# ARTIFICIAL INTELLIGENCE LITERACY MODEL DEVELOPMENT FOR SECONDARY SCHOOLS TEACHERS IN SHENZHEN

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A thesis submitted in partial fulfillment of the requirements for Doctor of Philosophy Program in Digital Technology Management for Education

Academic Year 2024

**Thesis Title** Artificial Intelligence Literacy Model Development for Secondary Schools Teachers in Shenzhen

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| **Academic Year** | **2024** |

## Abstract

The purposes of this research were: 1) To study the current level of knowledge of secondary school teachers' artificial intelligence literacy. 2) To develop a teachers' artificial intelligence literacy improvement model for secondary schools. 3) To evaluate the teachers' artificial intelligence literacy improvement model.

The study invited 21 experts to conduct three rounds of consulting using the Delphi method to identify core competencies and refine the model components. This was done to determine the variable issues of effective teachers' artificial intelligence literacy, resulting in the developing of a model for improving secondary school teachers' primary index factors includes: Cognition, Ethics, Artificial Intelligence Applications, Artificial Intelligence Pedagogy, Development, and Evaluation. artificial intelligence literacy. For the accuracy of the data, the interviewees were experts with professorial titles from artificial intelligence professionals, the online education field, and normal universities. The expert qualifies to have the rank of professor or above and has at least 20 years of experience working in a related field.

The results of the study found that 30 secondary school teachers in Shenzhen had significantly higher post-test scores than pre-test scores at a significance level of 0.05.

**Keywords:** Artificial Intelligence Literacy, TAILM Model, Teacher Professional Development, Delphi Method, Educational Technology, AI Ethics

# Acknowledgments

As my journey as a doctoral student nears its end, I would like to take this opportunity to express my heartfelt gratitude to all the teachers and friends who have cared for me, supported me, encouraged me, and helped me along the way.

First and foremost, I would like to extend my deepest gratitude to my advisors. Thank you to Associate Professor Dr. Nainapas Injoungjirakit for providing me with the warmest guidance and encouragement during moments of confusion and difficulty. His rigorous and dedicated approach to academia will serve as a valuable learning example for me in the future. I am grateful to Asst. Prof. Associate Professor Dr Sombat Teekasap and Assistant Professor Dr. Prapai Sridama for imparting much knowledge and research methods throughout my coursework and for providing significant assistance and support during the period of my dissertation. I still remember their caring concern for my well-being and academic progress, much like that of elder family members.

I would like to express my gratitude to the faculty and staff of Bansomdejchaopraya Rajabhat University for providing me with a rich academic environment for both professional learning and personal growth.

I want to thank my family. They have been my greatest support and understanding during my busy study schedule. I also want to express my gratitude to my classmates, who have provided me with much help and support throughout my learning journey. It has been an honor to know them, and their dedication to learning has left a deep impression on me.

The past few years of study have been challenging. I have been busy with work and study, often staying up late to study and write papers. During my time studying in Thailand, I have learned to be independent and have had the opportunity to experience a unique and interesting culture. I am thankful for my perseverance and hard work over these years, which will be a source of confidence and foundation for me in the future. These challenging yet meaningful experiences will be valuable assets on my life journey and will be remembered for a long time to come.

Wu Zhaobin

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# Chapter 1
# Introduction

## Rationale

**AI Has Become a Part of People's Lives Around the World.**

Artificial intelligence (AI) is no longer a figment of science fiction but a technology deeply embedded in the fabric of daily life. From smartphone assistants like Siri and Google Assistant to recommendation algorithms on Netflix and Amazon, AI technologies serve a variety of functions that aid and augment human activities. These technologies are also instrumental in fields like healthcare, where AI algorithms assist in diagnostics and personalized treatment plans; in transportation, where autonomous vehicles are becoming a reality; and in finance, where AI-driven analytics are used for risk assessment and fraud detection. The global acceptance and integration of AI highlight its transformative power and its role as a key driver of the Fourth Industrial Revolution. It is not merely a technological innovation but a societal paradigm shift, influencing how we live, work, and interact.

Artificial intelligence literacy plays an important role in future society. In the future society, artificial intelligence technology will have great potential in promoting social progress, bridging the digital divide, and supporting the construction of an inclusive knowledge society based on human rights, gender equality, and empowerment. The United Nations Educational, Scientific and Cultural Organization (UNESCO) believes that building an inclusive knowledge society is inseparable from four pillars: freedom of expression and information, universal access to information and knowledge, quality learning for all, and respect for linguistic and cultural diversity. Artificial intelligence technology can help build these four pillars. In addition, artificial intelligence technology is crucial to achieving the United Nations' 17 Sustainable Development Goals. In March 2019, UNESCO released the report "Artificial Intelligence in Education: Opportunities and Challenges for Sustainable Development", which clearly pointed out that artificial intelligence technology will be

widely used in future classrooms, so teachers must have artificial intelligence literacy, The cultivation of teachers' artificial intelligence literacy needs to be formed in pre-service learning and in-service training.

**Artificial Intelligence Will Also Be a Tool That Everyone Must Master in Life In the Future.**

As AI continues to evolve, its role is expected to expand beyond serving as a convenience or a specialized tool used by experts. Rather, understanding and utilizing AI will likely become basic skills that parallel reading, writing, and arithmetic in their importance for individual success and societal progress. Jobs of the future are expected to require some level of fluency in interacting with or leveraging AI systems. Even outside professional settings, the ethical and social implications of AI, such as data privacy and algorithmic bias, make it crucial for individuals to have a working understanding of this technology. Consequently, AI literacy will not be a luxury but a necessity, a skill set that enables informed participation in an increasingly AI-driven world.

**Current Secondary School Teachers' Skills in Artificial Intelligence Are Not Good Enough.**

Despite the rising importance of AI, there is a notable gap in the readiness of secondary school educators to impart AI literacy. Many teachers have limited exposure to AI concepts and tools and are, therefore, ill-equipped to guide students in this emerging field. This is particularly concerning given that secondary school education is a pivotal stage for skill development and career orientation. Teachers are the linchpin of effective education, and their lack of AI expertise can result in missed opportunities to prepare students for future challenges and opportunities. Preliminary surveys and studies indicate that a majority of teachers feel unprepared to integrate AI topics into their curriculum, citing lack of training, resources, and institutional support. This creates a pressing need for a comprehensive AI literacy model tailored for secondary school teachers, allowing them to become proficient in AI understanding and application and, consequently, better equip their students for the future.

For teachers, participating in courses that include the concept of artificial intelligence literacy is the most effective way to cultivate artificial intelligence literacy. Teachers' colleges or comprehensive universities should take the initiative to offer courses related to artificial intelligence and communication technology to provide teachers with an information perspective. Teachers can communicate with experts and teachers through various seminars, exchange meetings, and lectures, and continuously improve their artificial intelligence literacy in the process of communication and reference.

The rapid development of online teaching and artificial intelligence technology has impacted the traditional education pattern, prompting people to constantly think about how to deal with the opportunities and challenges brought by artificial intelligence. The cultivation of students' artificial intelligence literacy is inseparable from teachers.

Therefore, the cultivation of teachers' artificial intelligence literacy has increasingly become an important issue in the field of education.it is important, urgent and relevant to develop an AI literacy model for secondary school teachers.

