as follows:

$IOC_i = \frac{\sum_{i=1}^{n} C_i}{n}$

IOC_i : IOC value of the i-th item

n : Total number of the experts

C_i : Congruence score of the i-th item, which can be:

1 if the item is fully aligned with the objective,

0 if the item is partially aligned with the objective,

-1 if the item is not aligned with the objective.

The calculation formula of each dimension is as follows:

$$IOC_j = \frac{\sum_{j=1}^{m} C_j}{m}$$

IOC_j : IOC value of the j-th dimension

m : Total number of the items of each dimension

C_j : Congruence score of the j-th dimension, which can be a value between 0 and 1

When designing a questionnaire to evaluate the digital competency of college teachers, IOC would be used to ensure that each questionnaire item could accurately measure indicators in the college teachers' digital competency development model. Items with higher IOC values would be retained, while items with lower IOC values would be modified or deleted to improve the overall validity of the questionnaire.

Data Collection

The main process was as follows:

A college teachers' digital competency development model will be designed based on research objective 1, which identifies the current problems of college teachers' digital competency.

21 experts in the relevant field are selected. These experts are chosen for their knowledge, experience, and expertise in educational digital technology.

In the first round, experts are asked to provide their individual opinions or recommendations on the college teachers' digital competency development model. These responses will be collected and summarized by the researcher.

In subsequent rounds, experts are provided with a summary of the collective opinions from the previous round (anonymously). They are then asked to review and revise their own responses based on the group's feedback.

Data Analysis

Once the expert survey concluded, the researcher analyzed the expert responses to identify areas of agreement, and points of divergence. These findings could provide valuable insights into the research topic, help generate recommendations, or offer predictions about future developments. The researcher refined the model based on experts' opinions.

The criteria of average mean scores Likert (1970) stated that the evaluation form refer to a measure of the experts' opinions on the quality level of the test. The criteria of the average mean scores are presented as follows:

4.21 - 5.00 means the highest

3.41 - 4.20 means high

2.61 - 3.40 means moderate

1.81 - 2.60 means low

1.00 - 1.80 means the lowest

This section provided a detailed analysis of expert rating results, and processed and interpreted the data based on the mean (Mean), median (Md), mode (Mo) and interquartile range (IQR). These statistical data will be used to evaluate the effectiveness and acceptability of the model and provide a basis for further optimization.

Objective 3: The objective of this phase is to evaluate the proposed college teachers' digital competency development model.

The population / Sample Group

The Population

Experts in the field of educational digital technology in China.

The Sample Group

5 experts in the field of educational digital technology in China. The qualifications of the experts are as follows:

1) at least 15 years of college work experience in Inner Mongolia,

2) have extensive experience in educational digital technology,

3) graduated with Doctor's degree or academic title is associate professor or above.

Research Instruments

Expert Evaluation Form

Expert Interview is a research method that conducts in-depth conversations with experts in a field to gain their expertise, insights, and experience. It is often used to gain a deep understanding of complex issues. The instrument to collect the data for objective three, to evaluate the college teachers' digital competency development model is expert evaluation form. A structured interview would be designed to collect experts' opinions about the college teachers' digital competency development model. And the evaluation form would be filled by experts after the interview.

Data Collection

The main process was as follows:

Design a set of open-ended questions that will guide the interview. Clearly communicate the purpose of the interview, how the information will be used, and obtain informed consent from the expert. Schedule and conduct the interview at a time convenient for the expert. Actively listen to the expert's responses and ask follow-up questions to explore deeper insights. With the expert's consent, record the interview or take detailed notes. Finally, the experts rated each digital competency description.

Data Analysis

The structured interview about college teachers' digital competency development model in Inner Mongolia will be analyzed by content analysis. Then, the final model will be formed.

Chapter 4

Results of Analysis

This research was to study how to improve the digital competency of college teachers in Inner Mongolia, China. The data analysis results can be presented as follows:

1. To study the current problems and resolutions for improvement on digital competency of college teachers in Inner Mongolia, China

2. To design a digital competency model development for college teachers in Inner Mongolia, China

3. To evaluate the digital competency development model.

The details are as follows.

Results of Objective 1

Analysis of current problems and resolution of college teachers' digital competency in Inner Mongolia, China.

STEP 1: Analysis of relevant literature on college teachers' digital competency in various countries to understand research trends and identify research gaps.

Process of Systematic Literature Review

The Web of Science (WOS) and China National Knowledge Infrastructure (CNKI) databases were selected to conduct this systematic review of the literature. WOS is the most trusted and important database for obtaining academic information worldwide. CNKI is the most widely used and influential database in China. Retrieving literature from these two databases can obtain relatively comprehensive and accurate information.

The selected terms were searched in the title, keywords and abstract of papers which were published in English or Chinese from January 2015 to June 2024. The search strings were as follows:

TS= ((“digital competency” or “digital competence” or “digital literacy”) AND (“higher education” or “college teacher” or “university teacher

After the initial search, 791 articles from Web of Science Core Collection and 156 articles from CNKI were obtained, for a total of 947.

The study selection process was an iterative and incremental process. The setting of inclusion/exclusion criteria is a crucial step in systematic literature review, as it directly affects the quality and reliability of the review. As mentioned in Chapter 2, different countries and regions have different descriptions of digital competency. According to the definition of "digital competency" in this study, literatures which did not meet the connotation of digital competency was excluded during the literature selection process. For the research subject of this study is college teacher, research on college students, preservice teachers and administrators were excluded. In addition, due to the different training objectives between vocational education and regular undergraduate colleges in China, there are many differences, so the research on the digital competency of vocational college teachers were also excluded.

The inclusion and exclusion criteria were established to select studies that are focus on college teachers' digital competency. The inclusion criteria were: the study must be related to the digital competency of college teachers, and the research papers must be published between 2015 and 2024. Additionally, the papers should be written in either English or Chinese, and the full version of the publication must be available. The exclusion criteria were: the research must not be related to the digital competency of college teachers, or it must be published outside the time frame from 2015 to 2024. Papers not written in English or Chinese, or those without a full version available, are also excluded. Furthermore, studies that are highly similar to one another are not considered. After exclusion, 116 articles entered the screening process.

During the literature screening stage, a preliminary screening was performed by reading the titles and abstracts. 53 papers were deleted, and the remaining 63 were used for full-text screening.

Critical Appraisal Skills Programme (CASP) is a tool used to evaluate the quality of research, which is widely used in medicine and social sciences. It provides a structured approach for researchers, clinicians, and students to critically assess the validity and reliability of research. The CASP qualitative check list includes 10 questions (Table 4.1), each with three options: yes, can't tell and no, with scores of 1, 0.5 and 0.

Table 4.1 The 10 questions of the CASP qualitative checklist tool

Section A: Are the results of the study valid?
1. Was there a clear statement of the aims of the research?
2. Is a qualitative methodology appropriate?
3. Was the research design appropriate to address the aims of the research?
4. Was the recruitment strategy appropriate to the aims of the research?
5. Was the data collected in a way that addressed the research issue?
6. Has the relationship between researcher and participants been adequately considered?
Section B: What are the results?
7. Have ethical issues been taken into consideration?
8. Was the data analysis sufficiently rigorous?
9. Is there a clear statement of findings?
Section C: Will the results help locally?
10. How valuable is the research?

The quality criteria for quantitative research also include 10 questions:

1. Was there a clear statement of the aims of the research?
2. Is a quantitative methodology appropriate?
3. was the research designed appropriate to achieve the objectives?
4. was the instrument clearly described and design based?
5. Was the sample and population of the research clearly described, and was its size sufficient to carry out the proposed analyses?
6. Were the research questions adequately answered?
7. Were the conclusions clearly described and based on the results?
8. Did the authors discuss the problems and limitations of the research?
9. How valuable is the research?
10. Are future lines of research presented?

Each question had three options and answers were coded as yes (1 point), no (0 point) and partial (0.5 point). Two researchers independently evaluated the quality

of the 63 initially screened literature, and those with a score greater than or equal to 7 were included in the final list. In the end, 36 articles were selected to do the analysis and answer the research questions (Appendix A). This data extraction procedure is represented through a PRISMA flow in Figure 4.1.

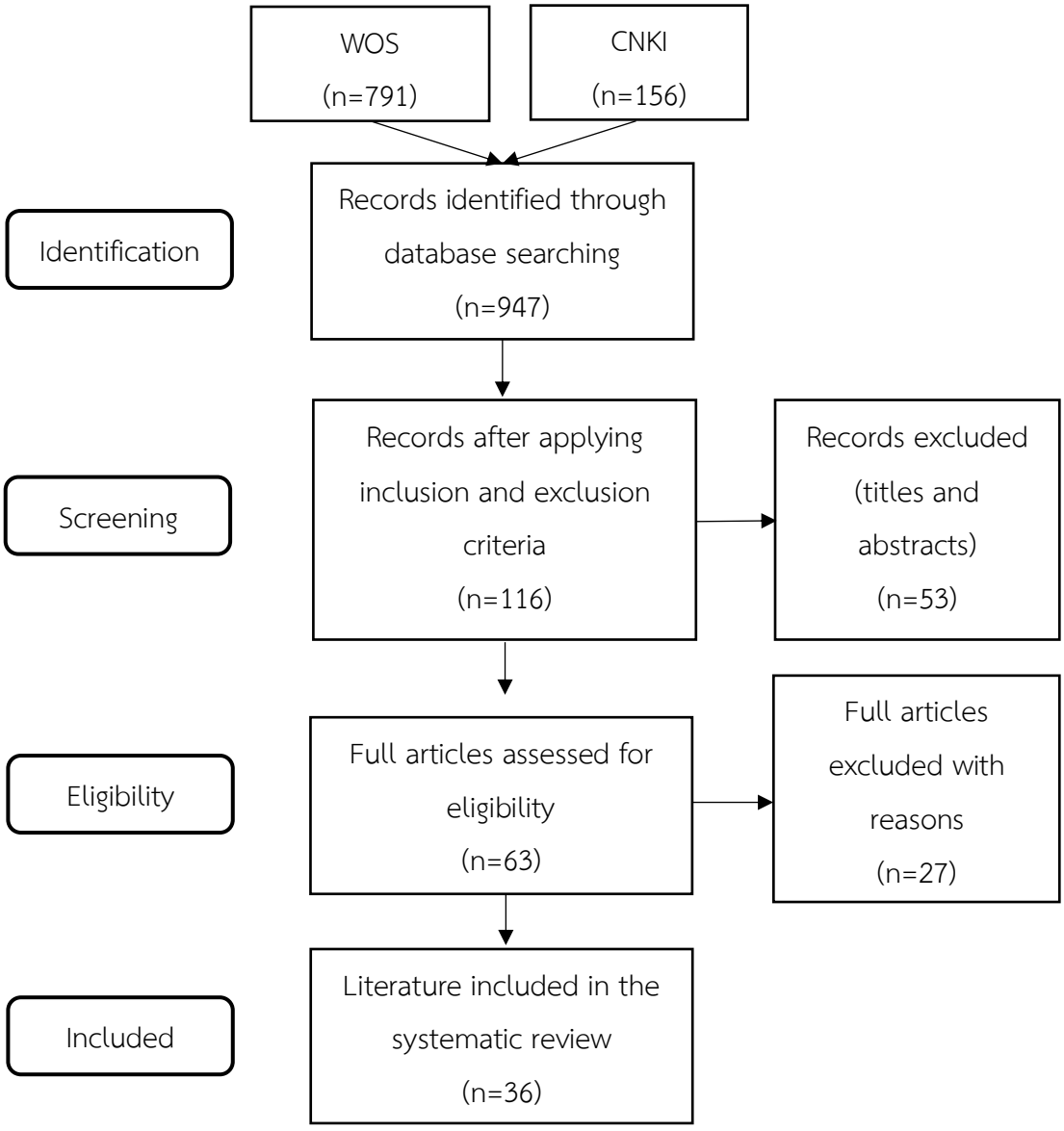

Figure 4.1 PRISMA flow: data extraction procedure

Analysis of Included Studies

Among the final 36 articles, there were 3 qualitative studies, 31 quantitative studies, and 2 studies combined qualitative and quantitative. There were 15 studies from Spain, 8 studies from China, 5 studies from Portugal, and 8 studies from other countries. (Table 4.2)

Table 4.2 Summary of Included Studies

Publication time					
2019	2020	2021	2022	2023	2024
1	3	9	6	14	3
Methodology					
Qualitative	Quantitative	Mix			
3	31	2			
Country					
Spain	China	Portugal	Others		
15	8	5	8		
Competency Model Used					
DigCompEdu	TPACK	Digital literacy of teachers	Designed by researcher		
15	2	2	19		
Research Method/Instrument					
DigCompEdu CheckIn	Questionnaire	Interview	Others		
11	20	3	4		
Sample size					
<100	100~500	501~1000	1000~3000	>3000	
2	19	6	8	1	

From the above data, it could be seen that European scholars, represented by Spain and Portugal, had produced more research results. Almost all of those studies

had used the DigCompEdu framework, half of which directly used the DigCompEdu Checkin self-assessment tool, and the other half conducted research by designing questionnaires based on the framework. Three studies used expert interview method.

For quantitative research, a sample size of less than 100 was considered insufficient to support the study and were excluded. Therefore, the sample sizes of all quantitative studies used for the final analysis were greater than 100. For qualitative research, there was no limit to the sample size. From Table 4.3, it can be seen that the sample size of most studies was between 100 and 500. There was also a study involving 7 countries with a sample size of 30407, which was the largest and most extensive coverage among related studies so far.

Research Results and Trends

In general, existing research on the digital competence of college teachers were mainly quantitative research. The DigCompEdu developed by the European Commission provides a detailed description of the key competencies required of teachers in a digital education environment. In addition to providing online self-assessment tools, it also offers guidelines and training materials, including case studies, workshops, and courses, to support teachers' ongoing professional development. Therefore, most of the relevant research in Europe has been conducted on this basis and has achieved many results. In comparison, other countries may lack scientific evaluation tools, and relevant scholars' research focused on developing evaluation tools.

In addition, two studies utilized the TPACK model, which is widely used in teaching research and has achieved significant results. According to the definition of digital competency in this study, the digital competency of college teachers is not limited to digital teaching abilities, but also includes digital research abilities, digital social responsibility, and other aspects. Therefore, a single TPACK model cannot fully reflect the digital competency of college teachers, but as an important component of college teachers' digital competency, relevant research results can be directly used to evaluate teachers' digital competency in teaching.

Scholars from all over the world have reached a consensus that college teachers in the digital age should have a relatively high level of digital competency in

order to cultivate students into qualified digital citizens. In studies that evaluated college teachers' digital competency level, most of the results showed that their digital competence was at a medium-low level. Only a few studies showed that the digital competence level of college teachers were relatively high.

Some scholars speculated that factors such as gender, age, professional field, and teaching experience may affect the digital competency level of college teachers. However, the conclusions of different studies were quite different and even contradictory. Thus, more relevant researches are needed to explore the relationship between these factors and the digital competency of college teachers.

In order to improve the digital competency of college teachers, it is necessary to design training programs targeting areas where digital competency is relatively weak, and to purposefully improve digital teaching ability or digital research ability. Developing training programs or courses to enhance the digital competency of college teachers and evaluating their effectiveness is also a future research area.

In China, scholars often referred to foreign digital competency frameworks and constructed evaluation models based on their own understanding before 2023. In 2022, the " Digital Literacy of Teacher" standard issued by the Ministry of Education clarifies the indicators of teacher digital competency and provides direction for the design and development of evaluation tools, but specific evaluation standards that can be effectively implemented have not yet emerged. In 2023, two studies utilized "Digital Literacy of Teachers", one of which explored the relationship between digital literacy beliefs and practices of Chinese college foreign language teachers, and the other constructing a digital competency framework of teachers in colleges and universities. Due to the large differences in education levels and digitalization degree among different regions of China, when implementing the "Digital Literacy of Teacher" standard, corresponding evaluation tools and reasonable evaluation standards should be developed taking into account the actual situation in different regions.

STEP 2: Analysis of current problems and resolution of college teachers' digital competence in Inner Mongolia, China.

In order to obtain more comprehensive and accurate information, 9 experts from four universities in Inner Mongolia were selected to participate in the expert

survey. Among them, 5 experts came from a teacher's college, 2 experts came from a finance and economics university, 1 expert came from a medical college, and 1 expert came from a science and engineering university. After communicating with experts about the purpose of this study and the requirements for questionnaire filling, the survey questionnaire (Appendix B) was sent via WeChat. The following is the basic information of the 9 experts. (Table 4.3)

Table 4.3 Personal information of the experts

	Work experience	Academic title	Education
Expert 1	18 years	Associate professor	Master's degree
Expert 2	12 years	Associate professor	Doctor's degree
Expert 3	18 years	Associate professor	Doctor's degree
Expert 4	15 years	Associate professor	Doctor's degree
Expert 5	17 years	Associate professor	Doctor's degree
Expert 6	20 years	Associate professor	Master's degree
Expert 7	16 years	Associate professor	Master's degree
Expert 8	17 years	Associate professor	Master's degree
Expert 9	16 years	Associate professor	Doctor's degree

Summary of Each Item

Based on the results of expert survey, a summary was made of the existing problems and possible solutions for each item proposed by experts. The following are details about the results:

1. Digital Awareness

It is defined as "the active reflection of digital-related activities in the minds of teachers, including digital cognition (Item 1-2), digital willingness (Item 3-4), and digital will (Item 5)" in "Digital Literacy of Teachers".