## Research Question

How can develop and evaluate a teachers’ artificial intelligence literacy improvement model for secondary schools?

## Objectives

1. To study the current level of knowledge of secondary schools teachers' artificial intelligence literacy.

2. To develop a teachers’ artificial intelligence literacy improvement model for secondary schools .

3. To evaluate the teachers' artificial intelligence literacy improvement model.

## Scope of the Research

### Population and the Sample Group

#### Population

2500 secondary school teachers in Shenzhen.

#### The Sample Group

30 secondary school teachers in Shenzhen were selected through purposive sampling.

### The Variable

#### Independent Variable

1. Online teaching technology.

2. Artificial Intelligence Technology: The impact of artificial intelligence on teachers' information technology literacy.

3. Teacher cognition and role understanding: teachers' understanding of the Artificial Intelligence literacy development model is an educational opportunity and not just a labor role.

4. Teaching quality: factors such as curriculum development, teaching materials, professional teaching standards, and evaluation mechanisms.

#### Dependent Variable

Effectiveness of teachers' artificial intelligence literacy development model.

#### Content

1. Regulatory framework: rules, policies and legalities surrounding teacher AI literacy development models.

2. Stakeholder participation: The impact of the participation of all parties (schools, teachers, students) on teachers' artificial intelligence literacy development model.

3. Teaching mechanism: teaching methods, resources and evaluation standards in the teachers' artificial intelligence literacy development model.

4. Faculty Development and Growth: Observe the personal and professional development of teachers, and their subsequent career or academic choices.

**Location**

Shenzhen City Guangdong Province of China.

**Time**

The research time of the researchers is from September 2023 to February 2025.

## Advantages

1. Study the influencing factors that affect teachers' artificial intelligence literacy

2. Evaluate the model for improving teachers' artificial intelligence literacy in online education

3. Use the "Guidelines" as a reference to improve teachers' artificial intelligence literacy.

## Definition of Terms

**Artificial Intelligence (AI)**, since its inception in the mid-20th century, has undergone a profound transformation from an arcane computer science subdomain to an omnipresent technological force, driving applications from online search to medical diagnosis. As AI technologies have permeated society, there has been a corresponding surge in the recognition of AI literacy, conceptualized as the knowledge and skills required to comprehend, critically evaluate, and ethically apply AI. This exposition traces the development background of AI literacy within the broader arc of AI's evolution.

The genesis of AI can be dated back to the 1950s, originating from the pioneering work of researchers such as Alan Turing, who postulated the idea of machines mimicking human intelligence. The Dartmouth Conference in 1956, where John McCarthy christened the term "artificial intelligence," marked a watershed moment. In these nascent years, AI was primarily confined to academic corridors, with minimal societal interface and, by extension, minimal public discourse or literacy initiatives.

However, as AI progressed from the 1970s onwards, spurred by advancements in machine learning and neural networks, its applications began filtering into real-world scenarios. This technological seepage heralded the first indications of a need for AI literacy. While still largely restricted to specialized domains, understanding the basics of AI became essential for professionals interfacing with these technologies.

The close of the 20th century and the onset of the 21st witnessed a pivotal shift. AI technologies were not just academic pursuits or high-end industrial tools but began to be enmeshed in everyday consumer applications. From Google's search algorithms to Amazon's recommendation engines, AI silently powered a myriad of tools the average person interacted with daily. Concurrently, the field itself recognized the blurring of lines between pure technology and its societal implications. Concerns surrounding ethics, transparency, and biases in AI models began emerging. These developments underscored a more profound, more widespread need for AI literacy - not just understanding AI's mechanics but its broader implications.

The 2010s marked a significant inflection point. With AI's footprint becoming global and its implications multifaceted, AI literacy began being recognized as pivotal. No longer was it adequate for only AI professionals to be literate; there was a clarion call for comprehensive societal AI literacy. Several facets defined this evolving concept:

Artificial Intelligence (AI) refers to technology enabling machines to mimic human intelligence through perception, learning, reasoning, and decision-making, driven by algorithms like machine learning and neural networks (EU White Paper, 2020). Key applications span healthcare, education, finance, and industrial automation.

Artificial Intelligence (AI) refers to technology enabling machines to mimic human intelligence through perception, learning, reasoning, and decision-making, driven by algorithms like machine learning and neural networks (EU White Paper, 2020). Key applications span healthcare, education, finance, and industrial automation.

Zhu Zhonghua (2019) emphasizes that AI advancements rely on refining core algorithms and their integration with real-world scenarios. Improved algorithms enhance computational capabilities, enabling practical social value creation. Wei Lintao (2019) describes AI as central to the Fourth Industrial Revolution, enabling autonomous machine evolution. Yang Pengyao (2019) prioritizes AI talent cultivation as the cornerstone of national competitiveness and innovation.

Liu Ge (2024) links AI to education reform, stressing its role in personalized learning and enhancing pedagogical effectiveness through intelligent systems. Deng Hanshuang (2024) discusses AI's integration into education since 2017, driving innovation in teaching methods and ideological-political education. Ma Xinyue (2024) examines generative AI (e.g., ChatGPT) as a societal disruptor, urging historical materialism to guide its ethical application.

Ran Jin et al. (2025) highlight AI's societal impact, noting students' growing ability to engage with AI applications and address its employment challenges through critical thinking. Zhu Shuo (2025) explores AI's role in industrial automation, where collaborative robots and advanced models redefine production efficiency and precision. Xu Guofeng (2025) advocates for AI-driven "smart learning ecosystems" to foster scientific literacy and lifelong adaptability in students. Zhang Xinzhi (2025) underscores advancements in AI-powered image recognition, achieved via deep learning models, large datasets, and hardware acceleration. Ye Biao (2025) positions AI as a catalyst for enterprise digital transformation, enabling rapid adaptation to complex market demands.

Ding Ziyu (2020) predicts AI-driven classrooms with personalized curricula, intelligent management, and redefined teacher-student roles. Zhao Shuai (2020) calls for robust AI policies to address ethical and societal risks amid rapid technological growth. Yu Wenhua (2020) acknowledges AI's potential for adaptive education but notes low public awareness of its benefits.

Wang Tao (2021) identifies a U-shaped relationship between AI adoption and manufacturing quality, initially hindered by innovation gaps but later boosting productivity. Wang Yuwen (2021) notes AI's liberation of humans from repetitive

labor, fostering new cognitive paradigms and lifestyles. Jin Xueting (2021) highlights China's AI curriculum mandates in basic education to cultivate future-ready talent. Ming-long Liu (2021) frames AI as reshaping higher education's operational modes and ideological-political challenges.

Xu Jun (2022) envisions AI enabling large-scale personalized learning and reshaping educational spaces. Zhu Chun (2022) analyzes AI's labor market effects, showing widened skill wage gaps due to task redistribution and automation.

Collectively, these scholars stress AI's transformative power, ethical challenges, and the urgency of literacy, policy, and talent development to harness its potential.

**Teachers' Cognition and Role Understanding:** refers to educators' perceptions of enhancing AI literacy in themselves and students, encompassing knowledge, skills, attitudes, and values to implement effective AI education (Ng et al., 2021; Su & Yang, 2022).