Item 1: Most experts believed that college teachers in Inner Mongolia do not have a deep understanding of the impact and value of digital technology in the field of education, and may not aware of the latest developments of digital technology in the economic, social, and educational aspects internationally. Some teachers may be

reserved about the digital transformation of education due to concerns about technology replacing traditional teaching methods, increasing dependence on technology, or doubts about their own digital abilities. Experts suggested improving this situation by popularizing digital technology in higher education, providing systematic training and resources, and encouraging interdisciplinary cooperation.

Item 2: Most experts believed that college teachers in Inner Mongolia have insufficient understanding of the degree, level, and scope of digital technology in promoting educational innovation and development, and lack awareness of possible ethical issues. They lack the awareness of applying digital resources to innovate teaching theories, teaching models, and teaching methods. Experts suggested enhancing teachers' awareness of educational innovation and understanding of ethical and moral issues through strengthening their digital skills training.

Item 3: All experts believed that college teachers in Inner Mongolia have little desire to proactively learn about digital technology resources and lack motivation to learn. The main reasons are psychological barriers, technology anxiety, and insufficient resources and support. Possible solutions to this problem include: increasing the experience of university teachers in applying digital technology resources in the teaching process; simplifying the process of using technology and provide customized learning resources; providing comprehensive training and support; promoting communication and sharing, etc.

Item 4: All experts believed that college teachers in Inner Mongolia are not very willing to carry out innovative practices in digital technology teaching, and lack innovative awareness and motivation, which partly because some colleges do not provide necessary software and hardware conditions. To solve this problem, it is recommended to increase investment in educational digital infrastructure, encourage teachers and students to participate in the innovation process, and continuously optimize and update teaching methods through practice.

Item 5: All experts believed that college teachers in Inner Mongolia lack confidence in overcoming difficulties and challenges encountered in digital education practices, and lack strategies for continuous improvement. The reasons may include age, knowledge structure, resistance to new technologies, lack of support systems,

workload and time management, etc. Experts advised to build confidence through ongoing training and technical support, establish feedback mechanisms to promote continuous learning and determination to adapt to new technologies, and provide psychological support and motivation.

2. Knowledge and Skills of Digital Technology

It is defined as “knowledge of digital technology that teachers should understand and skills that they need to master in their daily educational and teaching activities, including digital technology knowledge (Item 6) and digital skills (Item 7-8)” in “Digital Literacy of Teachers”.

Item 6: Most experts believed that college teachers in Inner Mongolia have insufficient understanding of common digital technology knowledge, lack of familiarity with its procedures and methods, limited practical experience, and lack of relevant training and support. It is recommended to start from these aspects to improve this situation: stimulating teachers' initiative to learn digital technology through systematic training; simplifying teaching methods and providing practical cases to reduce understanding barriers; and encouraging interdisciplinary learning and application to broaden the application perspective and depth of digital technology.

Item 7: All experts believed that college teachers in Inner Mongolia have a single strategy for selecting digital technology resources; lack of understanding of the practicality and applicability of digital technology resources; digital technology resources are updated frequently, making it difficult for teachers to keep up; some resources lack sustained technical support and maintenance, leading to usage problems. Experts suggested establishing a clear evaluation and screening mechanism for digital technology resources to promote resource sharing and exchange. Strengthen the basic construction of higher education teaching resources, organize and develop digital software suitable for most courses or courses with common characteristics by professional institutions, and keep resources updated and maintained.

Item 8: All experts believed that college teachers in Inner Mongolia are not proficient in the use of digital technology resources and lack the skills to use them, which may result in some digital resources not fully utilizing their functions and effects. Teachers also face difficulties in effectively integrating digital technology resources into

curriculum teaching, as well as problems such as digital resource management and maintenance. It is suggested to improve this situation through following ways: targeted training on the application of digital technology resources, providing specific demonstrations and guidance. Develop a teaching case library, which contains various digital technology resource use cases for teachers to refer to and learn from. Establish a mentor system or peer support system, experienced teachers are provided as mentors to offer specific guidance and assistance to other teachers. Improve the awareness of digital resource management and security.

3. Digital Application

It is defined as “the ability to use digital technology resources to carry out educational and teaching activities, including digital teaching design (Item 9-12), digital teaching implementation (Item 13-15), digital academic evaluation (Item 16-18), and digital collaborative education (Item 19-22)” in “Digital Literacy of Teachers”.

Item 9: More than half of the experts believed that the frequency of using digital technology to analyze learning situations among college teachers in Inner Mongolia is low, data collection is not comprehensive, and teachers fail to convert the analysis results into specific teaching improvement measures. There may be several reasons for this: teachers may lack systematic methods for analyzing students' learning situations, be unfamiliar with or underutilize data analysis tools, and face difficulties in data management and organization, which affect the effectiveness and accuracy of data analysis. Without an effective feedback mechanism, teachers and students may not be able to get the results of learning situation analysis and improvement suggestions timely. Teachers may not have enough time to conduct a comprehensive analysis of students’ learning situation due to busy work schedules. Lack of resources required for learning situation analysis, such as training and software tools. It is suggested that improvements can be made by increasing teachers' enthusiasm for using digital technology resources, adopting advanced analytical tools and techniques, enhancing teachers' ability to interpret and apply results, and establishing a feedback mechanism.

Item 10: All experts believed that for college teachers in Inner Mongolia, the channels to obtain digital educational resources are relatively single, and their ability

to produce digital educational resources is poor. The efficiency and quality of obtaining and producing digital educational resources are low. These measures may help improve this situation: enhancing the openness and accessibility of digital technology resource platforms in colleges and universities, expanding resource acquisition channels, simplifying technical operation processes, establishing a continuous content update and maintenance mechanism, and provide professional training in the production and management of digital teaching resources.

Item 11: All experts believed that the digital teaching activities designed by college teachers in Inner Mongolia are single in form. Teachers may encounter difficulties in effectively integrating digital technology with teaching content, and may fail to make full use of available digital tools and resources. In addition, the design of student participation and interaction is insufficient, which affects the effectiveness and attractiveness of teaching activities. Experts suggested strengthening targeted training on the application of digital technology resources, developing systematic teaching design methods, considering student needs, and enhancing interaction.

Item 12: Most experts believed that college teachers in Inner Mongolia usually have a single form of creating a blended learning environment, technology integration is difficult, and there is a lack of effective technology integration strategies. At the same time, insufficient student adaptability and participation may make it impossible to guarantee learning outcomes. It is recommended to improve this situation through various efforts: increasing diversified digital technology education resources, formulating clear digital technology integration strategies, and improving technical support and equipment conditions. By providing specialized training, teachers' digital technology application capabilities should be improved, while ensuring the good connection between online and offline learning resources and activities to provide a coherent learning experience and enhance students' adaptability and participation.

Item 13: More than half of the experts believed that the main problems are college teachers’ lack of management strategies and methods, insufficient integration and application of digital technologies, inadequate technical support and training, and false participation of some students. It is recommended to use customized technical

solutions to meet the needs of different teaching scenarios and provide flexible management tools to meet the personalized needs of different teachers and students. Improve college teachers' ability to use and integrate digital technology, develop systematic strategies and methods for organizing and managing teaching activities, and enhance technical support and training to improve the effectiveness of organizing teaching activities using digital technology resources.

Item 14: Most experts believed that the digital technology capabilities of college teachers in Inner Mongolia do not match the teaching needs, digital technology is difficult to integrate with teaching content, teaching process design is unreasonable, and data analysis and feedback mechanisms are insufficient. It is recommended to enhance teachers' digital technology capabilities by providing professional training and developing easy-to-integrate teaching tools to simplify the process of t combining technology and teaching, optimize teaching process design, and strengthen data analysis and feedback mechanisms.

Item 15: More than half of the experts believed that many college teachers in Inner Mongolia have not mastered the strategies for personalized teaching and cannot use digital technology resources to provide personalized guidance to students. There are difficulties in identifying and meeting students' personalized needs. In addition, there are concerns about data privacy and security. It is recommended to provide personalized teaching training and resource support for teachers, simplify technical operations and improve application effects, accurately identify student needs through data analysis tools, improve student participation and feedback mechanisms, and ensure data privacy and security.

Item 16: More than half of the experts believed that some college teachers in Inner Mongolia rarely use digital tools to collect student academic evaluation data, and there are problems with the operation and use of digital tools. More common problems are the difficulty in selecting digital tools, insufficient compatibility between academic evaluation data collection and teaching content, as well as data management and security issues. It is recommended to strengthen targeted training for teachers on the application of digital technology tools, simplify the operation of digital tools, provide technical support, and improve teachers' ability to manage and analyze

student academic data. At the same time, strict data protection policies should be formulated to ensure data security and compliance.

Item 17: More than half of the experts believed that college teachers in Inner Mongolia face difficulties in selecting models, poor data quality, and insufficient preprocessing in data analysis, which compromises the reliability and accuracy of the analysis results. Additionally, a lack of relevant skills and knowledge prevents effective interpretation and application of analysis results, reducing the practical value of data analysis. It is recommended to optimize the selection and application of data analysis models, ensure the comprehensiveness and accuracy of data collection, and improve teachers' understanding and application ability of data analysis results through training.

Item 18: More than half of the experts believed that many college teachers in Inner Mongolia rarely visualize academic data, lack skills in using data visualization tools, and have insufficient data interpretation abilities. It is recommended to strengthen teachers' application training of digital technology resources in a targeted manner, improve their ability to use visualization tools, design intuitive and easy-to-understand visualization tools, and provide clear explanations and guidance to help users correctly interpret the information behind the data.

Item 19: All experts believed that college teachers in Inner Mongolia Teachers generally do not pay enough attention to cultivating students' digital literacy, and there are insufficient digital teaching resources and tools for cultivating students. In addition, teachers' own digital literacy levels vary, making it difficult to effectively guide students to use digital resources appropriately. It is recommended to improve teachers' digital literacy through training and communication, increase the emphasis on cultivating students' digital literacy. Formulate a digital literacy training program for students, closely integrate digital literacy education with real life and learning scenarios, continue to improve students' ability to integrate knowledge within and across disciplines, and cultivate students' critical thinking to avoid excessive reliance on technology.

Item 20: All experts believed that most college teachers in Inner Mongolia rarely use digital resources to carry out moral education, and the ways and models of using digital technology resources to carry out moral education lack innovation. The

main reason is that teachers lack digital literacy and moral education ability. It is recommended to improve teachers' digital literacy and moral education ability through training and communication, optimize the combination of digital technology and moral education content, and develop more digital moral education resources for selection. A feedback mechanism should be established to regularly collect opinions and suggestions from students and teachers, adjust and improve moral education activities and digital technology applications based on feedback information.

Item 21: Most experts believed that college teachers in Inner Mongolia are not making sufficient use of digital technology resources to carry out mental health education. The main reason is that teachers' inadequate digital literacy and mental health education abilities. It is recommended to improve teachers' digital literacy and mental health education abilities, develop more scientific digital technology resources for mental health education, relevant digital tools and services comply with privacy protection standards, and use data analysis to provide customized mental health support and intervention measures.

Item 22: Most experts believed that many college teachers in Inner Mongolia do not believe that university teachers need to take on the responsibility of collaborative education between colleges and families. The communication channels between families and college teachers are single, and parental participation is insufficient. insufficient parental participation, and privacy and data security issues. In addition, there are issues of privacy protection and data security in the communication between teachers and parents.

4. Digital Social Responsibility

It is defined as “the responsibility in terms of ethics and behavioral norms in digital activities, including legal and ethical norms (Item 23-25), and digital security protection (Item 26-28)” in “Digital Literacy of Teachers”.

Item 23: More than half of the experts believed that most college teachers in Inner Mongolia are able to access the internet in accordance with the law, because teachers and students have unified digital technology resource usage standards during teaching, strict network supervision, and high awareness of network security. A few

experts believed that it is difficult to regulate online behavior and users lack awareness of laws and regulations.

Item 24: More than half of the experts believed that college teachers in Inner Mongolia are able to use digital products and services reasonably, because digital technology resources are purchased and guided by the college, and there is strict network supervision, and teachers have a high level of network security awareness. However, a few experts believed that some teachers may be at risk of over-reliance on technology, as well as issues such as information security and data protection.

Item 25: More than half of the experts believed that college teachers in Inner Mongolia are able to abide by the order of online communication, because digital technology resources are purchased and guided by colleges for teachers and students to use, and there is strict network supervision. Teachers have a high awareness of network security. But there are also a few experts who believed that teachers lack the ability to deal with online violence and the spread of false information. It is necessary to strengthen digital literacy education, cultivate users' ability to identify and resist harmful information, and combat cyber-related illegal activities through technical and legal means.

Item 26: More than half of the experts believed that some college teachers in Inner Mongolia have weak awareness of privacy protection, inadequate information management and protection measures, and poor internet usage habits, leading to the risk of data leakage and privacy infringement. It is recommended to strengthen the formulation and implementation of laws and regulations, improve the public's awareness of privacy protection, and adopt advanced security technologies to protect personal information from unauthorized access or abuse. In addition, teachers need to improve their network usage habits to avoid leaking personal information.

Item 27: More than half of the experts believed that college teachers in Inner Mongolia are able to maintain data security at work because they have reasonable channels to collect and keep relevant information, and colleges have relevant training to maintain work data security. However, other experts believed that some teachers have insufficient awareness of data security, lack emergency response and data recovery abilities, and need to improve their abilities in these two areas. It is

recommended to conduct regular security training and risk assessments to improve teachers' awareness of security and data protection abilities.

Item 28: More than half of the experts believed that college teachers in Inner Mongolia are able to identify, prevent, and handle network risk behaviors, because colleges regularly provide students and teachers with network security education, including daily network security education and various reminders, strict network supervision, and anti-fraud apps. The country also widely promotes the prevention of network risks. However, other experts believed that teachers' awareness of network security is still insufficient, their network usage habits are unsafe, and lack the ability to deal with network attacks and threats. They recommended improving these aspects.

5. Professional Development

It is defined as “the ability to use digital technology resources to promote their own and community professional development, including digital learning and training (Item 29-31), and digital teaching research and innovation (Item 32-33)” in “Digital Literacy of Teachers”.

Item 29: Most experts believed that college teachers in Inner Mongolia cannot updated learning resources in a timely manner and lack the internal motivation for continuous learning. Digital technology is mostly used for learning in professional fields, and less for education and teaching management. The reasons may include teachers' lack of channels or abilities to access high-quality digital technology resources, difficulty in adapting to new technologies and tools, and unfamiliarity with how to use these resources efficiently for learning. Teachers have heavy daily work tasks, making it difficult to allocate time for continuous learning and technical improvement, as well as a lack of learning support and guidance. It is recommended to carry out targeted and scientific digital learning according to the needs of teachers and the characteristics of the subject, continuously update and optimize learning resources, and enhance learners' continuous learning motivation by establishing incentive mechanisms and learning communities, improving time management, and providing effective learning support and guidance.

Item 30: Most experts believed that college teachers in Inner Mongolia are less likely to use digital technology resources to support teaching reflection and

improvement. They lack understanding or skills on how to effectively use digital tools, have insufficient data processing abilities, and have difficulty interpreting data. The reflection process lacks a clear structure, which leads to a disordered or unsystematic reflection process and difficulty in forming effective improvement measures. At the same time, there is a disconnect between teaching reflection and actual improvement. Teachers may not arrange sufficient time for reflection, and reflective activities become a formality, making it difficult to conduct in-depth analysis and improvement. It is recommended to provide easy-to-understand data analysis tools and methods, as well as establishing a supportive feedback loop to encourage data-based decision-making and continuous improvement. It is also recommended to improve teachers' enthusiasm and skills in using digital technology resources for teaching reflection.

Item 31: Most experts believed that college teachers in Inner Mongolia lack the willingness and motivation to participate in online, and the results are not good. There are several reasons for this: teachers may encounter technical problems, such as unstable network environments, technical failures when using platforms, etc., which affect the training experience. Heavy workload, unreasonable online training schedule, poor relevance and quality of training content, and insufficient follow-up and support will reduce teachers' enthusiasm for participating in online training.

Item 32: Most experts believed that college teachers in Inner Mongolia lack initiative in conducting research on digital teaching, with insufficient research ability and experience, limitations in research methods, and insufficient practicality of research results. There is a lack of feedback mechanism for research results, and teachers cannot understand the effect and impact of research results in actual teaching. Teachers may lack opportunities to collaborate with other educators or research institutions, which affects the breadth and depth of their research. It is recommended to guide teachers to recognize the development trend of digital education and expand their research perspectives through interdisciplinary collaboration and innovative research methods. At the same time, increase opportunities for cooperation and communication, improve research abilities and experience through training and communication, expand digital technology resource platforms, increase digital resources and technical support,

optimize the application of research methods and tools, and promote the practical application of research results.

Item 33: Most experts believed that college teachers in Inner Mongolia lack awareness and ability to innovate teaching models, have few available digital technology resources, inadequate training and support, and face challenges in compatibility with existing education systems and adaptability of teachers and students. It is recommended to enhance teachers' innovation awareness and ability through continuous professional development training, strengthen technical support and resource allocation, and provide guidance and support for students to adapt to new learning methods.

Resolution to Problems

In the face of these current problems, experts have provided corresponding suggestions, which can be summarized from the perspectives of teachers and colleges.

1. Advice for Teachers

Improve digital skills: Improve teachers' digital skills through systematic training and simplified technology use process.

Encourage innovation: Support teachers' innovation in teaching and research, and establish a mentor system.

Provide psychological support: Establish an effective feedback mechanism and provide psychological support to enhance teachers' sense of participation and motivation.

Strengthen security and privacy protection: Improve teachers' awareness of data privacy protection, strengthen security training and risk assessment.

Improve personalized teaching: Improve teaching methods to help students adapt to new learning models.

2. Advice for Colleges

Popularize digital technology: Promote the application of digital technology and increase investment in educational digital infrastructure.

Increase resource support: Provide more technical support and digital resources to optimize the use of resources.

Establish an evaluation mechanism: Establish a digital resource evaluation mechanism to ensure the effective use of resources.

Results of Objective 2

A digital competency development model is designed for college teachers in Inner Mongolia, with reference to the structure of UNESCO ICT-CFT. (Figure 4.2)

Design a Digital Competency Development Model

This model is organized over three successive stages or levels of a teacher's digital competency.

The first level is "Knowledge Acquisition", where teachers acquire knowledge about using digital technology and basic digital competencies. The Knowledge Acquisition level demands that teachers be aware of national development goals and how these correspond to education, and their role in achieving these ends.

The second level is "Knowledge Application", where teachers are able to effectively integrate digital technology into various aspects of teaching, research, and professional development with good digital competency.

The third level is "Knowledge Creation", where teachers have excellent digital competency and a strong sense of innovation, and are willing to innovate in teaching, scientific research, etc., to improve teaching effectiveness and effectively promote students' development.

	Knowledge Acquisition	Knowledge Application	Knowledge Creation
Digital Awareness	Understanding Digitalization of Education	Responding to Digitalization of Education	Promoting Digitalization of Education
Knowledge and Skills of Digital Technology	Basic Knowledge of Digital Technology	Application of Digital Skills	Innovation of Digital Knowledge
Digital Application	Knowledge of PCK, TCK & TPK	Implementation of TPACK	Empowering Students
Digital Social Responsibility	Knowledge of Digital Citizenship	Digital Citizenship Behavior	Digital Citizenship Education
Professional Development	Teacher as Learner	Teacher as Collaborator	Teacher as Innovator

Figure 4.2 Digital Competency Development Model for College Teachers in Inner Mongolia, China

Level 1: Knowledge Acquisition

In this level, the goal is to enable teachers to:

1. Understand the significance of digital technology in international digital economy competition and promoting the digital transformation of education.

2. Understand the connotation and characteristics of common digital technologies, as well as the procedures and methods for solving problems.

3. Master pedagogical content knowledge (PCK), technological content knowledge (TCK) and technological pedagogical knowledge (TPK).

4. Understand the basic concept of digital citizenship, know that individuals should use digital technology and the Internet effectively, safely and responsibly, and understand the ethical, legal and social norms in the digital environment.

5. Ability to study independently using digital resources according to individual needs.

	Knowledge Acquisition
Digital Awareness	Understanding Digitalization of Education
Knowledge and Skills of Digital Technology	Basic Knowledge of Digital Technology
Digital Application	Knowledge of PCK, TCK & TPK
Digital Social Responsibility	Knowledge of Digital Citizenship
Professional Development	Teacher as Learner

Figure 4.3 Level 1 of DCDM for College Teachers in Inner Mongolia, China

Dimension 1: Understanding Digitalization of Education

This aspect encourages teachers to understand the impact of digital technology on the development of international digital economy competition, and the significance of digital technology in promoting the digital transformation of education. Teachers are encouraged to recognize that digital technology is promoting educational innovation and development, and to understand that the rational use of digital technology resources can promote high-quality development of education.

Dimension 2: Basic Knowledge of Digital Technology

This aspect encourages teachers to understand the connotation and characteristics of common digital technologies, as well as the procedures and methods for solving problems.

Dimension 3: Knowledge of PCK, TCK & TPK

This aspect encourages teachers to acquire the knowledge to effectively integrate technology into the teaching of specific subject content (TCK), the knowledge

to use technology to support and improve teaching methods during the teaching process (TPK), and the knowledge to integrate teaching strategies with subject content (PCK).

Dimension 4: Knowledge of Digital Citizenship

This aspect encourages teachers to understand Internet laws and regulations; understand the principles of legitimate necessity, informed consent, clear purpose, and security assurance; understand the management and protection methods of personal information and private data; and have the basic knowledge of identifying, preventing, and handling network risk behaviors.

Dimension 5: Teacher as Learner

This aspect encourages teachers to use digital technology resources to carry out learning according to personal development needs. Use digital technology resources to analyze personal teaching practices and support teaching reflection and improvement.

Level 2: Knowledge Application

In this level, the goal is to enable teachers to:

1. Have the awareness and ability to proactively respond to the digitization of education.

2. Be able to effectively select appropriate digital tools, master the usage methods of digital equipment and tools required for education and teaching, proficiently operate digital tools, and solve common problems.

3. Possessing TPACK and implementation ability, able to design and implement effective teaching activities while considering technology, teaching, and content comprehensively. It reflects the comprehensive application of PCK, TCK and TPK in specific teaching contexts.

4. Demonstrate responsible and ethical behavior in digital environment, using technology and the Internet effectively and respectfully.

5. Be able to proactively seek cooperation opportunities, participate in or create online research communities, and carry out teaching and research activities as needed.

	Knowledge Application
Digital Awareness	Responding to Digitalization of Education
Knowledge and Skills of Digital Technology	Application of Digital Skills
Digital Application	Implementation of TPACK
Digital Social Responsibility	Digital Citizenship Behavior
Professional Development	Teacher as Collaborator

Figure 4.4 Level 2 of DCDM for College Teachers in Inner Mongolia, China

Dimension 1: Responding to Digitalization of Education

This aspect encourages teachers to actively understanding the functions and roles of digital technology resources, realize that the application of digital technology resources in the education and teaching process will generate innovative requirements in teaching theory, teaching mode, and teaching methods. Teachers have the desire to use them in education and teaching, have the initiative to implement the integration of digital technology and education and teaching, and be willing to carry out innovative practices in education and teaching.

Dimension 2: Application of Digital Skills

This aspect encourages teachers to master the principles and methods of selecting digital equipment, software, and platforms in education and teaching, and be proficient in using digital equipment, software, and platforms to solve common problems.

Dimension 3: Implementation of TPACK

This aspect encourages teachers to comprehensively apply knowledge of technology, teaching methods and content in the teaching process, to achieve

effective teaching practice. Teachers are encouraged to dynamically adjust the combination of technology, teaching methods, and content based on students' feedback and learning needs in the actual teaching process.

Dimension 4: Digital Citizenship Behavior

This aspect encourages teachers to comply with Internet laws and regulations, and consciously regulate various online behaviors. Teachers should use digital products and services in accordance with the principles of legitimate necessity, informed consent, clear purpose, and security assurance, and respect intellectual property rights. Comply with the order of online communication, and manage and protect personal information and privacy data effectively. Pay attention to data security maintenance when collecting, storing, using, and disseminating data from students, parents, and others at work. Be able to effectively identify, prevent, and deal with network risk behaviors.

Dimension 5: Teacher as Collaborator

This aspect encourages teachers to participate in or host online training communities to learn together, share experiences, seek help, solve problems, and use digital technology resources to support teaching research activities in response to digital teaching issues.

Level 3: Knowledge Creation

In this level, the goal is to enable teachers to:

1. Firmly believe in and continue to explore digital education and teaching practices to promoting the digital transformation of education.

2. Be able to perfect or improve certain digital technologies or tools.

3. By using digital tools and various educational strategies and methods, help students develop independent learning, critical thinking, problem-solving abilities, enhancing their self-confidence, sense of social responsibility, and mental health.

4. Cultivate students to become qualified digital citizens, actively contribute to the digital community, and take on broader social responsibilities.

5. Having enthusiasm and ability for educational innovation and effectively promote educational innovation.

	Knowledge Creation
Digital Awareness	Promoting Digitalization of Education
Knowledge and Skills of Digital Technology	Innovation of Digital Knowledge
Digital Application	Empowering Students
Digital Social Responsibility	Digital Citizenship Education
Professional Development	Teacher as Innovator

Figure 4.5 Level 3 of DCDM for College Teachers in Inner Mongolia, China

Dimension 1: Promoting Digitalization of Education

This aspect encourages teachers to be able to predict the ethical and moral issues that may arise in the use of digital technology in education and teaching. Teachers are encouraged to overcome the difficulties and challenges faced in the use of digital technology resources and innovation of teaching methods in the practice of digital education.

Dimension 2: Innovation of Digital Knowledge

This aspect encourages teachers to be able to continuously update digital technology knowledge, identify problems with digital tools and technologies based on usage experience, improve or refine the use of digital tools, optimize usage processes, etc.

Dimension 3: Empowering Students

This aspect encourages teachers to help students enhance their self-confidence, ability and autonomy through support, guidance and motivation in all aspects of education and teaching, so that they can take the initiative to control their own learning process and life and become more confident and autonomous people.

Dimension 4: Digital Citizenship Education

This aspect encourages teachers to strive to cultivate students into citizens with safety awareness, responsibility and ethics, effective communication, critical thinking, technical literacy, and active participation in the digital society.

Dimension 5: Teacher as Innovator

This aspect encourages teachers to use digital technology resources to continuously innovate teaching models, improve teaching activities, and transform students' learning methods.

Improve the Digital Competency Development Model

First-Round of Expert Survey

The model adopts the five dimensions specified in "Digital Literacy of Teachers" issued by the Chinese Ministry of Education. Therefore, the expert survey mainly explores whether the three-level competency division in each dimension is reasonable and whether the description of each competency is clear.

The expert survey questionnaire is all open-ended questions, consisting of six parts (Appendix E). The first part is the basic information of the expert, and the following five parts are descriptions of three competency levels for each dimension. Experts are required to provide their own opinions and suggestions for each dimension.

Before the expert survey was implemented, 5 experts were invited to conduct Content Validity Index (IOC) evaluation of the questionnaire. Experts evaluated each item, +1 means the item is congruent with the objectives, 0 means the item is uncertain to be congruent with the objectives, and -1 means the item is not congruent with the objectives. The items that obtain the IOC between 0.6–1.0 were deemed acceptable.

The IOC value of each item in the first round of expert survey questionnaire was above 0.6 (Appendix F), and the content validity of each dimension was high (Table 4.4). The quality of the questionnaire met the research requirements.

Table 4.4 Results of IOC for the First Round of Expert Survey Questionnaire

Dimensions	IOC Value	Result
Digital Awareness	0.9	Acceptable
Knowledge and Skills of Digital Technology	0.8	Acceptable
Digital Application	0.8	Acceptable
Digital Social Responsibility	0.9	Acceptable
Professional Development	1.0	Acceptable

21 experts from 6 universities in Inner Mongolia were selected to participate in two-rounds expert survey to improve the initial model (Appendix D). 11 experts were interviewed face-to-face, and 10 experts were interviewed by phone and WeChat. The researcher recorded and sorted out the main results of the expert interviews.

The main conclusions of the first round of expert surveys are that the division of the five dimensions into three stages of the questionnaire is generally reasonable, but the descriptions of some dimensions are difficult to evaluate, and are recommended to be further specified. Based on the specific suggestions made by the expert surveys for each dimension, the following items were modified:

For the dimension of “Digital Awareness”, some experts thought that the descriptions of items 1, 2, 4, and 10 are relatively abstract, and recommended that the descriptions be clearer and more specific, and try to use a more unified description method. The modified items are shown in Table 4.5.

Table 4.5 Modified Items in "Digital Awareness"

Level	Original Description	Modified Description
Knowledge Acquisition	1. Understanding the international digital economy competition triggered by digital technology.	1. Be able to understand that digital technology plays a vital role in international digital economic competition and promotes the transformation and development of the global economic structure.
	2. Understand the importance of digital technology in promoting the digital transformation of education.	2. Be able to understand the significance of digital technology in improving the quality of education, increasing accessibility and personalization of education, and adapting to the needs of modern society and economy.
	4. Understanding and rationally using digital technology resources can promote high-quality development of education.	4.Be able to understand that the proper use of digital technology resources can improve the quality of teaching, learning, management and assessment.
Knowledge Creation	10. Be aware that the application of digital technology resources in the education and teaching process may raise ethical and moral issues.	10. Be able to predict the ethical issues that may arise in education and teaching using digital technology.

For the dimension of "Knowledge and Skills of Digital Technology", the main problem was that the descriptions of items 1 and 2 were relatively broad. Experts

suggested listing some digital technologies to help teachers accurately understand the meaning of the questions. The modified items were shown in Table 4.6.

Table 4.6 Modified Items in "Knowledge and Skills in Digital Technology"

Level	Original Description	Modified Description
Knowledge Acquisition	1. Be able to understand the connotation and characteristics of common digital technologies.	1. Be able to understand the connotation and characteristics of multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.
	2. Be able to understand common digital technology problem-solving procedures and methods.	2. Be able to understand the procedures and methods of solving problems with multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.
Knowledge Creation	6. Be able to discover problems with digital tools and technologies based on usage experience, improve or modify the use of digital tools, optimize usage processes, etc.	6. Be able to discover problems with digital tools and technologies based on usage experience.
		7. Be able to improve or refine the use of digital tools, optimize the usage process, etc.

For the dimension of "Digital Application", experts generally believed that the item descriptions were clear and detailed, and did not need to be adjusted. A few experts suggested that item 14 should list specific activities to help teachers understand the meaning accurately. Therefore, the description of item 14 was modified as follows (Table 4.7).

Table 4.7 Modified Items in "Digital Application"

Level	Original Description	Modified Description
Knowledge Creation	14. Be able to use digital technology resources to assist in various forms of mental health education activities.	14. Being able to utilize digital technology resources to assist in various forms of mental health education activities such as mental health diagnosis, group counseling, psychological training, situational design, role-playing, game counseling, etc.

For the dimension of "Digital Social Responsibility", experts believed that the descriptions of some items were not specific enough and suggested to modify items 4, 7, and 10. The modified descriptions were as follows (Table 4.8):

Table 4.8 Modified Items in "Digital Social Responsibility"

Level	Original Description	Modified Description
Knowledge Acquisition	4. Have basic knowledge of identifying, preventing, and dealing with network risk behaviors.	4. Have Basic knowledge of identifying and preventing online rumors, cyber violence, telecommunications fraud, information theft, and other network risk behaviors.
Knowledge Application	7. Comply with the rules of online communication.	7.Be able to comply with the order of online communication and maintain a positive and healthy online environment.
	10. Be able to effectively identify, prevent, and deal with network risk behaviors.	10. Be able to effectively identify, prevent, and deal with online rumors, cyberbully, telecommunications fraud, information theft, and other network risk behaviors.

Table 4.8 (Continued)

Level	Original Description	Modified Description
Knowledge Creation	11. Pay attention to students' physical and mental health.	12. Be able to pay attention to students' physical and mental health, and be able to guide and help students identify, prevent, and deal with online risk behaviors.
	13. Help students identify, prevent, and deal with risky online behaviors.	
	14. Educate students about digital citizenship.	13. Be able to spread digital citizenship knowledge to students in the process of education and teaching.

For the dimension of "Professional Development", experts generally believed that the descriptions were clear and did not need to be modified. Some experts suggested that the description of item 1 be more detailed and specific. The modified description was as follows (Table 4.9):

Table 4.9 Modified Items in "Professional Development"

Level	Original Description	Modified Description
Knowledge Acquisition	1. Be able to use digital technology resources for learning according to personal development needs.	1. Be able to use digital educational resources to learn professional knowledge, teaching methodology knowledge, technical knowledge, education and teaching management, and other related knowledge according to personal development needs.

Second-Round of Expert Survey

After the first round of expert survey and modification of some items, the second round of expert survey questionnaire was formed, which was a semi-structured

questionnaire (Appendix E). Experts were asked to evaluate whether the descriptions of each competency are clear and reasonable, based on their own experience.

The IOC value of each item in the second round of expert survey questionnaire was above 0.6 (Appendix F), and the content validity of each dimension was high (Table 4.10). The quality of the questionnaire met the research requirements.

Table 4.10 Results of IOC for the Second Round of Expert Survey Questionnaire

Dimensions	IOC Value	Result
Digital Awareness	0.9	Acceptable
Knowledge and Skills of Digital Technology	0.9	Acceptable
Digital Application	0.9	Acceptable
Digital Social Responsibility	0.9	Acceptable
Professional Development	1.0	Acceptable

The results of the first round of expert survey and the modified survey questionnaire were sent again to the 21 experts for the second round of survey. The survey results are as follows:

In terms of "Digital Awareness", the mean values of nine out of eleven competency descriptions were higher than 4.20, indicating that these competency descriptions were highly recognized by experts. The IQR values of ten descriptions were between 0 and 1, indicating that the experts' opinions were relatively consistent. The IQR value of item 10 was 2, indicating that there were disagreements among experts (Table 4.11).