**AI Evolution & Definition:** McCarthy (2007) defined AI as "the science of making intelligent machines," evolving into adaptive systems mimicking human reasoning. Wang (2019) expanded this to include cognitive tasks like learning and problem-solving via machine learning and neural networks (Zawacki-Richter et al., 2019).

**AI Applications & Workforce Impact:** AI enhances efficiency across industries (e.g., healthcare, education) but risks job displacement, with 15% of global work hours automated by 2030 (Manyika, 2017). Women face heightened vulnerability, as 72% of clerical roles in advanced economies are at risk.

**AI Literacy & Education:** AI literacy, critical for 21st-century skills, combines technical proficiency with ethical discernment (Steinbauer et al., 2021). Initially limited to university-level programming, K–12 education now integrates AI through age-appropriate tools (e.g., gamified STEAM activities) (Ng & Chu, 2021; Zou et al., 2019). Educators leverage everyday technologies (e.g., chatbots) to teach AI concepts, though challenges persist in simplifying syntax-based programming for younger learners (Wong et al., 2020).

**Ethical Concerns:** Algorithmic bias and malicious AI use pose risks, yet ethics are often sidelined in technical development (Brundage et al., 2018; Hagendorff, 2020). Strengthening ethical education for developers and citizens is vital to ensure socially responsible AI deployment (Dignum, 2019).

**Research Trends:** Studies on AI literacy surged post-2014, reflecting its growing societal relevance (Google Scholar data).

AI literacy, encompassing technological comprehension (e.g., algorithms, neural networks), ethical considerations (bias, transparency), practical application (benefits vs. risks), and societal impacts (socio-cultural, economic), has evolved from a niche skill to a societal imperative. Post-2010s global initiatives integrated AI modules across educational disciplines, driven by digital transformation accelerated during the pandemic, which normalized AI-driven tools in remote work, education, and healthcare. For educators, AI literacy is critical in digital classrooms (leveraging personalized platforms), curriculum integration (explaining AI basics), ethical guidance (addressing data privacy, deepfakes), and future workforce preparation (adapting to automation and emerging roles). Teachers must embrace lifelong learning to foster inclusion (personalized AI tools for diverse learners), collaboration (global professional networks), and holistic education (discussing AI's societal ethics). As AI reshapes norms and structures, empowering educators with AI literacy is not merely necessary but an urgent imperative to ethically integrate AI into pedagogy and ensure equitable, future-ready education systems.

## Research Framework

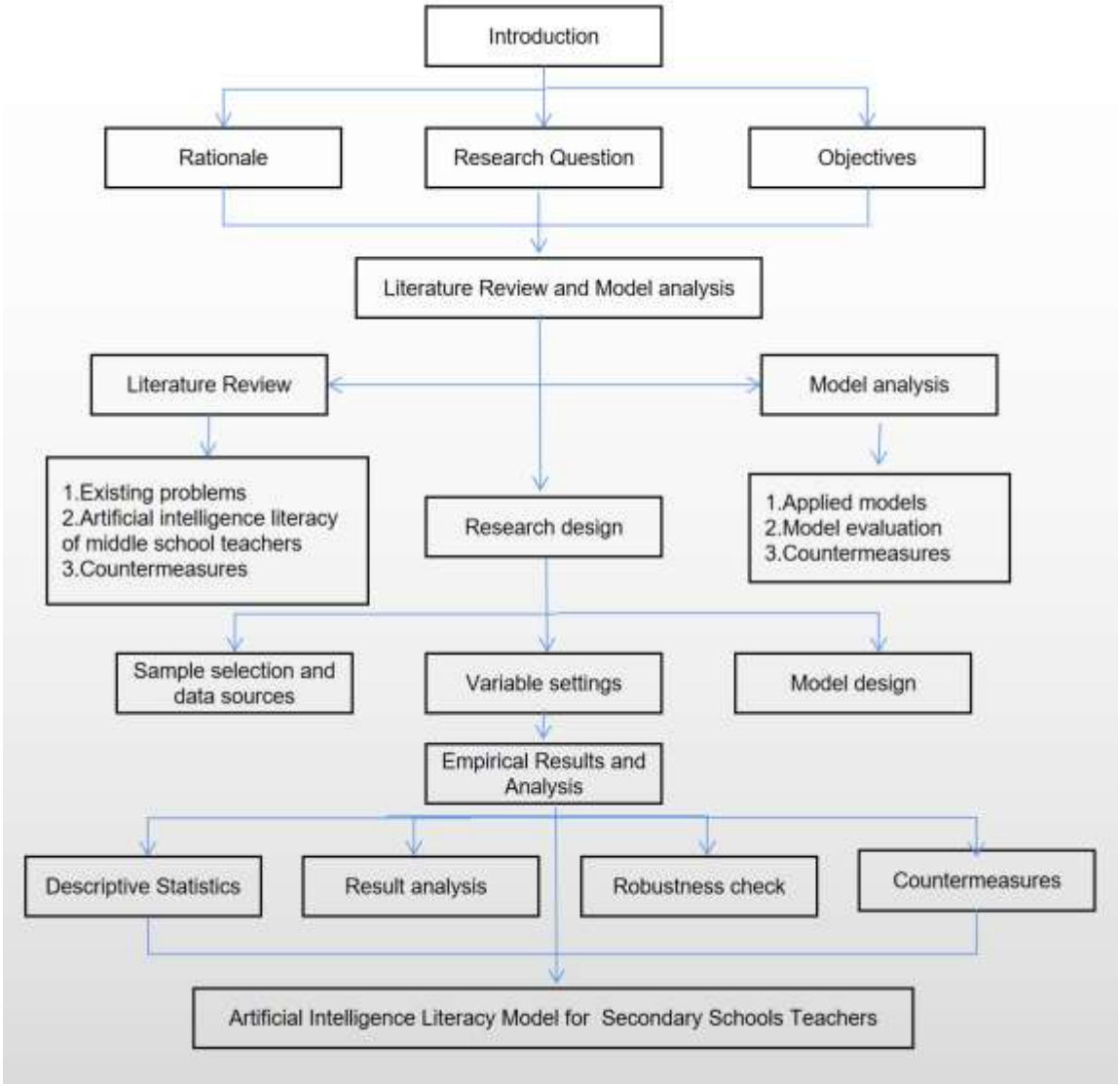



**Figure 1.1** Research Framework

# Chapter 2

# Literature Review

The literature review on the development mode of AI knowledge literacy of middle school teachers in Shenzhen was analyzed, and the literature, concepts, theories and studies related to artificial intelligence and teachers' knowledge literacy were analyzed. details as follows

1. Online teaching technology
2. Artificial intelligence technology
3. Teachers' cognition and role understanding
4. Quality of Teaching
5. Related studies

## Online Teaching Technology

Online teaching technology refers to the collection of a series of technical means and methods of distance teaching activities by relying on the Internet and related digital tools, aiming to break the limitation of time and space and provide learners with flexible and convenient learning experience.

**Definition of Online Teaching Techniques**

Online teaching technology is a general term of a series of technical means with the help of the Internet, computer and other digital equipment and related software tools to support and optimize the content presentation, teacher-student interaction, teaching management and other links in the teaching process, in order to realize the smooth development of distance teaching activities. It integrates a variety of technical fields, integrates resources, builds platforms, realizes interaction and other functions, achieves the teaching and learning goals across the limitation of time and space, and promotes the innovation and development of education mode.

Shen Jie, Chen Jian, Liu Jie, and Sheng Zhaoyuan (2024) believe that online education refers to the way of distance teaching and learning in Internet virtual

classrooms through mobile devices. Online education has increasingly become an important teaching form and one of the key measures in education. The school actively explores the practice and carries out the online teaching. Online distance teaching, time and space separation, flexible and low cost, which provides an opportunity for the progress of educational technology.

Chen Nijiao (2024) believes that online education technology is from the macro national level, Improve the online teaching guiding support policies and teaching platform, Including the implementation of policies supporting the development of online teaching competency, Build a resource platform for the implementation of online teaching, To coordinate the systematic training of pre-service and post-service teachers; At the school level, To improve the environment and management system of online teaching implementation, Including multiple measures to create an online teaching implementation environment, Multi-level incentive online teaching process evaluation, Multi-angle force online teaching innovation management; At the microscopic-individual level, To update teachers professional development planning and literacy system, Including a correct professional attitude, Update the business knowledge, Form the capacity for sustainable development.

At present, the definition of "online teaching" has not been unified, but the definition of "online teaching" by different researchers emphasizes that "online teaching" is a process of carrying out teaching activities with the help of multimedia resources and virtual network information technology.

Qu Jiamin (2023) defined "online teaching" as a new teaching form formed by teachers and students relying on network information technology and online platforms, that is, a series of teaching behaviors and activities carried out by teachers that are separated from the time and space of students.

Chen Lei (2022) believes that online teaching driven by big data contains data with wide application value. Through the construction of teaching variables related research model, we can explore the influence mechanism of teaching behavior situation, which has high application value.

Shang Naigui (2021) believes that compared with traditional classroom teaching, online teaching poses higher requirements and stricter challenges for teachers, both in terms of technical aspects and educational concepts. As the organizers of teaching activities, teachers' experience, feelings and reflection in the process of online teaching all directly affect and determine the final implementation effect of online teaching.

Wu Yijun (2021) research points out that live online teaching online course flip learning two mode in the case, including live online teaching mode has the function of live and instant messaging platform and electronic equipment utilization rate is higher, learning resources are more play the role of auxiliary teacher teaching, mainly use teaching type, situational learning teaching strategy. In the flipped learning of online courses, teachers will upload the learning resources to the learning platform before class, and students will independently conduct the problem of course resource learning generation. In class, teachers and students will interact online based on online media to deepen the understanding of the course learning content.

Tsai-Fa (TF) Yen (2020) believes that a flipped classroom online teaching model is created based on the pre-class, in-class and after-class activities based on the epidemic background, and it is proved that the online teaching model can effectively improve students' performance through empirical research.

Jiao Jianli (2020) sorted out and analyzed domestic online teaching cases and programs, and summarized four typical online teaching modes: online classroom, live online teaching and students' independent learning. Xie Yongru (2020) also summarized four types of online teaching modes in primary and secondary schools: online live teaching, online course teaching, dual-teacher collaborative online teaching and mixed multiple online teaching through case analysis.

Hu Tiesheng (2011) divided "micro course" into 11 categories such as teaching, question answering and discussion; according to teaching process, review, new introduction, knowledge understanding, practice and consolidation, and summary expansion. Based on the survey, some researchers found that the free online course

resources provided by many online teaching platforms mainly include digital textbooks, supporting famous teacher courseware, real-time recording of famous teachers, micro class video, online live courses, online tutoring, online reading, practice question bank, test papers and other nine categories.

M.Abdous (2011) put forward a process-oriented online teaching ability model based on the study of the role and ability of online teaching. The model is a process-oriented theoretical framework based on practice and constructed around three continuous non-linear stages: (1) before online teaching: preparation, planning and design; (2) during online teaching: promotion, interaction and feedback; and (3) after online teaching: reflection. The main objectives of the model are three aspects: a systematic and practical framework to clarify skills related to online teaching; to enable teachers to create and promote effective learning opportunities; and to establish a comprehensive and effective teacher development plan for online course teachers.

According to Ding Xingfu (2001), distance education refers to the bilateral interaction of teaching and learning between teachers and students through various teaching resources and two-way communication. Yang Jiaxing (2006) believes that online teaching refers to the teaching activities conducted by teachers and students relying on online platforms. Peters Think that distance education is a way of using media technology to transmit information. Holmberg It is believed that teachers and students in distance education are in a remote state, and teachers cannot supervise and manage students face to face, but students can still benefit from teaching organization activities.

**Application Scenarios of Online Teaching Technology**

The application scenario of online teaching technology refers to the combination of specific environments and conditions constructed by using online teaching technology to support teaching and learning activities under various educational and teaching situations. It covers the personnel, technical tools, teaching content and activity organization forms involved in the teaching process. These scenarios aim to break through the limitations of traditional teaching in time and

space with the help of online teaching technology, meet the diverse learning needs of different learners, and improve the teaching effect and education quality.

Fang Cancan (2025) believes that in the face of different language and cultural background challenges and uneven distribution of educational resources, international Chinese education will usher in new development opportunities under the popularization of online teaching mode. In order to adapt to the changing skills needed in the online teaching environment, international Chinese teachers pay special attention to the role of teachers, skill requirements, and the transformation of teaching methods. Teachers should have the ability to make full use of media resources to improve their teaching experience, and should be familiar with and master the online teaching platform to guide students to effectively obtain resources. In addition, teachers are required to provide personalized learning support, using data from online platforms to track and evaluate students; progress, and adjust their teaching strategies accordingly. These studies not only deepen the understanding of the skills needs of international Chinese teachers, but also provide directions for teachers; professional development and teaching philosophy.

Ren Chunliang (2025) believes that online teaching has become a common teaching method in colleges and universities, but its teaching quality is influenced by factors such as network infrastructure, online teaching platform, teachers 'quality, students' learning ability, teaching resources and online teaching management. In order to ensure the quality of online teaching in colleges and universities, it is necessary to strengthen the construction of network infrastructure, choose the appropriate online teaching platform, improve teachers 'information teaching ability, stimulate students' enthusiasm for online learning, optimize online teaching resources, establish a scientific and effective online teaching management mechanism, and provide comprehensive technical support services.

Chen Yinfeng (2024) that online teaching can break the limit of time and space, effectively cope with education emergencies, teaching activities in colleges and universities has played a more and more important role, but suddenly large-scale application to colleges and universities, teachers, students brought

unprecedented challenges, especially in terms of online teaching resources quality assurance.

Zhang Liping (2022) believes that the rapid development of digital technology has had a profound impact on teachers; teaching methods, and online teaching puts forward new requirements for teachers; information-based teaching ability. Teachers can use KAP theory framework to build teachers evaluation index system of online course informatization teaching ability, the teachers ;online course informatization teaching ability into three level indicators, nine secondary indicators and 22 level 3 index, combined with the TFAHP method, calculate the weight of indicators at all levels, and build teachers; online course information teaching ability of comprehensive evaluation model.