Table 4.11 Expert Rating Results of "Digital Awareness"

	Digital Awareness	Mean	Md	Mo	IQR
Knowledge Acquisition	1. Be able to understand that digital technology plays a vital role in international digital economic competition and promotes the transformation and development of the global economic structure.	4.50	5	5	1
	2. Be able to understand the significance of digital technology in improving the quality of education, increasing accessibility and personalization of education, and adapting to the needs of modern society and economy.	4.81	5	5	0
	3. Recognize that digital technology is driving innovation in education.	4.81	5	5	0
	4. Be able to understand that the proper use of digital technology resources can improve the quality of teaching, learning, management and assessment.	4.67	5	5	1
Knowledge Application	5. Actively understand the functions and roles of digital technology resources.	4.24	4	4	1
	6. Be able to realize that the application of digital technology resources in the education and teaching process will generate innovative requirements in terms of teaching theories, teaching models, and teaching methods.	4.62	5	5	1
	7. Desire to use digital technology in education and teaching.	4.60	5	5	1

Table 4.11 (Continued)

	Digital Awareness	Mean	Md	Mo	IQR
Knowledge Application	8. Have the initiative to implement the integration of digital technology and education and teaching.	4.40	5	5	1
	9. Willing to carry out innovative practices in education and teaching.	4.43	5	5	1
Knowledge Creation	10. Be able to predict the ethical issues that may arise in education and teaching using digital technology.	3.76	4	3	2
	11. Be able to overcome the difficulties and challenges in the use of digital technology resources and innovative teaching methods in the practice of education digitalization.	4.20	4	5	1

In terms of “Knowledge and Skills of Digital Technology”, the mean values of three competency descriptions were "high", and the others were “the highest”, indicating that these competency descriptions were widely recognized by experts. The IQR value of six descriptions were 1, indicating that experts’ opinions were relatively consistent. The IQR value of the second item was 2, indicating that there were large disagreements among experts (Table 4.12). The experts’ disagreement mainly focused on whether descriptions 1 and 2 needed to be merged. This issue would be further explored in the next stage of expert interviews. Therefore, the researcher decided to retain both descriptions at this stage.

Table 4.12 Expert Rating Results of “Knowledge and Skills of Digital Technology”

Knowledge and Skills of Digital Technology		Mean	Md	Mo	IQR
Knowledge Acquisition	1. Be able to understand the connotation and characteristics of multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.	4.48	5	5	1
	2. Be able to understand the procedures and methods of solving problems with multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.	4.10	5	5	2
Knowledge Application	3. Be able to master the principles and methods of selecting digital equipment, software, and platforms in education and teaching.	4.29	4	4	1
	4. Proficient in using digital equipment, software, and platforms to solve common problems.	4.33	4	5	1
Knowledge Creation	5. Be able to continuously update digital technology knowledge.	4.19	4	4	1
	6. Be able to discover problems with digital tools and technologies based on usage experience.	4.24	4	4	1
	7. Be able to improve or refine the use of digital tools, optimize the usage process, etc.	4.14	4	4	1

In terms of “Digital Application”, the mean values of six out of fifteen competency descriptions were "high", and the others were “the highest”, indicating that these competency descriptions were widely recognized by experts. The IQR value of twelve descriptions were 1, indicating that experts’ opinions were relatively

consistent. The IQR value of the rest three items were 2, indicating that there were large disagreements among experts (Table 4.13).

Table 4.13 Expert Rating Results of “Digital Application”

	Digital Application	Mean	Md	Mo	IQR
Knowledge Acquisition	1. Be able to use digital evaluation tools to analyze students' learning situation.	4.48	5	5	1
	2. Be able to design teaching activities that integrate digital technology resources based on teaching objectives.	4.29	4	5	1
	3. Be able to use digital technology resources to organize teaching activities in an orderly manner, enhance student participation and communication initiative.	4.43	5	5	1
	4. Be able to use digital tools to collect real-time student feedback, improve teaching behavior, optimize teaching processes, and regulate teaching progress.	4.52	5	5	1
	5. Be able to use digital technology resources to identify students' learning differences and provide targeted guidance.	4.14	5	5	2
	6. Be able to reasonably select and use digital tools to collect multimodal academic evaluation data.	3.86	4	5	2
Knowledge Application	7. Be able to collect data from multiple channels, and select, manage, and produce digital educational resources based on teaching needs.	4.24	4	4	1

Table 4.13 (Continued)

	Digital Application	Mean	Md	Mo	IQR
Knowledge Application	8. Be able to design teaching activities that integrate digital technology resources based on teaching objectives.	4.14	4	4	1
	9. Be able to use digital technology resources to break through the limitations of time and space, and create a learning environment that integrates online and physical learning spaces.	4.33	4	5	1
	10. Be able to select and apply appropriate data analysis models for academic data analysis.	4.14	4	4	1
	11. Be able to use digital tools to visualize and present academic data analysis results and provide reasonable explanations.	4.33	4	4	1
Knowledge Creation	12. Be able to guide students to appropriately select and use digital technology resources to support learning, and focus on cultivating students' computational thinking and digital social responsibility.	4.33	4	4	1
	13. Be able to use digital technology resources to broaden moral education pathways and innovate moral education models.	4.29	4	4	1

Table 4.13 (Continued)

	Digital Application	Mean	Md	Mo	IQR
Knowledge Creation	14. Being able to use digital technology resources to assist in various forms of mental health education activities such as mental health diagnosis, group counseling, psychological training, situational design, role-playing, game counseling, etc.	4.05	4	4	1
	15. Be able to use digital technology resources to achieve collaborative education between college and families, actively seek social resources, and broaden educational pathways.	4.14	4	5	2

The disagreement on item 5 mainly lied in whether this description belongs to "Knowledge Acquisition" or "Knowledge Application". The main reason for the disagreement on item 6 was that experts had inconsistent understandings of the description, so the language description needed to be further modified to avoid misunderstandings. The disagreement on item 15 was that experts have different opinions on whether college teachers need to take on the responsibility of co-education between home and college. This issue would be further explored in the next stage of expert interviews.

In terms of “Digital Social Responsibility”, the mean values of twelve competency descriptions were higher than 4.20, indicating that these competency descriptions were highly recognized by experts. The IQR values of all the descriptions were between 0 and 1, indicating that the experts’ opinions were relatively consistent. (Table 4.14)

Table 4.14 Expert Rating Results of "Digital Social Responsibility"

	Digital Social Responsibility	Mean	Md	Mo	IQR
Knowledge Acquisition	1. Understand Internet laws and regulations.	4.00	5	5	1
	2. Understand the principles of legitimate necessity, informed consent, clear purpose, and safety assurance.	4.40	5	5	1
	3. Understand the management and protection methods of personal information and privacy data.	4.40	5	5	1
	4. Have Basic knowledge of identifying and preventing online rumors, cyber violence, telecommunications fraud, information theft, and other network risk behaviors.	4.48	5	5	1
Knowledge Application	5. Comply with Internet laws and regulations, and consciously regulate all online behaviors.	4.76	5	5	0
	6. Use digital products and services in accordance with the principles of legitimate necessity, informed consent, clear purpose, and security protection, and respect intellectual property rights.	4.81	5	5	0
	7. Be able to comply with the order of online communication and maintain a positive and healthy online environment.	4.81	5	5	0
	8. Manage and protect personal information and privacy data effectively.	4.57	5	5	1
	9. Pay attention to data security when collecting, storing, using, and disseminating data from students, parents, and others in at work.	4.76	5	5	0

Table 4.14 (Continued)

	Digital Social Responsibility	**Mean**	**Md**	**Mo**	**IQR**
Knowledge Application	10. Be able to effectively identify, prevent, and deal with online rumors, cyberbully, telecommunications fraud, information theft, and other network risk behaviors.	4.57	5	5	1
Knowledge Creation	11. Use the internet to spread positive energy	4.76	5	5	0
	12. Be able to pay attention to students' physical and mental health, and be able to guide and help students identify, prevent, and deal with online risk behaviors.	4.71	5	5	0
	13. Be able to spread digital citizenship knowledge to students in the process of education and teaching.	4.43	5	5	1

In terms of “Professional Development”, the mean values of all the competency descriptions were higher than 4.20, indicating that these competency descriptions were highly recognized by experts. The IQR values of all the descriptions were 1, indicating that the experts’ opinions were relatively consistent. (Table 4.15)

Table 4.15 Expert Rating Results of “Professional Development”

	Professional Development	**Mean**	**Md**	**Mo**	**IQR**
Knowledge Acquisition	1. Being able to utilize digital technology resources to assist in various forms of mental health education activities such as mental health diagnosis, group counseling, psychological training, situational design, role-playing, game counseling, etc.	4.57	5	5	1
	2. Be able to use digital technology resources to analyze personal teaching practices and support teaching reflection and improvement.	4.57	5	5	1
Knowledge Application	3. Participate in or host online learning communities, learn together, share experiences, seek help, and solve problems.	4.29	5	5	1
	4. Be able to use digital technology resources to support teaching research activities in response to digital teaching issues.	4.43	5	5	1
Knowledge Creation	5. Be able to use digital technology resources to continuously innovate teaching models, improve teaching activities, and transform students' learning methods.	4.52	5	5	1

From the above results, it can be seen that the mean values of all competency descriptions were higher than 3.40. The IQR values of 46 out of 51 descriptions were 0 or 1, indicating that the model had been widely recognized by experts after two rounds of expert investigation, and their opinions were relatively consistent. The following was a widely recognized model by experts (Table 4.16).

Table 4.16 Proposed Digital Competency Model for College Teachers

Digital Awareness	
Knowledge Acquisition	1. Be able to understand that digital technology plays a vital role in international digital economic competition and promotes the transformation and development of the global economic structure.
	2. Be able to understand the significance of digital technology in improving the quality of education, increasing accessibility and personalization of education, and adapting to the needs of modern society and economy.
	3. Recognize that digital technology is driving innovation in education.
	4. Be able to understand that the proper use of digital technology resources can improve the quality of teaching, learning, management and assessment.
Knowledge Application	5. Actively understand the functions and roles of digital technology resources.
	6. Be able to realize that the application of digital technology resources in the education and teaching process will generate innovative requirements in terms of teaching theories, teaching models, and teaching methods.
	7. Desire to use digital technology in education and teaching.
	8. Have the initiative to implement the integration of digital technology and education and teaching.
	9. Willing to carry out innovative practices in education and teaching.
Knowledge Creation	10. Be able to overcome the difficulties and challenges in the use of digital technology resources and innovative teaching methods in the practice of education digitalization

Table 4.16 (Continued)

Knowledge and Skills of Digital Technology	
Knowledge Acquisition	1. Be able to understand the connotation and characteristics of multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.
	2. Be able to understand the procedures and methods of solving problems with multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.
Knowledge Application	3. Be able to master the principles and methods of selecting digital equipment, software, and platforms in education and teaching.
	4. Proficient in using digital equipment, software, and platforms to solve common problems.
Knowledge Creation	5. Be able to continuously update digital technology knowledge.
	6. Be able to discover problems with digital tools and technologies based on usage experience.
	7. Be able to improve or refine the use of digital tools, optimize the usage process, etc.
Digital Application	
Knowledge Acquisition	1. Be able to use digital evaluation tools to analyze students' learning situation.
	2. Be able to design teaching activities that integrate digital technology resources based on teaching objectives.
	3. Be able to use digital technology resources to organize teaching activities in an orderly manner, enhance student participation and communication initiative.
	4. Be able to use digital tools to collect real-time student feedback, improve teaching behavior, optimize teaching processes, and regulate teaching progress.
	5. Be able to use digital technology resources to identify students' learning differences and provide targeted guidance.

Table 4.16 (Continued)

Digital Application	
Knowledge Application	6. Be able to collect data from multiple channels, and select, manage, and produce digital educational resources based on teaching needs.
	7. Be able to design teaching activities that integrate digital technology resources based on teaching objectives.
	8. Be able to use digital technology resources to break through the limitations of time and space, and create a learning environment that integrates online and physical learning spaces.
	9. Be able to select and apply appropriate data analysis models for academic data analysis.
	10. Be able to use digital tools to visualize and present academic data analysis results and provide reasonable explanations.
Knowledge Creation	11. Be able to guide students to appropriately select and use digital technology resources to support learning, and focus on cultivating students' computational thinking and digital social responsibility.
	12. Be able to use digital technology resources to broaden moral education pathways and innovate moral education models.
Knowledge Creation	13. Being able to use digital technology resources to assist in various forms of mental health education activities such as mental health diagnosis, group counseling, psychological training, situational design, role-playing, game counseling, etc.
Digital Social Responsibility	
Knowledge Acquisition	1. Understand Internet laws and regulations.
	2. Understand the principles of legitimate necessity, informed consent, clear purpose, and safety assurance.
	3. Understand the management and protection methods of personal information and privacy data.

Table 4.16 (Continued)

Digital Social Responsibility	
Knowledge Acquisition	4. Have Basic knowledge of identifying and preventing online rumors, cyber violence, telecommunications fraud, information theft, and other network risk behaviors.
Knowledge Application	5. Comply with Internet laws and regulations, and consciously regulate all online behaviors.
	6. Use digital products and services in accordance with the principles of legitimate necessity, informed consent, clear purpose, and security protection, and respect intellectual property rights.
	7. Be able to comply with the order of online communication and maintain a positive and healthy online environment.
	8. Manage and protect personal information and privacy data effectively.
	9. Pay attention to data security when collecting, storing, using, and disseminating data from students, parents, and others in at work.
Knowledge Application	10. Be able to effectively identify, prevent, and deal with online rumors, cyberbully, telecommunications fraud, information theft, and other network risk behaviors.
Knowledge Creation	11. Use the internet to spread positive energy
	12. Be able to pay attention to students' physical and mental health, and be able to guide and help students identify, prevent, and deal with online risk behaviors.
	13. Be able to spread digital citizenship knowledge to students in the process of education and teaching.

Table 4.16 (Continued)

Professional Development	
Knowledge Acquisition	1. Being able to utilize digital technology resources to assist in various forms of mental health education activities such as mental health diagnosis, group counseling, psychological training, situational design, role-playing, game counseling, etc.
	2. Be able to use digital technology resources to analyze personal teaching practices and support teaching reflection and improvement.
Knowledge Application	3. Participate in or host online learning communities, learn together, share experiences, seek help, and solve problems.
	4. Be able to use digital technology resources to support teaching research activities in response to digital teaching issues.
Knowledge Creation	5. Be able to use digital technology resources to continuously innovate teaching models, improve teaching activities, and transform students' learning methods.

The researcher thought that there were large disagreements among experts regarding item 10 of "Digital Awareness" and item 15 of "Digital Application", and some experts believed that they should not be included. Therefore, these two competency descriptions would be further explored in the next stage of expert interviews after revision.

Although the opinions of experts on item 2 of "Knowledge and Skills of Digital Technology", items 5 and 6 of "Digital Applications" were also inconsistent, the disagreements mainly focused on the level at which these competencies should belong and the lack of clarity in the descriptions. Therefore, these three items were retained for further discussion in the next stage of expert interviews.

Results of Objective 3

Results of evaluating the proposed college teachers' digital competency development model.

Process of Expert Evaluation

A structured interview was designed to collect experts' opinions about the college teachers' digital competency development model. The goal of expert interviews was to obtain comprehensive feedback on the model, and to evaluate the effectiveness and applicability of the model's dimensions, hierarchy and competency descriptions.

The experts who participated in the interviews all have more than 15 years of teaching experience and have professional backgrounds in education, educational technology, management, psychology, etc. (Table 4.17)

Table 4.17 Basic Information of the Experts

Experts	Professional Qualifications	Education	Teaching Experience	Institution	Research Field
Mr. Yuan J.	Associate Professor	Doctor	18	Baotou Teachers' College	Educational Management
Mrs. Xiao F.	Associate Professor	Master	25	Baotou Teachers' College	Educational Technology
Mr. Li Z.	Associate Professor	Master	16	Baotou Teachers' College	Educational Research
Mr. Li J.	Associate Professor	Doctor	15	Inner Mongolia University of Finance and Economics	Educational Management
Mrs. Wang S.	Associate Professor	Master	20	Baotou Medical College	Educational Management

In order to improve the efficiency of the interview, relevant materials were sent to the experts before the interview, including the theoretical basis of this study, a detailed explanation of the model, the interview outline and evaluation form. According to the convenience of the experts, interviews were conducted via telephone or video conference, with each expert's interview lasting approximately half an hour. The researcher recorded and sorted out the feedback and suggestions of the experts. The interview outline was as follows (Table 4.18):

Table 4.18 Outline of the Expert Evaluation Form

Overall Evaluation of the Model	
Q1	What is your overall impression of this digital competency development model for college teachers?
Q2	Is the structure and content of the model clear and reasonable?
Q3	Is the model easy to understand and operate in practical applications?
Level Evaluation	
Q4	Is the distinction between the three levels of each dimension reasonable? Can it accurately reflect the different levels of teachers' digital competency?
Q5	Is the description of the level clear and easy to understand? Is there any ambiguity or lack of clarity?
Competency Description Evaluation	
Q6	Does the description effectively describe the competencies at different levels?
Q7	Are there any missing competency or inaccurate descriptions?
Q8	Do you need to add or modify descriptions of certain competency?
Improvement Suggestions	
Q9	Based on your experience and observation, which aspects of the model do you think need improvement?

Results of Expert Evaluation

For Q1, all five experts agreed the proposed digital competency development

model for college teachers was comprehensive and well-structured. It covered a wide range of competencies essential for college teachers in the digital age. The model is divided into clear dimensions which provide a holistic view of the knowledge and skills needed for digital proficiency in education. This structure allowed for a relative detailed assessment of teachers' digital competencies, ensuring that all critical areas are addressed.

For Q2, all five experts agreed the structure of the model was logical and easy to follow. The content appeared to be reasonable, as it aligned well with the current trends and demands in digital education. The inclusion of aspects such as "Digital Social Responsibility" and "Professional Development" reflected a forward-thinking approach, acknowledging that digital competency extends beyond just technical skills to include ethical considerations and continuous professional growth.

For Q3, three experts thought that the model was easy to understand and the explanations of related terms were clear, which could help teachers conduct self-evaluation to understand their own shortcomings in digital competency. Two experts thought that the model was relatively easy to understand, but they were concerned that teachers from different majors had different understandings of some competence descriptions.

Overall, the structure and content of the model were recognized by experts and were suitable for evaluating and supporting the development of digital competency among college teachers.