Du Yanhong (2020) believes that online teaching is crucial to the digital transformation of education. It is an open, diversified and constructive form of vocational education to meet students; diversified learning needs; the internal risks of online teaching, exploring the future direction of online teaching of vocational education, and highlighting the combination of vocational education and social culture and humanistic value, which is the inevitable requirement of the digital transformation of education. Through the development of online and offline integrated education, reshape the concept of digital teaching, establish the online teaching humanistic care, reconstruct the digital teaching relationship, improve the information ability of teachers and students, rebuild the digital teaching process, optimize the online teaching evaluation, recast the digital teaching quality and other measures.

Chen Nijiao (2020) believes that the hybrid teaching with the deep integration of online and offline flexibly expands the extension of the teaching process, effectively gives full play to the maximization of complementary advantages, adapts to the important strategy of education digitalization in education development, and becomes the trend direction of the online curriculum development. Teachers' online teaching competence is an important prerequisite for carrying out mixed learning, and also an urgent need for current junior middle school history teachers.

Yuan Jing (2019) believes that online teaching resource database is an important course teaching resource. The traditional online teaching resource database is constructed by means of "front and back platform + local database", which has the disadvantages of centralized storage, decentralized presentation and high operating costs. Blockchain technology with decentralization, imtamability and traceability is widely used in the field of education, and also provides new possibilities for the sharing of teaching resources. Based on the framework structure of its online teaching resource library, the network structure is constructed, and the working mechanism of resource uploading, downloading, updating and deletion of the online teaching resource library based on the alliance chain is designed.

Li Geng (2019) believes that the normative online teaching at this stage has dynamic factors such as social needs, policy incentives and healthy competition among universities, but also faces resistance factors such as hardware constraints and incomplete teaching ecosystem. The feasible construction path for online teaching is to improve the hardware infrastructure, realize the convergence of high-quality teaching resources, improve the online education ecosystem inside and outside the school, and prepare the online teaching implementation process and evaluation.

Liu Xie (2018) Online teaching has a unique characteristics, Including student-centered personalized teaching, diversified teaching types, rich teaching tools; According to the professional rules of business administration, Make full use of the advantages of online and offline teaching, Use appropriate online teaching methods and tools in the whole process before, during and after class, To ensure the quality and efficiency of teaching; Teachers and students should take the initiative to change their teaching concepts, master all kinds of online teaching standards and norms, improve the teaching design, improve the teaching level and digital learning skills, make full use of digital technology, enhance the internationalization degree, etc., Jointly promote the development of the teaching subjects and subjects of business administration courses.

Si-min zhang, Zhang Chuxuan and Li Shaomei (2017) that "Internet +" online teaching advantage is mainly the teachers and students without gathering and realize

the teaching activities, is a perfect supplement to the conventional teaching process, can improve the efficiency of classroom teaching, effective use of fragmented time, is the future has the potential of education equalization "tool". "Internet +" online teaching has difficulties such as difficult to guarantee students 'learning quality, higher requirements for teachers' comprehensive quality, and higher requirements for educational hardware equipment and environment. In the process of "Internet +" online teaching, students should have stronger self-discipline and independent thinking ability, teachers should improve their own information technology level and ability, and the government should also provide certain policy guarantee for them.

**Table 2.1** Application factors influencing online education

| | Fang Cancan (2025) | Ren Chunliang (2025) | Chen Yinfeng (2024) | Zhang Liping (2022) | Chen Nijiao (2020) | Shang Nui (2021) | Jiao Jianli (2020) | Yuan Jing (2019) | Li Geng (2019) | Liu Xie (2018) | Hu Tiesheng (2011) | Zhang Simin, Shaomei (2017) | Hu Tiesheng (2011) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Online teaching resource library | √ | | | √ | √ | √ | | √ | | √ | | √ | √ |
| 2. Professional teaching application | | √ | | √ | | | | √ | | | | √ | √ |
| 3. Teacher teaching ability | √ | | √ | √ | | √ | √ | | | | √ | | √ |
| 4. Utilization and integration of teaching resources | √ | | √ | | | | | | √ | √ | √ | | |
| 5. Aynchronous autonomous learning scenarios | √ | √ | | | √ | √ | | √ | | | √ | | |
| 6. Virtual lab scenario | | | √ | | | | | | | √ | | | |
| 7. Mixed teaching | √ | | | √ | | √ | | | √ | | | √ | |
| 8. Personalized learning | | √ | | | | | √ | | | | | | √ |

**Online Teaching Platform and Tools**

The infrastructure construction of online teaching resources and platforms is an important guarantee for the intellectual training schools to carry out effective online teaching.

According to statistics by Liu Yi (2021), the highest usage rate of online teaching in schools during the epidemic was QQ group, Dingding, enterprise WeChat and Tencent Classroom. According to the survey results of Fu Weidong et al. (2020), schools use QQ to carry out live teaching for the largest proportion, followed by nail platform, wechat group voice or video, education cloud platform at all levels and Tencent conference. In general, the platforms and tools used by schools in various regions are concentrated, mainly mainstream social and office software tools, while the utilization rate of professional education and teaching platforms is low.

Zhou Baorong (2020) believes that the quality of learning resources provided by teachers largely determines the efficiency of students' resource utilization, and thus affects the quality of online teaching. Online teaching resources play an important role in supporting the implementation of high-quality online teaching. Some researchers have divided the construction of online education resources into four aspects: the construction of online course database, the construction of material teaching resources, the development of online teaching resource management system and the development of distance teaching support platform. Han Xibin, Cheng Jiangang, Zhao Shuli (2002).

Chen Shi (2020) divided the online teaching platforms and tools used during the epidemic period into the following four categories according to the scope of influence: (1) national platforms, Namely, the national primary and secondary school network cloud platform and special TV channels opened by the Ministry of Education; (2) Provincial and municipal platforms, That is, the online teaching platform open by various provinces and cities; (3) University-level platform, That is, the relevant platform services organized or purchased by each school itself, Such as cctalk, infinite treasure, nail, etc.; (4) Social platform, The online teaching tools launched by social institutions and enterprises, Such as Tencent Classroom, zoom,

etc., Generally, as a supplement to the national, provincial and municipal platforms, Compared with the university-level platform, its functions are weak, The function of live broadcast and screen sharing can meet the needs of teachers and students for online teaching interaction.

Zhi-hong huang (2020) research also points out that the development of special education online resources should be based on the students 'body and mind and learning characteristics, to the students' life practice as the learning background, resource content and presentation should fit students 'life learning reality, consider in the process of developing resources project activity design and students' individualized education plan, and guidance for parents to facilitate its assistance in online teaching. The research of Gao Pengling (2020) points out that micro-course is an important medium for training schools to implement home education and training for students. It is necessary to think about improving the level of micro-course design and production, take micro-video as the core resource and presentation carrier, and the resource library of micro-online video courses, including resource composition, teaching process and online courses. Wang Chen (2020) pointed out that the construction of online curriculum resources relying on the "new special education online Education platform" presents the characteristics of regional, school-based and shared platform resources.

Huang Ronghuai (2020) according to the online teaching platform and tools for each teaching link and different activities support classification, including resources design platform tools, support asynchronous teaching tools, support online teaching platform, support students self-study teaching tools, support learning analysis tools, support students to construct knowledge tools, support homework exercises and test evaluation tools, support learning resources and classroom management tools eight classes.

Chen Jingya (2020) divides the online teaching platform into three categories according to its functional characteristics in the following: (1) resource platform; (2) real-time communication tools, such as Tencent Conference, wechat and QQ; and (3) comprehensive learning management platform. Some scholars are also divided

into (1) integrated online teaching platform, which has the functions of live teaching, asynchronous teaching and learning management system; (2) live teaching platform, emphasizing teaching synchronization and real-time; (3) after-school tutoring online test tools, such as QQ group homework, teacher assistant, exam cool, etc. In general, domestic scholars have summarized and classified online teaching platforms and tools from the perspectives of influence degree, support for teaching, and functions and characteristics.

Zhou Huiying (2009) proposed to increase the investment of special education information technology infrastructure to meet the needs of special students. During the period of "difference" special education expert seminar, professor lei Jianghua pointed out that through the research found information resources construction better area can take appropriate measures to respond to the outbreak, and resources platform and information construction is weak areas has many problems, so he thinks the development of special education informatization should focus on software and hardware facilities, strengthen the construction of information platform. Zhang Yuexin, Wang Yan (2020)

## Artificial Intelligence Technology

Artificial Intelligence, hereinafter referred to as AI, is an emerging technology science that simulates, extends and extends the theory, method, technology and application system of human intelligence. It enables computer systems to sense, learn, reason, decision making, and natural language processing.

### Definition

Artificial intelligence technology is a comprehensive subject field that aims to simulate, extend and expand human intelligence through machines or computer systems, providing it with the ability of perception, learning, reasoning, decision-making and natural language processing to complete complex tasks that usually require the participation of human intelligence.

Artificial intelligence technology aims to enable machines to mimic human intelligent behavior in terms of perception, thinking, learning and action. Relying on large amounts of data for training, and use various algorithms to achieve intelligence. Machine learning algorithms are the core, which can automatically discover patterns and patterns from data, make predictions and make decisions. Artificial intelligence systems have autonomous learning ability, which can continuously optimize and improve their own performance with the increase of data and the environment changes. Reinforcement learning is a typical embodiment. In the process of interacting with the environment, the agent gradually learns the optimal behavior in a specific environment by constantly trying different behaviors and adjusting the strategy according to the reward feedback, so as to adapt to a variety of complex and changeable tasks and scenarios. Artificial intelligence technology is widely used, covering medical care, transportation, finance, education, entertainment and many other fields.

According to the 2020 EU White Paper on Artificial Intelligence, when defining AI, on the one hand, it should be able to adapt to the rapid changes and progress of technological development, and the definition should show flexibility. On the other hand, the definition should be precise enough to ensure a certainty under the constraints of the law. From the perspective of technology application, the relationship between artificial intelligence and artificial intelligence technology shows the relationship of universality and particularity. That is, AI represents a broad concept, covering many specific technologies and applications, and these specific AI technologies reflect the special implementation and applications in different scenarios.

Ran Jin, Huali, Xiao Chen Road, Qian Aihua, Mao Jianhua, Xi Jing, Sun Jinli (2025) believe that the wide application of artificial intelligence technology has a profound impact on the society. In the modern of advanced technology, students have various ways of cognitive artificial intelligence. With the gradual promotion of artificial intelligence technology, students can understand the common AI application scenarios and identify common AI products; at the same time, when faced with the

impact of breakthrough artificial intelligence and artificial intelligence may cause on human employment, students can also face the opportunities and challenges brought by artificial intelligence technology with a dialectical perspective.

Zhu Shuo (2025) considers the transformative impact of AI on collaborative robots, comparing several popular models and methods used to achieve these advances. In recent years, the field of industrial automation has undergone major changes, fundamentally changing the way production lines and manufacturing processes are designed and executed. Driven by the relentless pursuit of efficiency and productivity, the shift to automation has led to the development of complex machinery and technologies that can perform complex tasks precisely and reliably.

Xu Guofeng (2025) that in the era of intelligence, learning space more open, learning resources, increasingly rich information technology more mature, good at using artificial intelligence technology for students to build a new type of wisdom learning ecological field, explore new path of science teaching, promote students' scientific literacy and information literacy comprehensive development, to adapt to the modern social development and lay the foundation for lifelong development.

Zhang Xinzhi (2025) believes that the application of image recognition technology in the background of artificial intelligence presents a development trend of diversification, systematization and high efficiency. With the help of artificial intelligence technology, deep learning logic and visual information language, improving the application system of image recognition technology will be the key to improve the application effectiveness of image recognition technology. Under the background of artificial intelligence in the new period of image recognition technology, through the building of deep learning model, the use of large-scale data sets and hardware acceleration technology optimization of many basic strategy, enhance the integration of artificial intelligence technology and image recognition technology development, strengthen the artificial intelligence technology in image recognition technology application level.

Ye Biao (2025) believes that in the digital age, Artificial intelligence (hereinafter referred to as "AI") is not only a symbol of technological innovation, but also a key engine for enterprises to achieve digital transformation. With the explosive growth of data and the increasing maturity of technology, the application of AI is changing the pattern of traditional industries at an unprecedented speed and scale. Facing the increasingly competitive market environment, companies need to use AI to enable digital transformation to address the increasingly complex and rapidly changing market challenges.

Liu Ge (2024) believes that artificial intelligence is the main driving force leading the new round of scientific and technological revolution and industrial transformation, which has a profound impact on people's production and lifestyle, and profoundly changes the content, mode and method of education. Promoting the intelligent transformation of education and improving the effect of education are not only the theoretical and practical issues that the party and the state attach great importance to, but also the goal of education. In the background of artificial intelligence era, it is particularly important to explore how to improve the effect of education. The application of artificial intelligence not only brings an objective, comprehensive and complex perspective to education, but also deepens the effectiveness of education. Therefore, in the new era of governance education, actively promoting the deep integration of artificial intelligence and education has become a key way to improve the quality and effect of education.

Deng Hanshuang (2024) that with the rapid development of modern information technology, represented by artificial intelligence of a new revolution of science and technology is quietly promoting the social many industries and fields change, closely linked with the era technology of education, is artificial intelligence thinking, technology and methods, with the education idea, thinking and methods of new change. Since The State Council first proposed "intelligent education" in 2017, the embedding and integration depth of artificial intelligence technology in the field of education has been increasing, and the thinking and technology of artificial

intelligence have brought new development opportunities to the ideological and political education methods in universities.

Ma Xinyue (2024) believes that the development of science and technology has a driving role in human society. At present, the development of the Internet, the Internet of Things, big data and other technologies, especially the emergence of generative artificial intelligence, has promoted great social changes and aroused widespread attention and profound reflection of human beings. The generative artificial intelligence represented by Chat GPT is popular around the world with its powerful dialogue and interaction ability, indicating the advent of the era of generative artificial intelligence. Its "humanoid intelligence" makes many technical pessimists face their enemies. How to correctly understand the generative artificial intelligence is a problem of The Times that needs to be seriously considered. The use of historical materialism to research generative artificial intelligence is not only more conducive to us to deeply understand and correctly view generative artificial intelligence, but also to provide theoretical support for us to better use and use generative artificial intelligence, so that it can better serve the construction and governance of society and the free and comprehensive development of human beings.