For Q4, all five experts agreed that it is reasonable to divide the digital competency of college teachers into three levels: knowledge acquisition, knowledge application and knowledge creation, as it reflects the different stages of the gradual development of teachers' digital competency. Knowledge acquisition focuses on fundamental knowledge and awareness, which is the first step in developing digital competency. Knowledge application emphasizes the ability to effectively integrate and apply this knowledge in actual teaching scenarios. And knowledge creation represents the highest level, where teachers not only apply knowledge but also innovate and contribute new ideas or practices in digital teaching.

For Q5, three experts thought the descriptions of the levels were clear and

easy to understand. Two experts thought some areas might need further clarification to enhance understanding.

Overall, this progression from acquiring knowledge to applying it and then creating new knowledge aligns well with how competency typically develops in professional contexts. While the description was mostly clear, some additional details or examples could help eliminate potential ambiguity and make the model more user-friendly for educators attempting to evaluate or improve their digital competency.

For Q6, three experts thought that the description can effectively distinguish the three levels of competence in each dimension - knowledge acquisition, knowledge application and knowledge creation. Each level was built upon the foundation of the previous level, reflecting the natural progression from basic understanding to practical application, and ultimately to innovation and creation. One expert thought that the level of the description of some competencies was not reasonable enough. One expert thought that the description of some competencies was not involved in all subject teachers and needed to be further discussed.

For Q7, four experts thought that the competency described in this model were comprehensive and covered a wide range of knowledge and skills required for digital competence in education. One expert thought that some descriptions were not clear enough, and suggests using examples to make the competency descriptions more specific and easier for teachers to understand accurately.

For Q8, experts thought that these descriptions effectively distinguish different levels of competency, but there was room to improve clarity and comprehensiveness by adding more specific details and expanding certain areas.

In general, most of the competency descriptions in the digital competency development model for college teachers are clear and reasonable, which can reflect the characteristics of different levels of competency. However, a few descriptions are not specific enough, and further improvement is recommended.

For Q9, two experts mentioned that it is recommended to make some competency descriptions clearer and easier to evaluate by adding descriptions of degree. One expert mentioned that some competency descriptions are not specific enough, which may lead to misunderstandings. One expert mentioned that some

competency descriptions at the "knowledge creation" level are relatively abstract and difficult to evaluate, and suggested further improvement.

After the interview, the experts fed back the evaluation form to the researchers, and the results were as follows (Table 4.19):

Table 4.19 Results of Expert Evaluation

	Digital Competencies Description	Percentage
Digital Awareness		
Knowledge Acquisition	1. Be able to understand that digital technology plays a vital role in international digital economic competition and promotes the transformation and development of the global economic structure.	80
	2. Be able to understand the significance of digital technology in improving the quality of education, increasing accessibility and personalization of education, and adapting to the needs of modern society and economy.	100
	3. Recognize that digital technology is driving innovation in education.	100
	4. Be able to understand that the proper use of digital technology resources can improve the quality of teaching, learning, management and assessment.	100
Knowledge Application	5. Actively understand the functions and roles of digital technology resources.	60
	6. Be able to realize that the application of digital technology resources in the education and teaching process will generate innovative requirements in terms of teaching theories, teaching models, and teaching methods.	100
	7. Desire to use digital technology in education and teaching.	100
	8. Have the initiative to implement the integration of digital technology and education and teaching.	80

Table 4.19 (Continued)

	Digital Competencies Description	Percentage
Digital Awareness		
Knowledge Creation	9. Willing to carry out innovative practices in education and teaching.	80
	10. Be able to propose improvement suggestions for educational policies of institutions or countries, and predict the potential impact of these changes.	60
	11. Be able to overcome the difficulties and challenges in the use of digital technology resources and innovative teaching methods in the practice of education digitalization.	100
Digital Technology and Skills		
Knowledge Acquisition	1. Be able to understand the connotation and characteristics of multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.	100
	2. Be able to understand the procedures and methods of solving problems with multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.	80
Knowledge Application	3. Be able to master the principles and methods of selecting digital equipment, software, and platforms in education and teaching.	100
	4. Proficient in using digital equipment, software, and platforms to solve common problems.	80
Knowledge Creation	5. Be able to continuously update digital technology knowledge.	100
	6. Be able to discover problems with digital tools and technologies based on usage experience.	80
	7. Be able to improve or refine the use of digital tools, optimize the usage process, etc.	60

Table 4.19 (Continued)

	Digital Competencies Description	**Percentage**
Digital Applications		
Knowledge Acquisition	1. Be able to use digital evaluation tools to analyze students' learning situation.	100
	2. Be able to effectively integrate digital technologies into the teaching of specific professional or subject content.	80
	3. Be able to use digital technology resources to organize teaching activities in an orderly manner, enhance student participation and communication initiative.	100
	4. Be able to use digital tools to collect real-time student feedback, improve teaching behavior, optimize teaching processes, and regulate teaching progress.	100
	5. Be able to use digital technology resources to identify students' learning differences and provide targeted guidance.	100
	6. Be able to reasonably select and use digital tools to collect multimodal academic evaluation data.	80
Knowledge Application	7. Be able to collect data from multiple channels, and select, manage, and produce digital educational resources based on teaching needs.	80
	8. Be able to design teaching activities that integrate digital technology resources based on teaching objectives.	80
	9. Be able to use digital technology resources to break through the limitations of time and space, and create a learning environment that integrates online and physical learning spaces.	100
	10. Be able to select and apply appropriate data analysis models for academic data analysis.	100

Table 4.19 (Continued)

	Digital Competencies Description	**Percentage**
Digital Applications		
Knowledge Application	11. Be able to use digital tools to visualize and present academic data analysis results and provide reasonable explanations.	80
Knowledge Creation	12. Be able to guide students to appropriately select and use digital technology resources to support learning, and focus on cultivating students' computational thinking and digital social responsibility.	80
	13. Be able to use digital technology resources to broaden moral education pathways and innovate moral education models.	60
	14. Be able to use digital technology resources to assist in various forms of mental health education activities such as mental health diagnosis, group counseling, psychological training, situational design, role-playing, game counseling, etc.	80
	15. Be able to use digital technology resources to achieve collaborative education between college and families, actively seek social resources, and broaden educational pathways.	60
Digital Social Responsibility		
Knowledge Acquisition	1. Understand Internet laws and regulations.	100
	2. Understand the principles of legitimate necessity, informed consent, clear purpose, and safety assurance.	100
	3. Understand the management and protection methods of personal information and privacy data.	100

Table 4.19 (Continued)

	Digital Competencies Description	**Percentage**
Digital Social Responsibility		
Knowledge Acquisition	4. Have basic knowledge of identifying and preventing online rumors, cyber violence, telecommunications fraud, information theft, and other network risk behaviors.	100
Knowledge Application	5. Comply with Internet laws and regulations, and consciously regulate all online behaviors.	100
	6. Use digital products and services in accordance with the principles of legitimate necessity, informed consent, clear purpose, and security protection, and respect intellectual property rights.	100
	7. Be able to comply with the order of online communication and maintain a positive and healthy online environment.	100
	8. Manage and protect personal information and privacy data effectively.	100
	9. Pay attention to data security when collecting, storing, using, and disseminating data from students, parents, and others in at work.	100
	10. Be able to effectively identify, prevent, and deal with online rumors, cyberbully, telecommunications fraud, information theft, and other network risk behaviors.	100
Knowledge Creation	11. Use the internet to spread positive energy.	100
	12. Be able to pay attention to students' physical and mental health, and be able to guide and help students identify, prevent, and deal with online risk behaviors.	100

Table 4.19 (Continued)

	Digital Competencies Description	**Percentage**
Digital Social Responsibility		
Knowledge Creation	13. Be able to spread digital citizenship knowledge to students in the process of education and teaching.	80
Professional Development		
Knowledge Acquisition	1. Be able to use digital educational resources to learn professional knowledge, teaching methodology knowledge, technical knowledge, education and teaching management, and other related knowledge according to personal development needs.	100
	2. Be able to use digital technology resources to analyze personal teaching practices and support teaching reflection and improvement.	80
Knowledge Application	3. Participate in or host online learning communities, learn together, share experiences, seek help, and solve problems.	100
	4. Be able to use digital technology resources to support teaching research activities in response to digital teaching issues.	100
Knowledge Creation	5. Be able to use digital technology resources to continuously innovate teaching models, improve teaching activities, and transform students' learning methods.	100

From the expert evaluation results, it could be seen that all digital competency descriptions had received recognition from more than half of the experts, and the digital competency development model for college teachers had been generally approved by the experts. However, for the description of some competencies, there were still some different opinions among the experts, which need further discussion.

Chapter 5

Conclusion Discussion and Recommendations

The aims of the present study include 1) to study the current problems and resolution for improvement on digital competency of college teachers in Inner Mongolia, China 2) to design a digital competency development model for college teachers in Inner Mongolia, China. 3) to evaluate the digital competency development model.

The details are as follows.

Conclusion

Current Problems of College Teachers' Digital Competence

The digital transformation of higher education not only brings new teaching resources and professional development opportunities for university teachers, but also forces them to constantly update educational concepts, improve educational methods, and optimize educational models.

According to the results of expert survey, among the five dimensions of " Digital Literacy of Teachers", only "Digital Social Responsibility" has fewer problems, while the other four dimensions have more problems. The details are as follows:

1. In the dimension of "Digital Awareness", college teachers generally have problems such as insufficient digital awareness, shallow understanding of the role of digital technology in education, lack of innovation awareness and motivation, low enthusiasm for actively learning technology, and insufficient confidence in meeting the challenges of digital education.

2. In the dimension of "Knowledge and Skills of Digital Technology", college teachers have deficiencies in digital technology knowledge, resource selection, usage skills, and management. The main problems include insufficient understanding of digital technology knowledge, single resource selection strategies, frequent updates of technology resources without continuous support, and insufficient ability to use and integrate digital technology

3. The dimension of “Digital Applications” revolves entirely around the application of digital technology in teaching and student education.

The main problems of “digital teaching design” are: rarely using digital technology to analyze learning situations, single channels for obtaining digital educational resources, single forms of digital teaching activities, difficulty in technology integration, lack of systematic teaching design methods and digital technology application abilities.

The main problems of “digital teaching implementation” are: college teachers' digital technology abilities do not match teaching needs, digital technology is difficult to integrate with teaching content, teaching process design is unreasonable, and data analysis and feedback mechanisms are insufficient. Teachers have not mastered personalized teaching strategies and find it difficult to use digital technology to provide personalized guidance.

The main problems of “digital academic evaluation” are: low frequency of using digital tools to collect academic evaluation data, difficulties in operating and using these tools, difficulties in model selection, poor data quality, and insufficient preprocessing in data analysis, which affect the reliability and accuracy of analysis results. In terms of data visualization, teachers use fewer visualization tools and lack relevant skills and data interpretation abilities.

The main problems of “digital collaborative education” are: college teachers generally neglect the cultivation of students' digital literacy, and their own levels of digital literacy vary, making it difficult to effectively guide students to use digital resources. In addition, teachers lack innovation in using digital resources for moral education and mental health education. Teachers and families do not have a strong sense of responsibility for collaborative education, family participation is low, and there are issues with privacy protection and data security.

4. There are relatively few problems in the dimension of “Digital Social Responsibility”. Most teachers can use the Internet and digital technology legally and in compliance with regulations, maintain data security, comply with online communication rules, and have a high level of digital security awareness. However, there are still some problems such as weak awareness of privacy protection, insufficient

information management, and inadequate ability to respond to network risks and data security to a certain extent.

5. In the dimension of “Professional Development”, college teachers have difficulties in updating learning resources, continuous learning and technological improvement. Digital technology is mainly used in professional fields, with less application in education and teaching management. In addition, teachers also perform poorly in teaching reflection, online training participation, and digital teaching research, mainly due to technical problems, insufficient data processing abilities, lack of innovation awareness and ability, etc.

Digital Competency Development Model for College Teachers

The digital competency development model is crucial for college teachers, especially in today's rapidly developing digital age. An effective model should comprehensively cover the digital skills required by teachers in teaching, research, and management, helping them better adapt to and use digital technology to improve teaching quality and efficiency.

This study drew on the ICT-CFT framework to design a digital competency development model for college teachers in Inner Mongolia, and used Two-Rounds expert survey to improve the model. The model included 5 dimensions, 3 levels and 51 competency descriptions, summarizing the different levels of digital competency of college teachers. Among them, “knowledge acquisition” is the basic competency that all teachers need to achieve. “Knowledge application” is the general level of digital competency of teachers, which can ensure the advancement of digital transformation of education. “Knowledge creation” is a discriminative competency that excellent teachers can achieve at a higher level.

By comparing the competency descriptions in the model, college teachers can evaluate their digital competency level and identify the dimensions that need improvement. This helps teachers to reflect on themselves and improve their relevant digital competencies in a targeted manner.

Model Evaluation

Five associate professors in the field of education with more than 15 years of teaching experience conducted a comprehensive evaluation of the effectiveness,

rationality, and practicality of the model from several aspects, including overall design of the model, hierarchical division, and description of digital competency, and put forward suggestions for improvement.

All 51 digital competency descriptions in the model had received support from more than half of the experts, with a minority of the experts thought that some descriptions still needed to be improved. Overall, experts believed that this model can combine the current trends in educational technology development, meet the actual needs of teachers' work, and provide a clear guidance path. It is a valuable tool that can promote teachers' professional development and students' learning experience.

Discussion

According to the results of the expert survey, there are certain problems in multiple dimensions of digital competency among college teachers in Inner Mongolia, and the level of digital competency is at a medium-low level, which is basically the same as the research conclusions of other literature. Under the guidance of DigCompEdu, many studies have been conducted in Europe, and some effective measurement tools have been developed. However, relevant research in China is still limited, and a scientific and reasonable evaluation tool has not yet appeared in Inner Mongolia. In addition, this study has the following limitations:

Understanding Differences May Affect Evaluation Results

When using the digital competency development model to evaluate college teachers' digital competency, teachers with different professional backgrounds may have different understandings and levels of attention to digital competency. Some teachers may focus more on the use of technological tools, while others may be more concerned with innovative applications of digital teaching. This difference may lead to teachers having different focuses when answering questions, thus affecting the accuracy of the assessment. Therefore, future research should consider how to better unify the definition of digital competency or provide more detailed guidance to ensure that teachers from different backgrounds can conduct self-assessment with consistent standards.

Self-assessment May Affect Effectiveness

The digital competency development model for college teachers used a self-assessment questionnaire, and this type of questionnaire has common problems with its effectiveness. When filling out self-assessment questionnaires, teachers may be affected by biases in their self-perception, different understandings of the questions, or psychological tendencies (such as overconfidence or over-caution) that affect the accuracy of their answers. Especially when evaluating complex concepts such as digital competency, the subjectivity of self-assessment may lead to biased evaluation results. Therefore, future research should explore more objective evaluation tools or combine multiple evaluation methods to reduce the errors caused by self-assessment.

Limitations of the Research Sample

Although this study conducted several in-depth surveys of some experts in the field, the sample size was relatively limited and did not cover a broader group of teachers. Due to limitations of the sample, the generalizability of the research results may be affected, especially when considering different colleges, regions, or cultural backgrounds, where digital competency may show different characteristics. Therefore, future research should expand the scope of measurement to include more teachers from different backgrounds, ages, and teaching experiences to improve the representativeness and application value of the research results.

Recommendations

Implications

This digital competency development model can be used both by teachers and colleges, to evaluate the digital competency level of teachers and promote their self-reflection and professional development. The following are recommendations for teachers and colleges:

Recommendations for Teachers

1. Self-evaluation and Reflection

College teachers can use this model for regular self-assessment to understand their strengths and weaknesses in the application of digital technology. Through result analysis, teachers can reflect on what they need to improve, such as how to use digital tools more effectively in the classroom and how to design more

interactive online learning content, etc. Teachers can combine the evaluation results with teaching practice. For example, if the evaluation results show that they are weak in data analysis or the use of online interactive tools, they can actively participate in corresponding training courses or online learning resources to improve these skills. Evaluation can also help teachers set goals for digital teaching and plan future development paths.

2. Develop A Personal Development Plan

The evaluation results can be a reference for teachers to develop personal digital teaching development plans. Teachers can set short-term and long-term goals for improving their digital competency based on the weak links found in the model, such as mastering advanced features of a certain teaching software or designing a digital teaching case within the next academic year. Teachers can use this model to determine specific development directions, such as gradually improving digital competency through self-study, digital technology training provided by the college, or collaborating with peers to develop new teaching methods.

3. Promote Teaching Reflection and Improvement

Teachers can use the model again after the course, to evaluate whether progress has been made in the skill improvement planned in the early stage, and reflect on the teaching effectiveness based on student feedback. For example, teachers can assess whether their interaction effectiveness in online classroom management has improved and whether they have better used digital tools to support personalized teaching. After evaluation, teachers can adjust their teaching methods according to the new results and continuously optimize their teaching design. The model can help teachers identify specific areas for improvement, such as how to use online platforms for learning management more effectively, or how to improve the design and application abilities of digital resources.

Recommendations for Colleges

1. Hierarchical Training for Teachers' Digital Competency

Colleges can conduct hierarchical digital technology training for teachers based on the digital competency level evaluated by the model. For example, for teachers at the “knowledge acquisition” level, basic technical operation training is

provided, while for teachers at the “knowledge application” level, more advanced training is provided, such as teaching design or digital innovation courses. This model can help colleges customize personalized training plans, allocate training resources reasonably through results orientation, and improve the pertinence and effectiveness of training. Colleges can organize seminars regularly to help teachers share experiences and improve skills in specific cases.