Xu Jun (2022) believes that artificial intelligence is widely used in many fields of social production and life. The education field is an important subdivision of the application of artificial intelligence. The combination of the education field and artificial intelligence has brought about major changes in the educational space and teaching methods, and large-scale personalized learning will gradually become a reality.

Zhu Chun (2022) believes that the development of artificial intelligence causes the redistribution of production tasks and the flow of production factors between departments; the flow direction depends on the relative speed of new tasks and machine substitution; compared with the situation of only capital deepening, AI development further expands the skill wage gap.

Wang Tao (2021) believes that there is a significant positive correlation between the application level of artificial intelligence, namely the level of industrial intelligence, and the development quality of manufacturing industry. After the result of replacing indicators and considering the endogeneity is still stable, and there is a U-shaped relationship. The possible reasons are that the lack of scientific and technological innovation, the complexity of the application of industrial robots and the lack of skilled talents inhibit the positive role of artificial intelligence in the high-quality development of manufacturing industry in the early stage. When the required conditions matching the degree of intelligent application are improved, artificial intelligence will play an active role in all production links of the manufacturing industry, thus playing a promoting role in promoting the high-quality development of the manufacturing industry.

Wang Yuwen (2021) believes that the development and maturity of artificial intelligence technology is profoundly changing the world of human life, and intelligent robots that used only as science fiction are gradually becoming reality. The application of artificial intelligence technology has brought great convenience to human life. AI technology has profoundly changed the mode of human production, and a lot of repetitive and hard work can be done by intelligent robots. The addition of artificial intelligence truly liberates human beings from heavy labor and thus has a new intelligent lifestyle. The increasing breakthrough of AI technology has greatly changed the way of human thinking and further expanded the field of human cognition.

Jin Xueting (2021) believes that with the development of artificial intelligence technology, artificial intelligence has become a new trend in the future development of artificial intelligence technology. China's Ministry of Education has issued a number of documents to promote the realization of artificial intelligence courses in basic education in China. The document clearly states that intelligent education projects should be widely popularized, and courses related to artificial intelligence should be set up in the compulsory education stage, and programming education should be gradually promoted.

Ming-long liu (2021) that artificial intelligence is the core of a new round of science and technology revolution, is the master of information technology, it is not only a tool or carrier, but also a constant iterative update environment, its development profoundly affects the development of modern education, change the education operation mode, cognitive strategy, environmental carrier, quality evaluation, etc., for the college students; outlook on life outlook world values cultivation and form opened a new era, also to the ideological and political education in colleges and universities brings unprecedented opportunities and challenges.

Ding Ziyu (2020) believes that the focus of artificial intelligence may bring to education: new teacher-student relationship, breaking through the school wall, the organizational form of class boundary, new heuristic curriculum and personalized classroom, organic school management and so on. The educational environment and normal management of the school are intelligent, and the class is mainly mixed class system and intelligent classroom; in the digital classroom, the teacher becomes the leader of students, and teachers or teaching assistants are trained. Exclusive courses are customized according to students, and learning blind spots and weak points are discovered with artificial intelligence; the course system is customized and personalized, and various forms of intelligent cloud classrooms are developed and used.

Zhao Shuai (2020) that the rapid development of artificial intelligence will bring a series of social problems, the world is not enough attention, to seize a new round of artificial intelligence development opportunities, you need to develop reasonable and effective policy to ensure the institutional environment of the development of artificial intelligence, so the study of artificial intelligence related policy has its necessity.

Yu Wenhua (2020) believes that the application of artificial intelligence in the field of education has solved a major pain point of the current intelligent education and provided a more scientific possibility for "teaching students in accordance with their aptitude". Artificial intelligence education has promoted the upgrading of the

education industry. However, as a new thing, artificial intelligence education is currently in the period of rapid growth of the industry, and the public's familiarity and recognition of artificial intelligence education is still at a low level.

Wei Lintao (2019) believes that the fourth industrial revolution, brought about by a series of scientific and technological developments, such as artificial intelligence, is profoundly changing the survival and lifestyle of human beings. In the past, non-intelligent machines lacked autonomy and initiative, and human beings had absolute control over machines. However, due to the emergence of new technologies, the development of artificial intelligence is going through a new historical stage. Intelligent machines have realized self-learning, self-organization and self-evolution.

Yang Pengyao (2019) believes that the most important technological change facing the world is artificial intelligence. The country has raised the development of artificial intelligence to an important position, which provides the macro policy basis and background support for us to carry out the research on artificial intelligence talent training. Talent construction and knowledge innovation are the twin engines of the development of artificial intelligence. The construction and cultivation of high-end talents is the Chinese plan to implement the development of artificial intelligence, and talents are the most important in the era of artificial intelligence. To develop artificial intelligence, it is fundamentally talent training.

Zhu Zhonghua (2019) believes that the main force driving AI progress lies in the improvement of various basic AI algorithms and the combination of these algorithms with specific scenarios. These algorithms are usually executed by generic or specialized computer equipment. Through the improvement of the algorithm, the ability of computer equipment in certain aspects can be greatly improved. By combining the algorithm with specific scenes, artificial intelligence can be truly implemented and create real social value.

**Table 2.2** Factors affecting the AI literacy of middle school teachers

| | Zhu Shuo (2025) | Xu Guofeng (2025) | Liu Ge (2024) | Deng Hanshuang (2024) | Xu Jun (2022) | Liu Minglong (2021) | Ding Ziyun (2020) | Zhao Shuai (2020) | Yu Wenhua (2020) | Wei Lintao (2019) | Yang Pengyao (2019) | Zhu Zhonghua (2019) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Basic AI knowledge and requirements | √ | | √ | | √ | | √ | | | √ | √ | √ |
| 2. Teaching and teaching integration of artificial intelligence | | √ | | | √ | | | | √ | √ | | |
| 3. Computational thinking and problem solving | | | | √ | | | | | | √ | | √ |
| 4. Moral and responsible use of AI | √ | | | √ | | | √ | | | | | |
| 5. Professional development and lifelong learning | | √ | | | | √ | | | √ | √ | | √ |
| 6. AI tools and resource management | √ | | | √ | √ | √ | √ | √ | | | √ | √ |
| 7. AI-supported student empowerment | | | | | | | | | | | | |
| 8. Systemic challenges and institutional support | √ | √ | | √ | | | | | √ | | √ | |

## Teachers' Cognition and Role Understanding

Teachers' understanding of the artificial intelligence literacy development mode, refers to the teachers for how to improve themselves and students in artificial intelligence related knowledge, skills, attitudes and values quality formed by cognition and perception, it involves the development path, influencing factors, goal setting and other multiple dimensions, to promote the effective implementation of artificial intelligence education in the teaching practice is of great significance.