2. Promote Digital Teaching Innovation

Colleges can use the model to identify groups of teachers with strong digital competency, and provide them with more resources and support to encourage them to innovate in teaching and research. For example, teachers can be supported to develop new online courses or promote cross-disciplinary digital teaching cooperation. Based on the evaluation results, colleges can form digital teaching innovation teams to support these teachers in conducting digital teaching experiments, research, and cross departmental cooperation, promote teaching method reform, and further improve the overall teaching quality and competitiveness of the college.

3. Provide a Basis for College Management Decision-making

The college management can use this model regularly to conduct digital competency assessments for all teachers, in order to collect overall data on digital teaching. Based on these data, colleges can more accurately understand the current status of digital technology applications and identify areas for improvement. Using the data collected by the model, colleges can formulate long-term digital development strategies. For example, for certain disciplines or departments where digital teaching is weak, colleges can give priority to investing resources to improve the level of digital teaching in that field. In addition, data can also help colleges adjust resource allocation and optimize the construction of digital infrastructure.

Future Researches

Future research can focus on the following aspects to further optimize the digital competency development model for college teachers, and improve its application effectiveness:

1. Terminology Explanation and Language Simplification

It is recommended that future research focus on providing clear and concise definitions for professional terms in the model. By using easy-to-understand language and avoiding over-specialization, college teachers, especially those with non-technical backgrounds, can quickly understand the core concepts and operational steps of the model. This will improve the readability and application effectiveness of the model, help more teachers get started easily, and ensure that the model has wide adaptability in different educational backgrounds.

2. Provide Practical Tools and Resources

It is recommended that future Research could develop a series of specific tools and resources, including practical cases, operational guidelines, and evaluation tools, according to the different development level of digital competency, to help college teachers develop digital competency in actual teaching environments. By refining and applying these tools, future research can provide teachers with all-round support from theory to practice. Research can also explore how to provide these resources through online platforms or mobile applications to make them more convenient in actual work.

3. Large-scale Measurement Experiments to Improve the Model

It is recommended that future research conduct larger-scale measurement experiments, covering teacher groups in different regions, disciplines, and college types, to further verify the applicability and universality of the model. Through the collection and analysis of large sample data, potential shortcomings in the model can be identified and optimized accordingly to ensure its adaptability to diverse educational environments and needs. This will not only improve the reliability of the model, but also help provide a strong basis for policy making and college teacher training.

These research directions will help improve the practicality and wide application of the digital competency development model for college teachers, and promote further development of the digital transformation of education.

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Appendixes

Appendix A

Summary Descriptions of Studies Included in SLR

Author & Year	Country	Methodology	Sample Size	Competency Model	Research Method/ Instrument
Yang Shuang & Zhou Zhiqiang, 2019b	China	Quantitative	295	Designed by researcher	Questionnaire
Guillén-Gámez & Mayorga-Fernández, 2021	Spain	Quantitative	867	Designed by researcher	Questionnaire
Dias-Trindade et al., 2020b	Portugal	Quantitative	118	DigCompEdu	DigCompEdu CheckIn
Dias-Trindade & Ferreira, n.d. 2020	Portugal	Quantitative	118	DigCompEdu	DigCompEdu CheckIn
Cabero-Almenara, Guillén-Gámez, et al., 2021a	Spain	Quantitative	1104	DigCompEdu	DigCompEdu CheckIn
Cabero-Almenara, Guillén-Gámez, et al., 2021b	Spain	Quantitative	2180	DigCompEdu	DigCompEdu CheckIn
Guillén-Gámez et al., 2021	Spain	Quantitative	1704	Designed by researcher	Questionnaire
Guillén-Gámez et al., 2021	Spain	Quantitative	2180	DigCompEdu	DigCompEdu CheckIn
Cabero-Almenara, Barroso-Osuna, et al., 2021	Spain	Quantitative	300	DigCompEdu	DigCompEdu CheckIn
Bandrés et al., 2021	Spain	Quantitative	121	Designed by researcher	Questionnaire
Mercader & Duran-Bellonch, 2021	Spain	Quantitative	527	Designed by researcher	Questionnaire
Sarango-Lapo et al., 2021	Spain	Mix	271/15	Designed by researcher	Questionnaire & interview
Santos et al., 2021	Portugal	Quantitative	846	DigCompEdu	DigCompEdu CheckIn

Author & Year	**Country**	**Methodology**	**Sample Size**	**Competency Model**	**Research Method/ Instrument**
Dias-Trindade & Albuquerque, 2022	Portugal	Quantitative	249	DigCompEdu	DigCompEdu CheckIn
Basantes-Andrade et al., 2022	Ecuador	Quantitative	297	Designed by researcher	Questionnaire
Antón-Sancho et al., 2022	Venezuela	Quantitative	261	Designed by researcher	Questionnaire
Demeshkant et al., 2022	Poland	Quantitative	103	TPACK & DigCompEdu	Questionnaire
Myyry et al., 2022	Finland	Quantitative	265	Designed by researcher	Scale
Li Jing, 2022	China	Quantitative	277	Designed by researcher	O*NET
Guillén-Gámez, Ruiz-Palmero, & García, 2023	Spain	Quantitative	1740	Designed by researcher	Survy
Guillén-Gámez, Ruiz-Palmero, & Gómez-García, 2023	Spain	Quantitative	1740	Designed by researcher	Questionnaire
Moreira et al., 2023	Portugal	Quantitative	118	DigCompEdu	DigCompEdu CheckIn
Betancur-Chicué & García-Valcárcel Muñoz-Repiso, 2023	Spain	Qualitative	9	DigCompEdu	Peer review
Vergara et al., 2023	Latin American	Quantitative	1062	Designed by researcher	Questionnaire
Inamorato dos Santos et al., 2023	7 Countries	Qualitative	30407	DigCompEdu	DigCompEdu CheckIn
Sánchez-Macías et al., 2023	Mexico	Quantitative	270	Designed by researcher	Questionnaire

Author & Year	Country	Methodology	Sample Size	Competency Model	Research Method/ Instrument
Wang & Chu, 2023	China	Quantitative	525	Designed by researcher	Questionnaire
Sang et al., 2023	China	Quantitative	321	DigComEdu	Questionnaire
Bilbao-Aiastui et al., n.d., 2023	Spain	Quantitative	154	DigComEdu	Questionnaire
Fernández-Morante et al., 2023	Spain	Quantitative	610	DigCompEdu	DigCompEdu CheckIn
Hu Jiehui & Zhang Tiefu, 2023	China	Mix	271/3	Digital literacy of teachers	Questionnaire & Interview
Xiong Ye, 2023	China	Qualitative	9	Designed by researcher	Interview
He Chang & Guan Yuqiao, 2023	China	Quantitative	678	Digital Literacy of Teachers & TPACK	Questionnaire
Guillén-Gámez et al., 2024	Spain	Quantitative	1740	Designed by researcher	Questionnaire
Nagy & Dringó-Horváth, 2024	Hungary	Quantitative	116	Designed by researcher	Questionnaire
Yang Wenyang, 2024	China	Quantitative	196	Designed by researcher	Questionnaire

Appendix B

List of Specialists and Letters of specialists Invitation for lOC Verification

	Name	Professional Qualifications	Institution	Education	Teaching Experience
1	Yuan Jiazhi	Associate Professor	Baotou Teachers' College	Doctor's Degree	18 Years
2	Li Junhu	Associate Professor	Inner Mongolia University of Finance and Economics	Doctor's Degree	15 Years
3	Li Zhiqiang	Associate Professor	Baotou Teachers' College	Master's Degree	16 Years
4	Xiao Fengyan	Associate Professor	Baotou Teachers' College	Master's Degree	25 Years
5	Wang Shuping	Associate Professor	Baotou Medical College	Master's Degree	20 Years

Ref.No. MHESI 0643.14/ ว 193

Bansomdejchaopraya Rajabhat University
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Thonburi Bangkok 10600

14 August 2024

Subject: Invitation to validate research instrument

Dear Associate Professor Yuan Jiazhi

Mrs. Wang Xiao is a graduate student in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled " Digital competency development model for college teachers in Inner Mongolia,China"

The thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument.

With your expertise, we would like to ask your permission to validate the attached research instrument. In this regard, we would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Yours faithfully,

Assistant Professor Dr.Thanaput Chancharoen
(Vice Dean of Graduate School for Dean of Graduate School)

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14 August 2024

Subject: Invitation to validate research instrument

Dear Associate Professor Li Junhu

Mrs. Wang Xiao is a graduate student in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled " Digital competency development model for college teachers in Inner Mongolia,China"

The thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument.

With your expertise, we would like to ask your permission to validate the attached research instrument. In this regard, we would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Yours faithfully,

Assistant Professor Dr.Thanaput Chancharoen
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Subject: Invitation to validate research instrument

Dear Associate Professor Li Zhiqiang

Mrs. Wang Xiao is a graduate student in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled " Digital competency development model for college teachers in Inner Mongolia,China"

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Yours faithfully,

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14 August 2024

Subject: Invitation to validate research instrument

Dear Associate Professor Xiao Fengyan

Mrs. Wang Xiao is a graduate student in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled " Digital competency development model for college teachers in Inner Mongolia,China"

The thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument.

With your expertise, we would like to ask your permission to validate the attached research instrument. In this regard, we would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Yours faithfully,

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Subject: Invitation to validate research instrument

Dear Associate Professor Wang Shuping

Mrs. Wang Xiao is a graduate student in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled " Digital competency development model for college teachers in Inner Mongolia,China"

The thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument.

With your expertise, we would like to ask your permission to validate the attached research instrument. In this regard, we would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Yours faithfully,

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Appendix C

Expert Opinion Survey Questionnaire

No.	Items	Problems	Solutions	IF No Problem, Reasons
1	Understanding the Value of Digital Technology in Economic, Social, and Educational Development			
2	Understanding the Opportunities and Challenges brought by the Development of Digital Technology to Education and Teaching			
3	Willing to actively learn and use digital technology resources.			
4	Willing to actively carry out educational digital practice, exploration, and innovation.			
5	Having the confidence and determination to overcome the difficulties and challenges encountered in digital education practices.			
6	Understanding the concepts and basic principles of common digital technologies (such as the Internet, big data, artificial intelligence).			
7	Mastering the principles and methods of selecting digital devices, software, and platforms in education and teaching.			
8	Proficient in operating and using digital devices, software, and platforms to solve common problems.			
9	Ability to use digital evaluation tools to analyze the learning situation of students.			

10	Ability to collect from multiple channels and select, manage, and produce digital education resources based on teaching needs.			
11	Ability to design teaching activities that integrate digital technology resources based on teaching objectives.			
12	Ability to use digital technology resources to create blended learning environments.			
13	Ability to use digital technology resources to organize teaching activities in an orderly manner, enhance student participation and communication initiative			
14	Ability to use digital tools to collect student feedback in real-time and optimize teaching processes.			
15	Ability to use digital technology resources to provide personalized guidance			
16	Ability to reasonably select and use digital tools to collect academic evaluation data.			
17	Ability to select and apply appropriate data analysis models for academic data analysis.			
18	Ability to visualize academic data analysis results and provide reasonable explanations using digital tools.			
19	Ability to guide students in the appropriate selection and use of digital technology resources to support			

	learning, emphasizing the cultivation of students' computational thinking and digital social responsibility.			
20	Ability to use digital technology resources to carry out moral education			
21	Ability to use digital technology resources to carry out mental health education			
22	Ability to use digital technology resources to achieve collaborative education between college and families.			
23	Being able to use the Internet in accordance with the law.			
24	Being able to pay attention to network security, respect intellectual property rights, and pay attention to the physical and mental health of students, when using digital products and services.			
25	Being able to abide by the order of online communication and maintain a positive and healthy online environment.			
26	Being able to manage and protect personal information and privacy data effectively.			
27	Being able to pay attention to data security maintenance when collecting, storing, using, and disseminating data from students, parents, and others in the workplace			
28	Being able to identify, prevent, and handle network risk behaviors.			
29	Being able to use digital technology resources to carry out continuous			

	learning based on personal development needs.			
30	Being able to use digital technology resources to analyze personal teaching practices, support teaching reflection and improvement.			
31	Being able to participate in or lead online training communities, learn together, share experiences, seek help, and solve problems.			
32	Being able to use digital technology resources to support teaching and research activities in response to digital teaching issues.			
33	Ability to use digital technology resources to continuously innovate teaching models, improve teaching activities, and transform student learning methods.			
	Any Other Problems?			

Appendix D

List of 21 Experts

	Experts	Education	Teaching experience (year)	Workplace
1	Associate Professor Zhang X.	Doctor	11	Baotou Teachers' College
2	Associate Professor Yuan J.	Doctor	18	Baotou Teachers' College
3	Associate Professor Li Q	Master	13	Baotou Teachers' College
4	Lecturer Zheng Y.	Master	5	Baotou Teachers' College
5	Associate Professor Zhang Y.	Doctor	17	Baotou Teachers' College
6	Lecturer Wang X.	Doctor	9	Baotou Teachers' College
7	Associate Professor He X.	Doctor	16	Baotou Teachers' College
8	Associate Professor Duan Y.	Master	20	Inner Mongolia University of Science & Technology
9	Lecturer WANG M.	Maste	13	Inner Mongolia University of Science & Technology
10	Lecturer Leng X.	Doctor	7	Inner Mongolia University of Science & Technology
11	Associate Professor Yu X.	Master	14	Hetao College
12	Associate Professor Li J.	Doctor	14	Inner Mongolia University of Finance and Economics
13	Lecturer Dong S.	Doctor	7	Inner Mongolia University of Finance and Economics
14	Associate Professor Zhang Y	Doctor	17	Chifeng University
15	Associate Professor Liu Y.	Master	21	Chifeng University

	Experts	Education	Teaching experience (year)	Workplace
16	Associate Professor Li X.	Master	13	Baotou Teachers' College
17	Associate Professor Ji X.	Doctor	11	Baotou Teachers' College
18	Associate Professor Li Z.	Master	16	Baotou Teachers' College
19	Associate Professor Wang S.	Master	19	Baotou Medical College
20	Lecturer Pan F.	Master	12	Baotou Medical College
21	Lecturer Zhang B.	Master	13	Baotou Medical College

Appendix E

Research Instrument

1. First Round of Expert Survey Questionnaire
2. Second Round of Expert Survey Questionnaire

Expert Survey Questionnaire (First Round)

Subject

Digital Competency Model Development for College Teachers in Inner Mongolia, China

Research objective

To evaluate and improve the Digital Competency Development Model for college teachers in Inner Mongolia, China.

Explanation

This study constructs a model based on the five dimensions and 33 indicators in the "Digital Literacy of Teachers" released by Chinese Ministry of Education's, to evaluate the digital competency level of college teachers. Each dimension is divided into three continuous levels: "Knowledge Acquisition", "Knowledge Application", and "Knowledge Creation", representing different stages of the development of teachers' digital competency. "Knowledge Acquisition" refers to having basic awareness or knowledge, which are fundamental competencies for competent college teachers. "Knowledge Application" refers to teachers having a certain degree of initiative and being able to use digital technology knowledge and tools reasonably, which are digital competencies that most college teachers are expected to achieve. "Knowledge Creation" refers to competencies to creatively apply digital technology or innovate digital technology knowledge, which are digital competencies that a few outstanding college teachers can possess. There are a series of specific descriptions of the digital competencies that each stage should possess, and high-level competencies are the improvement and development of related abilities based on low-level competencies.

As an expert, please evaluate whether the descriptions of the following competencies are clear and reasonable, based on your own experience. Please fill in your suggestions in the blanks. The survey results are only for scientific research. Thank you for your support and help!

Part 1: General information of experts

Expert code_____

Teaching experience (year)_____

Education_____

Part 2: Digital Awareness

Digital awareness is the active reflection of objective digital-related activities in the minds of teachers, including digital cognition, digital willingness, and digital will.

Level	Competency Description
Knowledge Acquisition	1. Understanding the international digital economy competition triggered by digital technology.
	2. Understand the importance of digital technology in promoting the digital transformation of education.
	3. Recognize that digital technology is driving innovation in education.
	4. Understanding and rationally using digital technology resources can promote high-quality development of education.
Knowledge Application	5. Actively understand the functions and roles of digital technology resources.
	6. Be able to realize that the application of digital technology resources in the education and teaching process will generate innovative requirements in terms of teaching theories, teaching modes, and teaching methods.
	7. Desire to use digital technology in education and teaching.
	8. Have the initiative to implement the integration of digital technology and education and teaching.
	9. Willing to carry out innovative practices in education and teaching.
Knowledge Creation	10. Be aware that the application of digital technology resources in the education and teaching process may raise ethical and moral issues.

Knowledge Creation	11. Being able to overcome the difficulties and challenges in the use of digital technology resources and innovative teaching methods in the practice of education digitalization.
Suggestions	

Part 3: Digital Technology and Skills

The digital technology knowledge that teachers should understand and the digital technology skills that they need to master in their daily educational and teaching activities, including digital technology knowledge and digital technology skills.

Level	Competency Description
Knowledge Acquisition	1. Be able to understand the connotation and characteristics of common digital technologies.
	2. Be able to understand common digital technology problem-solving procedures and methods.
Knowledge Application	3. Be able to master the principles and methods of selecting digital equipment, software, and platforms in education and teaching.
	4. Proficient in using digital equipment, software, and platforms to solve common problems.
Knowledge Creation	5. Be able to continuously update digital technology knowledge.
	6. Be able to discover problems with digital tools and technologies based on usage experience, improve or modify the use of digital tools, optimize usage processes, etc.
Suggestions	

Part 4: Digital Applications

The ability of teachers to use digital technology resources to carry out educational and teaching activities, including digital teaching design, digital teaching implementation, digital academic evaluation, and digital collaborative education.

Level	Competency Description
Knowledge Acquisition	1. Be able to use digital evaluation tools to analyze students' learning situation.
	2. Be able to effectively integrate digital technology into the teaching of specific professional or disciplinary content.
	3. Be able to use digital technology resources to organize teaching activities in an orderly manner, enhance student participation and communication initiative.
	4. Be able to use digital tools to collect real-time student feedback, improve teaching behavior, optimize teaching processes, and regulate teaching progress.
	5. Be able to use digital technology resources to identify students' learning differences and provide targeted guidance.
	6. Be able to reasonably select and use digital tools to collect multimodal academic evaluation data.
Knowledge Application	7. Be able to collect data from multiple channels, and select, manage, and produce digital educational resources based on teaching needs.
	8. Be able to design teaching activities that integrate digital technology resources based on teaching objectives.
	9. Be able to use digital technology resources to break through the limitations of time and space, and create a learning environment that integrates online and physical learning spaces.
	10. Be able to select and apply appropriate data analysis models for academic data analysis.

Knowledge Application	11. Be able to use digital tools to visualize and present academic data analysis results and provide reasonable explanations.
Knowledge Creation	12. Be able to guide students to appropriately select and use digital technology resources to support learning, and focus on cultivating students' computational thinking and digital social responsibility.
	13. Be able to use digital technology resources to broaden moral education pathways and innovate moral education models.
	14. Be able to use digital technology resources to assist in various forms of mental health education activities.
	15. Be able to use digital technology resources to achieve collaborative education between college and families, actively seek social resources, and broaden educational pathways.
Suggestions	

Part 5: Digital Social Responsibility

The responsibility of teachers in terms of ethics and behavioral norms in digital activities, including legal and ethical norms, as well as digital security protection.

Level	Competency Description
Knowledge Acquisition	1. Understand Internet laws and regulations.
	2. Understand the principles of legitimate necessity, informed consent, clear purpose, and safety assurance.
	3. Understand the management and protection methods of personal information and privacy data.
	4. Have basic knowledge of identifying, preventing, and dealing with network risk behaviors.
Knowledge Application	5. Comply with Internet laws and regulations, and consciously regulate all online behaviors.

Knowledge Application	6. Use digital products and services in accordance with the principles of legitimate necessity, informed consent, clear purpose, and security protection, and respect intellectual property rights.
	7. Comply with the rules of online communication.
	8. Be able to manage and protect personal information and privacy data effectively.
	9. Pay attention to data security when collecting, storing, using, and disseminating data from students, parents, and others at work.
	10. Be able to effectively identify, prevent, and deal with network risk behaviors.
Knowledge Creation	11. Pay attention to students' physical and mental health.
	12. Use the internet to spread positive energy
	13. Help students identify, prevent, and deal with risky online behaviors.
	14. Educate students about digital citizenship.
Suggestions	

Part 6: Professional Development

Teachers' ability to use digital technology resources to promote their own and community's professional development, including digital learning and training, as well as digital teaching research and innovation.

Level	Competency Description
Knowledge Acquisition	1. Be able to use digital technology resources for learning according to personal development needs.
	2. Be able to use digital technology resources to analyze personal teaching practices and support teaching reflection and improvement.

Knowledge Application	3. Participate in or host online learning communities, learn together, share experiences, seek help, and solve problems.
	4. Be able to use digital technology resources to support teaching research activities in response to digital teaching issues.
Knowledge Creation	5. Be able to use digital technology resources to continuously innovate teaching models, improve teaching activities, and transform students' learning methods.
Suggestions	

Expert Survey Questionnaire (Second Round)

Subject

Digital competency model development for college teachers in Inner Mongolia, China

Research objective

To evaluate and improve the Digital Competency Development Model for college teachers in Inner Mongolia, China.

Explanation

This study constructs a model based on the five dimensions and 33 indicators in the "Digital Literacy of Teachers" released by Chinese Ministry of Education's, to evaluate the digital competency level of college teachers. Each dimension is divided into three continuous levels: "Knowledge Acquisition", "Knowledge Application", and "Knowledge Creation", representing different stages of the development of teachers' digital competency. There are a series of specific descriptions of the digital competencies that each stage should possess, and high-level competencies are the improvement and development of related abilities based on low-level competencies.

As an expert, please evaluate whether the descriptions of the following competencies are clear and reasonable, based on your own experience. Likert 5-level scale is used to evaluate each item.

1 represents very unreasonable;

2 represents relatively unreasonable;

3 represents uncertainty;

4 represents relatively reasonable

5 represents very reasonable.

If you have specific suggestions for each description, please fill in the blanks. The survey results are only for scientific research. Thank you for your support and help!

Part 1: General information of experts

Expert code_____

Teaching experience (year)_____

Education_____

Part 2: Digital Awareness

Digital awareness is the active reflection of objective digital-related activities in the minds of teachers, including digital cognition, digital willingness, and digital will.

Level	Competency Description	1	2	3	4	5
Knowledge Acquisition	1. Be able to understand that digital technology plays a vital role in international digital economic competition and promotes the transformation and development of the global economic structure.					
	2. Be able to understand the significance of digital technology in improving the quality of education, increasing accessibility and personalization of education, and adapting to the needs of modern society and economy.					
	3. Be able to recognize that digital technology is driving innovation in education.					
	4.Be able to understand that the proper use of digital technology resources can improve the quality of teaching, learning, management and assessment.					
Knowledge Application	5. Actively understand the functions and roles of digital technology resources.					

Knowledge Application	6. Be able to realize that the application of digital technology resources in the education and teaching process will generate innovative requirements in terms of teaching theories, teaching modes, and teaching methods.					
	7. Desire to use digital technology in education and teaching.					
	8. Have the initiative to implement the integration of digital technology and education and teaching.					
	9. Willing to carry out innovative practices in education and teaching.					
Knowledge Creation	10. Be able to predict the ethical issues that may arise in education and teaching using digital technology.					
	11. Be able to overcome the difficulties and challenges in the use of digital technology resources and innovative teaching methods in the practice of education digitalization.					
Are there any other suggestions for dimension 1?						

Part 3: Digital Technology and Skills

The digital technology knowledge that teachers should understand and the digital technology skills that they need to master in their daily educational and teaching activities, including digital technology knowledge and digital technology skills.

Level	Competency Description	1	2	3	4	5
Knowledge Acquisition	1. Be able to understand the connotation and characteristics of multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.					
	2. Be able to understand the procedures and methods of solving problems with multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.					
Knowledge Application	3. Be able to master the principles and methods of selecting digital equipment, software, and platforms in education and teaching					
	4. Proficient in using digital equipment, software, and platforms to solve common problems.					
Knowledge Creation	5. Be able to continuously update digital technology knowledge.					
	6. Be able to discover problems with digital tools and technologies based on usage experience.					
	7. Be able to improve or refine the use of digital tools, optimize the usage process, etc.					
Are there any other suggestions for dimension 2?						

Part 4: Digital Applications

The ability of teachers to use digital technology resources to carry out educational and teaching activities, including digital teaching design, digital teaching implementation, digital academic evaluation, and digital collaborative education.

Level	Competency Description	1	2	3	4	5
Knowledge Acquisition	1. Be able to use digital evaluation tools to analyze students' learning situation.					
	2. Be able to effectively integrate digital technology into the teaching of specific professional or disciplinary content.					
	3. Be able to use digital technology resources to organize teaching activities in an orderly manner, enhance student participation and communication initiative.					
	4. Be able to use digital tools to collect real-time student feedback, improve teaching behavior, optimize teaching processes, and regulate teaching progress.					
	5. Be able to use digital technology resources to identify students' learning differences and provide targeted guidance.					
	6. Be able to reasonably select and use digital tools to collect multimodal academic evaluation data.					
Knowledge Application	7. Be able to collect data from multiple channels, and select, manage, and produce digital educational resources based on teaching needs.					

Knowledge Application	8. Be able to design teaching activities that integrate digital technology resources based on teaching objectives.					
	9. Be able to use digital technology resources to break through the limitations of time and space, and create a learning environment that integrates online and physical learning spaces.					
	10. Be able to select and apply appropriate data analysis models for academic data analysis.					
	11. Be able to use digital tools to visualize and present academic data analysis results and provide reasonable explanations.					
Knowledge Creation	12. Be able to guide students to appropriately select and use digital technology resources to support learning, and focus on cultivating students' computational thinking and digital social responsibility.					
	13. Be able to use digital technology resources to broaden moral education pathways and innovate moral education models.					
	14. Be able to use digital technology resources to assist in various forms of mental health education activities such as mental health diagnosis, group counseling, psychological training, situational design, role-playing, game counseling, etc.					
	15. Be able to use digital technology resources to achieve collaborative education between college and families, actively seek social resources, and broaden educational pathways.					

Are there any other suggestions for dimension 3?

Part 5: Digital Social Responsibility

The responsibility of teachers in terms of ethics and behavioral norms in digital activities, including legal and ethical norms, as well as digital security protection.

Level	Competency Description	1	2	3	4	5
Knowledge Acquisition	1. Understand Internet laws and regulations.					
	2. Understand the principles of legitimate necessity, informed consent, clear purpose, and safety assurance.					
	3. Understand the management and protection methods of personal information and privacy data.					
	4. Have Basic knowledge of identifying and preventing online rumors, cyberbully, telecommunications fraud, information theft, and other network risk behaviors.					
Knowledge Application	5. Comply with Internet laws and regulations, and consciously regulate all online behaviors.					
	6. Use digital products and services in accordance with the principles of legitimate necessity, informed consent, clear purpose, and security protection, and respect intellectual property rights.					

Knowledge Application	7. Be able to comply with the order of online communication and maintain a positive and healthy online environment.					
	8. Be able to manage and protect personal information and privacy data effectively.					
	9. Pay attention to data security when collecting, storing, using, and disseminating data from students, parents, and others at work.					
	10. Be able to effectively identify, prevent, and deal with online rumors, cyberbully, telecommunications fraud, information theft, and other network risk behaviors.					
Knowledge Creation	11. Use the internet to spread positive energy					
	12. Be able to pay attention to students' physical and mental health, and be able to guide and help students identify, prevent, and deal with online risk behaviors.					
	13. Be able to spread digital citizenship knowledge to students in the process of education and teaching.					
Are there any other suggestions for dimension 4?						

Part 6: Professional Development

Teachers' ability to use digital technology resources to promote their own and community's professional development, including digital learning and training, as well as digital teaching research and innovation.

Level	Competency Description	1	2	3	4	5
Knowledge Acquisition	1. Be able to use digital educational resources to learn professional knowledge, teaching methodology knowledge, technical knowledge, education and teaching management, and other related knowledge according to personal development needs.					
	2. Be able to use digital technology resources to analyze personal teaching practices and support teaching reflection and improvement.					
Knowledge Application	3. Participate in or host online learning communities, learn together, share experiences, seek help, and solve problems.					
	4. Be able to use digital technology resources to support teaching research activities in response to digital teaching issues.					
Knowledge Creation	5. Be able to use digital technology resources to continuously innovate teaching models, improve teaching activities, and transform students' learning methods.					
Are there any other suggestions for dimension 5?						

Appendix F

The Results of the Quality Analysis of Research Instruments

1. lOC Verification Results of The First Round of Expert Survey Questionnaire
2. lOC Verification Results of The Second Round of Expert Survey Questionnaire

The Content Validity of the First-round Expert Survey

Conformity Evaluated Items		Score from Experts					IOC value	Results
Digital Awareness		1	2	3	4	5		
Knowledge Acquisition	1. Understanding the international digital economy competition triggered by digital technology.	1	0	1	1	1	0.8	Acceptable
	2. Understand the importance of digital technology in promoting the digital transformation of education.	1	1	1	1	1	1.0	Acceptable
	3. Recognize that digital technology is driving innovation in education.	1	1	1	1	1	1.0	Acceptable
	4. Understanding and rationally using digital technology resources can promote high-quality development of education.	1	1	1	1	0	0.8	Acceptable
Knowledge Application	5. Actively understand the functions and roles of digital technology resources.	1	0	1	1	1	0.8	Acceptable
	6. Be able to realize that the application of digital technology resources in the education and teaching process will generate innovative requirements in terms of teaching theories, teaching models, and teaching methods.	1	1	1	1	1	1.0	Acceptable
	7. Desire to use digital technology in education and teaching.	0	1	1	1	1	0.8	Acceptable
	8. Have the initiative to implement the integration of digital technology and education and teaching.	1	1	1	1	1	1.0	Acceptable
	9. Willing to carry out innovative practices in education and teaching.	0	1	1	1	1	0.8	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
Digital Awareness		**1**	**2**	**3**	**4**	**5**		
Knowledge Creation	10. Be aware that the application of digital technology resources in the education and teaching process may raise ethical and moral issues.	1	0	1	1	0	0.6	Acceptable
	11. Being able to overcome the difficulties and challenges in the use of digital technology resources and innovative teaching methods in the practice of education digitalization.	1	1	1	1	1	1.0	Acceptable
Total							**0.9**	**Acceptable**
Knowledge and Skills of Digital Technology								
Knowledge Acquisition	1. Be able to understand the connotation and characteristics of common digital technologies.	1	1	1	1	1	1.0	Acceptable
	2. Be able to understand common digital technology problem-solving procedures and methods.	0	1	1	1	1	0.8	Acceptable
Knowledge Application	3. Be able to master the principles and methods of selecting digital equipment, software, and platforms in education and teaching.	1	1	1	1	1	1.0	Acceptable
	4. Proficient in using digital equipment, software, and platforms to solve common problems.	1	1	1	1	1	1.0	Acceptable
Knowledge Creation	5. Be able to continuously update digital technology knowledge.	1	0	1	1	0	0.6	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
Knowledge and Skills of Digital Technology		**1**	**2**	**3**	**4**	**5**		
Knowledge Creation	6. Be able to discover problems with digital tools and technologies based on usage experience, improve or modify the use of digital tools, optimize usage processes, etc.	1	0	1	0	1	0.6	Acceptable
Total							**0.8**	**Acceptable**
	Digital Applications							
Knowledge Acquisition	1. Be able to use digital evaluation tools to analyze students' learning situation.	1	1	1	1	1	1.0	Acceptable
	2. Be able to effectively integrate digital technologies into the teaching of specific professional or subject content.	1	1	1	1	1	1.0	Acceptable
	3. Be able to use digital technology resources to organize teaching activities in an orderly manner, enhance student participation and communication initiative.	1	1	0	1	1	0.8	Acceptable
	4. Be able to use digital tools to collect real-time student feedback, improve teaching behavior, optimize teaching processes, and regulate teaching progress.	1	1	1	1	1	1.0	Acceptable
	5. Be able to use digital technology resources to identify students' learning differences and provide targeted guidance.	1	0	1	1	1	0.8	Acceptable
	6. Be able to reasonably select and use digital tools to collect multimodal academic evaluation data.	1	1	0	1	0	0.6	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
	Digital Applications	1	2	3	4	5		
Knowledge Application	7. Be able to collect data from multiple channels, and select, manage, and produce digital educational resources based on teaching needs.	1	1	1	1	0	0.8	Acceptable
Knowledge Application	8. Be able to design teaching activities that integrate digital technology resources based on teaching objectives.	1	1	1	1	1	1.0	Acceptable
	9. Be able to use digital technology resources to break through the limitations of time and space, and create a learning environment that integrates online and physical learning spaces.	1	1	1	1	1	1.0	Acceptable
	10. Be able to select and apply appropriate data analysis models for academic data analysis.	1	1	1	1	1	1.0	Acceptable
	11. Be able to use digital tools to visualize and present academic data analysis results and provide reasonable explanations.	0	1	1	1	1	0.8	Acceptable
Knowledge Creation	12. Be able to guide students to appropriately select and use digital technology resources to support learning, and focus on cultivating students' computational thinking and digital social responsibility.	1	0	1	0	1	0.6	Acceptable
	13. Be able to use digital technology resources to broaden moral education pathways and innovate moral education models.	1	1	1	0	1	0.8	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
	Digital Applications	**1**	**2**	**3**	**4**	**5**		
Knowledge Creation	14. Be able to use digital technology resources to assist in various forms of mental health education activities.	0	1	0	1	1	0.6	Acceptable
	15. Be able to use digital technology resources to achieve collaborative education between college and families, actively seek social resources, and broaden educational pathways.	0	1	1	0	1	0.6	Acceptable
Total							**0.8**	**Acceptable**
	Digital Social Responsibility							
Knowledge Acquisition	1. Understand Internet laws and regulations.	1	1	1	1	1	1.0	Acceptable
	2. Understand the principles of legitimate necessity, informed consent, clear purpose, and safety assurance.	1	1	1	1	1	1.0	Acceptable
	3. Understand the management and protection methods of personal information and privacy data.	1	1	1	1	1	1.0	Acceptable
	4. Have basic knowledge of identifying, preventing, and dealing with network risk behaviors.	1	1	1	1	1	1.0	Acceptable
Knowledge Application	5. Comply with Internet laws and regulations, and consciously regulate all online behaviors.	1	1	1	1	1	1.0	Acceptable
	6. Use digital products and services in accordance with the principles of legitimate necessity, informed consent, clear purpose, and security protection, and respect intellectual property rights.	1	1	1	1	0	0.8	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
	Digital Social Responsibility	**1**	**2**	**3**	**4**	**5**		
Knowledge Application	7. Comply with the rules of online communication.	1	1	1	1	1	1.0	Acceptable
	8. Manage and protect personal information and privacy data effectively.	1	1	1	1	1	1.0	Acceptable
	9. Pay attention to data security when collecting, storing, using, and disseminating data from students, parents, and others in at work.	1	1	1	1	1	1.0	Acceptable
	10. Be able to effectively identify, prevent, and deal with network risk behaviors.	1	0	1	1	1	0.8	Acceptable
Knowledge Creation	11. Pay attention to students' physical and mental health.	1	0	1	0	1	0.6	Acceptable
	12. Use the internet to spread positive energy	1	1	1	1	0	0.8	Acceptable
	13. Help students identify, prevent, and deal with risky online behaviors.	1	1	1	1	1	1.0	Acceptable
	14. Educate students about digital citizenship.	0	1	1	0	1	0.6	Acceptable
Total							**0.9**	**Acceptable**
	Professional Development							
Knowledge Acquisition	1. Be able to use digital technology resources for learning according to personal development needs.	1	1	1	1	1	1.0	Acceptable
	2. Be able to use digital technology resources to analyze personal teaching practices and support teaching reflection and improvement.	1	1	1	1	1	1.0	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
	Professional Development	**1**	**2**	**3**	**4**	**5**		
Knowledge Application	3. Participate in or host online learning communities, learn together, share experiences, seek help, and solve problems.	1	1	1	1	0	0.8	Acceptable
	4. Be able to use digital technology resources to support teaching research activities in response to digital teaching issues.	1	1	1	1	1	1.0	Acceptable
Knowledge Creation	5. Be able to use digital technology resources to continuously innovate teaching models, improve teaching activities, and transform students' learning methods.	1	1	1	1	1	1.0	Acceptable
Total							**1.0**	**Acceptable**

The Content Validity of the Second-round Expert Survey

Conformity Evaluated Items		Score from Experts					IOC value	Results
Digital Awareness		1	2	3	4	5		
Knowledge Acquisition	1. Be able to understand that digital technology plays a vital role in international digital economic competition and promotes the transformation and development of the global economic structure.	1	1	1	1	1	1.0	Acceptable
	2. Be able to understand the significance of digital technology in improving the quality of education, increasing accessibility and personalization of education, and adapting to the needs of modern society and economy.	1	1	1	1	1	1.0	Acceptable
	3. Recognize that digital technology is driving innovation in education.	1	1	1	1	1	1.0	Acceptable
	4. Be able to understand that the proper use of digital technology resources can improve the quality of teaching, learning, management and assessment.	1	1	1	1	1	1.0	Acceptable
Knowledge Application	5. Actively understand the functions and roles of digital technology resources.	1	0	1	1	1	0.8	Acceptable
	6. Be able to realize that the application of digital technology resources in the education and teaching process will generate innovative requirements in terms of teaching theories, teaching models, and teaching methods.	1	1	1	1	1	1.0	Acceptable
	7. Desire to use digital technology in education and teaching.	0	1	1	1	1	0.8	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
Digital Awareness		**1**	**2**	**3**	**4**	**5**		
Knowledge Application	8. Have the initiative to implement the integration of digital technology and education and teaching.	1	1	1	1	1	1.0	Acceptable
	9. Willing to carry out innovative practices in education and teaching.	0	1	1	1	1	0.8	Acceptable
Knowledge Creation	10. Be able to predict the ethical issues that may arise in education and teaching using digital technology.	0	1	1	1	0	0.6	Acceptable
	11. Being able to overcome the difficulties and challenges in the use of digital technology resources and innovative teaching methods in the practice of education digitalization.	1	1	1	1	1	1.0	Acceptable
Total							**0.9**	**Acceptable**
Knowledge and Skills of Digital Technology								
Knowledge Acquisition	1. Be able to understand the connotation and characteristics of multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.	1	1	1	1	1	1.0	Acceptable
	2. Be able to understand the procedures and methods of solving problems with multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.	1	1	1	1	1	1.0	Acceptable
Knowledge Application	3. Be able to master the principles and methods of selecting digital equipment, software, and platforms in education and teaching.	1	1	1	1	1	1.0	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
Knowledge and Skills of Digital Technology		**1**	**2**	**3**	**4**	**5**		
Knowledge Application	4. Proficient in using digital equipment, software, and platforms to solve common problems.	1	1	1	1	1	1.0	Acceptable
Knowledge Creation	5. Be able to continuously update digital technology knowledge.	1	1	1	1	0	0.8	Acceptable
	6. Be able to discover problems with digital tools and technologies based on usage experience.	1	1	1	1	1	1.0	Acceptable
	7. Be able to improve or refine the use of digital tools, optimize the usage process, etc.	1	0	1	1	1	0.8	Acceptable
Total							**0.9**	**Acceptable**
	Digital Applications							
Knowledge Acquisition	1. Be able to use digital evaluation tools to analyze students' learning situation.	1	1	1	1	1	1.0	Acceptable
	2. Be able to effectively integrate digital technologies into the teaching of specific professional or subject content.	1	1	1	1	1	1.0	Acceptable
	3. Be able to use digital technology resources to organize teaching activities in an orderly manner, enhance student participation and communication initiative.	1	1	0	1	1	0.8	Acceptable
	4. Be able to use digital tools to collect real-time student feedback, improve teaching behavior, optimize teaching processes, and regulate teaching progress.	1	1	1	1	1	1.0	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
Digital Applications		1	2	3	4	5		
Knowledge Acquisition	5. Be able to use digital technology resources to identify students' learning differences and provide targeted guidance.	1	0	1	1	1	0.8	Acceptable
	6. Be able to reasonably select and use digital tools to collect multimodal academic evaluation data.	1	1	0	1	0	0.6	Acceptable
Knowledge Application	7. Be able to collect data from multiple channels, and select, manage, and produce digital educational resources based on teaching needs.	1	1	1	1	0	0.8	Acceptable
	8. Be able to design teaching activities that integrate digital technology resources based on teaching objectives.	1	1	1	1	1	1.0	Acceptable
	9. Be able to use digital technology resources to break through the limitations of time and space, and create a learning environment that integrates online and physical learning spaces.	1	1	1	1	1	1.0	Acceptable
	10. Be able to select and apply appropriate data analysis models for academic data analysis.	1	1	1	1	1	1.0	Acceptable
	11. Be able to use digital tools to visualize and present academic data analysis results and provide reasonable explanations.	0	1	1	1	1	0.8	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
	Digital Applications	**1**	**2**	**3**	**4**	**5**		
	12. Be able to guide students to appropriately select and use digital technology resources to support learning, and focus on cultivating students' computational thinking and digital social responsibility.	1	0	1	1	1	0.8	Acceptable
	13. Be able to use digital technology resources to broaden moral education pathways and innovate moral education models.	1	1	1	0	1	0.8	Acceptable
Knowledge Creation	14. Being able to utilize digital technology resources to assist in various forms of mental health education activities such as mental health diagnosis, group counseling, psychological training, situational design, role-playing, game counseling, etc.	1	1	0	1	1	0.8	Acceptable
	15. Be able to use digital technology resources to achieve collaborative education between college and families, actively seek social resources, and broaden educational pathways.	0	1	1	0	1	0.6	Acceptable
Total							**0.9**	**Acceptable**
	Digital Social Responsibility							
Knowledge Acquisition	1. Understand Internet laws and regulations.	1	1	1	1	1	1.0	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
	Digital Social Responsibility	**1**	**2**	**3**	**4**	**5**		
Knowledge Acquisition	2. Understand the principles of legitimate necessity, informed consent, clear purpose, and safety assurance.	1	1	1	1	1	1.0	Acceptable
	3. Understand the management and protection methods of personal information and privacy data.	1	1	1	1	1	1.0	Acceptable
	4. Have basic knowledge of identifying and preventing online rumors, cyber violence, telecommunications fraud, information theft, and other network risk behaviors.	1	1	1	1	1	1.0	Acceptable
Knowledge Application	5. Comply with Internet laws and regulations, and consciously regulate all online behaviors.	1	1	1	1	1	1.0	Acceptable
	6. Use digital products and services in accordance with the principles of legitimate necessity, informed consent, clear purpose, and security protection, and respect intellectual property rights.	1	1	1	1	0	0.8	Acceptable
	7. Be able to comply with the order of online communication and maintain a positive and healthy online environment.	1	1	1	1	1	1.0	Acceptable
	8. Manage and protect personal information and privacy data effectively.	1	1	1	1	1	1.0	Acceptable
	9. Pay attention to data security when collecting, storing, using, and disseminating data from students, parents, and others in at work.	1	1	1	1	1	1.0	Acceptable

	Conformity Evaluated Items	Score from Experts					IOC value	Results
	Digital Social Responsibility	**1**	**2**	**3**	**4**	**5**		
Knowledge Application	10. Be able to effectively identify, prevent, and deal with online rumors, cyberbully, telecommunications fraud, information theft, and other network risk behaviors.	1	1	1	1	1	1.0	Acceptable
Knowledge Creation	11. Use the internet to spread positive energy.	1	0	1	0	1	0.6	Acceptable
	12. Be able to pay attention to students' physical and mental health, and be able to guide and help students identify, prevent, and deal with online risk behaviors.	1	1	1	1	0	0.8	Acceptable
	13. Be able to spread digital citizenship knowledge to students in the process of education and teaching.	1	1	1	1	1	1.0	Acceptable
Total							**0.9**	**Acceptable**
	Professional Development							
Knowledge Acquisition	1. Be able to use digital educational resources to learn professional knowledge, teaching methodology knowledge, technical knowledge, education and teaching management, and other related knowledge according to personal development needs.	1	1	1	1	1	1.0	Acceptable
	2. Be able to use digital technology resources to analyze personal teaching practices and support teaching reflection and improvement.	1	1	1	1	1	1.0	Acceptable

Conformity Evaluated Items		Score from Experts					IOC value	Results
	Professional Development	**1**	**2**	**3**	**4**	**5**		
Knowledge Application	3. Participate in or host online learning communities, learn together, share experiences, seek help, and solve problems.	1	1	1	1	0	0.8	Acceptable
	4. Be able to use digital technology resources to support teaching research activities in response to digital teaching issues.	1	1	1	1	1	1.0	Acceptable
Knowledge Creation	5. Be able to use digital technology resources to continuously innovate teaching models, improve teaching activities, and transform students' learning methods.	1	1	1	1	1	1.0	Acceptable
Total							**1.0**	**Acceptable**

Appendix G

Evaluation Form of the Proposed Model

Digital Awareness		Yes	No
Knowledge Acquisition	1. Be able to understand that digital technology plays a vital role in international digital economic competition and promotes the transformation and development of the global economic structure.		
	2. Be able to understand the significance of digital technology in improving the quality of education, increasing accessibility and personalization of education, and adapting to the needs of modern society and economy.		
	3. Recognize that digital technology is driving innovation in education.		
	4. Be able to understand that the proper use of digital technology resources can improve the quality of teaching, learning, management and assessment.		
Knowledge Application	5. Actively understand the functions and roles of digital technology resources.		
	6. Be able to realize that the application of digital technology resources in the education and teaching process will generate innovative requirements in terms of teaching theories, teaching models, and teaching methods.		
	7. Desire to use digital technology in education and teaching.		
	8. Have the initiative to implement the integration of digital technology and education and teaching.		
	9. Willing to carry out innovative practices in education and teaching.		

Knowledge Creation	10. Be able to propose improvement suggestions for educational policies of institutions or countries, and predict the potential impact of these changes.		
	11. Be able to overcome the difficulties and challenges in the use of digital technology resources and innovative teaching methods in the practice of education digitalization.		
Suggestions			
Digital Technology and Skills		**Yes**	**No**
Knowledge Acquisition	1. Be able to understand the connotation and characteristics of multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.		
	2. Be able to understand the procedures and methods of solving problems with multimedia, Internet, big data, virtual reality, artificial intelligence and other technologies.		
Knowledge Application	3. Be able to master the principles and methods of selecting digital equipment, software, and platforms in education and teaching.		
	4. Proficient in using digital equipment, software, and platforms to solve common problems.		
Knowledge Creation	5. Be able to continuously update digital technology knowledge.		
	6. Be able to discover problems with digital tools and technologies based on usage experience.		
	7. Be able to improve or refine the use of digital tools, optimize the usage process, etc.		
Suggestions			

Digital Applications		Yes	No
Knowledge Acquisition	1. Be able to use digital evaluation tools to analyze students' learning situation.		
	2. Be able to effectively integrate digital technologies into the teaching of specific professional or subject content.		
	3. Be able to use digital technology resources to organize teaching activities in an orderly manner, enhance student participation and communication initiative.		
	4. Be able to use digital tools to collect real-time student feedback, improve teaching behavior, optimize teaching processes, and regulate teaching progress.		
	5. Be able to use digital technology resources to identify students' learning differences and provide targeted guidance.		
	6. Be able to reasonably select and use digital tools to collect multimodal academic evaluation data.		
Knowledge Application	7. Be able to collect data from multiple channels, and select, manage, and produce digital educational resources based on teaching needs.		
	8. Be able to design teaching activities that integrate digital technology resources based on teaching objectives.		
	9. Be able to use digital technology resources to break through the limitations of time and space, and create a learning environment that integrates online and physical learning spaces.		
	10. Be able to select and apply appropriate data analysis models for academic data analysis.		
	11. Be able to use digital tools to visualize and present academic data analysis results and provide reasonable explanations.		

	12. Be able to guide students to appropriately select and use digital technology resources to support learning, and focus on cultivating students' computational thinking and digital social responsibility.		
	13. Be able to use digital technology resources to broaden moral education pathways and innovate moral education models.		
Knowledge Creation	14. Being able to use digital technology resources to assist in various forms of mental health education activities such as mental health diagnosis, group counseling, psychological training, situational design, role-playing, game counseling, etc.		
	15. Be able to use digital technology resources to achieve collaborative education between college and families, actively seek social resources, and broaden educational pathways.		
Suggestions			
Digital Social Responsibility		**Yes**	**No**
	1. Understand Internet laws and regulations.		
	2. Understand the principles of legitimate necessity, informed consent, clear purpose, and safety assurance.		
Knowledge Acquisition	3. Understand the management and protection methods of personal information and privacy data.		
	4. Have basic knowledge of identifying and preventing online rumors, cyber violence, telecommunications fraud, information theft, and other network risk behaviors.		
Knowledge Application	5. Comply with Internet laws and regulations, and consciously regulate all online behaviors.		

Knowledge Application	6. Use digital products and services in accordance with the principles of legitimate necessity, informed consent, clear purpose, and security protection, and respect intellectual property rights.		
	7. Be able to comply with the order of online communication and maintain a positive and healthy online environment.		
	8. Manage and protect personal information and privacy data effectively.		
	9. Pay attention to data security when collecting, storing, using, and disseminating data from students, parents, and others in at work.		
	10. Be able to effectively identify, prevent, and deal with online rumors, cyberbully, telecommunications fraud, information theft, and other network risk behaviors.		
Knowledge Creation	11. Use the internet to spread positive energy.		
	12. Be able to pay attention to students' physical and mental health, and be able to guide and help students identify, prevent, and deal with online risk behaviors.		
	13. Be able to spread digital citizenship knowledge to students in the process of education and teaching.		
Suggestions			
Professional Development		**Yes**	**No**
Knowledge Acquisition	1. Be able to use digital educational resources to learn professional knowledge, teaching methodology knowledge, technical knowledge, education and teaching management, and other related knowledge according to personal development needs.		

Knowledge Acquisition	2. Be able to use digital technology resources to analyze personal teaching practices and support teaching reflection and improvement.		
Knowledge Application	3. Participate in or host online learning communities, learn together, share experiences, seek help, and solve problems.		
	4. Be able to use digital technology resources to support teaching research activities in response to digital teaching issues.		
Knowledge Creation	5. Be able to use digital technology resources to continuously innovate teaching models, improve teaching activities, and transform students' learning methods.		
Suggestions			

Appendix H

Certificate of English

BANSOMDEJCHAOPRAYA
RAJABHAT UNIVERSITY

This is to certify that

Mrs. Wang Xiao

Achieved BSRU English Proficiency Test (BSRU-TEP) level

C2

Given on 22nd August 2021

(Assistant Professor Dr Kulsirin Aphiratvoradej)
Director

Appendix I

The Document for Acceptance Research

Interdisciplinary Academic and Research Journal
ISSN 2985-2749 (Online)
DR.KEN Institute of Academic Development and Promotion.
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No. IARJ 045/2025 14 February 2025

Acceptance Letter for Publication

To Wang Xiao, Sombat Teekasap, Nainapas Injoungjirakit, Prapai Sridama

Due to You submitted the article entitled "Digital Competency Development Model for College Teachers in Inner Mongolia, China" for publishing in **Interdisciplinary Academic and Research Journal (Online), Old ISSN 2774-0374 (Online): New ISSN 2985-2749 (Online) indexed by Thailand Citation Index (TCI) Tier 2, DOI CrossRef Member, ResearchGate, and SEMANTIC Scholar.** The editorial team has carried out the article review process by submitting it to the Peer Reviewer for consideration and editing for completeness of the article before publication. The editorial team would like to inform you that your article has been reviewed by peer reviewers, experts in the field of the article, come from various external institutions and are not affiliated with the same organization as the author. It is in the process of being published in Interdisciplinary Academic and Research Journal, volume 5, Issue 5, September-October 2025. follow the article at https://so03.tci-thaijo.org/index.php/IARJ/about
Thank you for submitting for publication. As always, the editorial team hopes to receive interesting and useful articles from you to publish in the journal's next issue.

Regards

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