Recently, age-appropriate AI-driven technologies and tools have emerged, leading to the introduction of AI education in K–12 contexts (Ng et al., 2021; Su & Yang, 2022; Williams et al., 2021). Teaching AI concepts can help students become informed citizens and prepare for AI-related careers (Kong & Abelson, 2022; Touretzky et al., 2019). Consequently, current research focuses on designing optimal curricula for young students (Chiu et al., 2022; Eguchi et al., 2021; Lin & Van Brummelen, 2021; Vartiainen et al.,2020; Zhou et al., 2020), highlighting the need to prepare teachers with the necessary competencies to teach AI concepts (Ayanwale et al., 2022; Kong & Abelson, 2022; Wilson, 2011).

Artificial intelligence (AI) was first defined as "The science and engineering of making intelligent machines" in 1956 (McCarthy, 2007, p.2). Throughout several decades of the 20th century, AI has evolved progressively into intelligent machines and algorithms that can reason and adapt based on sets of rules and environment which mimic human intelligence (McCarthy, 2007). Wang (2019) broadened the definition of AI which can perform cognitive tasks particularly learning and problem-solving with the exciting technological innovations such as machine learning, natural language processing and neural networks (Zawacki-Richter, Marín, Bond, & Gouverneur, 2019).

Currently, the use of AI has spread across industries (e.g., business, science, art, education) to enhance user experience and improve efficiency. Applications of AI exist in many parts of our everyday life (e.g., smart home appliances, smartphones, Google, Siri). Vast majority of the public acknowledges the existence of AI services and devices, but seldom do they know about the concepts and technology behind, or aware of potential ethical issues related to AI (Burgsteiner, Kandlhofer, & Steinbauer, 2016; Ghallab, 2019). Although AI will generate significant benefits for users, businesses and economies, and lift productivity and economic growth, AI is poised to eliminate millions of current jobs and cause declines in some occupations (Davenport & Ronanki, 2018; Manyika et al., 2017).

Second, studies reflect that the rise of AI will create many job opportunities in various industries, and AI will probably replace tomorrow's workplace. Even though not all disciplines are not going to be replaced by AI, people with AI knowledge will replace those that do not in the future of work. In a MicKinsey report, Manyika et al. (2017) estimated that 15% of the global working hours will be automated and 47% of American jobs are at high risk of automation by 2030.

Furthermore, the situation could be worse among women since over 160 million women worldwide may need to transition between occupations often into higher-skilled roles. Among different natures of work, clerical work such as secretaries and bookkeepers will be mostly easily eliminated by AI, given that 72% of those jobs in advanced economies are held by women (Manyika et al., 2017). As such, to gain a competitive advantage at work, similar to classic literacy which includes reading/writing and mathematical abilities, AI literacy has emerged as a new skill set that everyone should learn in response to this new era of intelligence.

Literacy was popularly understood as an ability to read and write (McBride, 2015). In today's digital era, the emergence of the knowledgebased society implies that every citizen must be 'digitally literate' and possess basic competencies in order to be on a better footing in terms of equal opportunities in their workplaces (Bawden, 2008, p.102). term has been extended to new literacies such as media, digital, information, computer and AI literacy (Kong et al., 2021). In the twenty-first century, students who are equipped with these skills could use related technologies and computers in very advanced ways to learn new knowledge and skills with their counterparts (Bell, 2010; Griffin & Care, 2014; Larson & Miller, 2011). Nowadays, AI technology emerges and becomes essential skills to play critical roles across disciplines and industries (Ng et al., 2021; Touretzky et al., 2019). Students need to learn how to use AI technologies judiciously, as well as to discriminate between ethical and unethical practices (Robinson, 2020; Rodríguez-García, Moreno-Leon, Rom´ an-Gonz´ alez, & Robles, 2020). AI potentially becomes one of the important technology skills in the twenty-first century. As such, to combine AI and literacy, AI literacy means having the essential abilities that people need to live, learn and work

in our digital world through AI-driven technologies, and this should be taught at the K-12 levels (Steinbauer et al., 2021). AI learning started in university computer science education which required advanced programming competencies that were not at an appropriate level for K-12 learners. Educators faced challenges in scaffolding K-12 children to understand AI concepts through syntax-based programming (e.g., McCarthy, 2007; Wong et al., 2020). The emergence of more age-appropriate hardwares and softwares enabled educators to improve the learning process for younger learners in recent years. The access to a wide range of technologies in day-to-day life, such as chatbots and translation apps, presents opportunities for everyone to understand and use AI in everyday life. This enables educators to leverage on the availability of AI technologies to inculcate AI literacy for young learners. For example, prior studies discussed the potential to incorporate AI learning in K-12 STEAM education via playful experience such as gamified and social media tools to prepare children for future science, technology, engineering, art and mathematics workforces (e.g., Ng, 2021; Ng & Chu, 2021; Zou, Wang, & Zhao, 2019). Knowing and using AI for future careers is only one aspect of teaching AI literacy for educators. Any technology as potent as AI would also bring new risks due to algorithmic bias and malicious uses of AI (Brundage et al., 2018). People often overlook the importance of the roles of AI ethics, which is considered as extraneous or surplus to technical concerns in work settings (Hagendorff, 2020). Software developers usually feel a lack of accountability and moral significance of their work, especially when economic incentives are easily overriding commitment to ethical principles and values (Hagendorff, 2020). As such, educating both citizens and computer scientists AI ethics is essential to strengthen their social responsibility, and consider social inclusion and diversity to apply AI for societal good (Dignum, 2019). In this review, we examine the published studies to evaluate the ethical concerns in the domain of AI literacy. According to Google Scholar search, there is a dramatic increase in AI literacy publications from 2014 to 2021 (see Fig. 1). As AI becomes more and more important in work settings and everyday life, researchers

This term has been extended to new literacies such as media, digital, information, computer and AI literacy (Kong et al., 2021). In the twenty-first century, students who are equipped with these skills could use related technologies and computers in very advanced ways to learn new knowledge and skills with their counterparts (Bell, 2010; Griffin & Care, 2014; Larson & Miller, 2011). Nowadays, AI technology emerges and becomes essential skills to play critical roles across disciplines and industries (Ng et al., 2021; Touretzky et al., 2019). Students need to learn how to use AI technologies judiciously, as well as to discriminate between ethical and unethical practices (Robinson, 2020; Rodríguez-García, Moreno-Leon, ´ Rom´ an-Gonz´ alez, & Robles, 2020). AI potentially becomes one of the important technology skills in the twenty-first century. As such, to combine AI and literacy, AI literacy means having the essential abilities that people need to live, learn and work in our digital world through AI-driven technologies, and this should be taught at the K-12 levels (Steinbauer et al., 2021). AI learning started in university computer science education which required advanced programming competencies that were not at an appropriate level for K-12 learners. Educators faced challenges in scaffolding K-12 children to understand AI concepts through syntax-based programming (e.g., McCarthy, 2007; Wong et al., 2020). The emergence of more age-appropriate hardwares and softwares enabled educators to improve the learning process for younger learners in recent years. The access to a wide range of technologies in day-to-day life, such as chatbots and translation apps, presents opportunities for everyone to understand and use AI in everyday life. This enables educators to leverage on the availability of AI technologies to inculcate AI literacy for young learners. For example, prior studies discussed the potential to incorporate AI learning in K-12 STEAM education via playful experience such as gamified and social media tools to prepare children for future science, technology, engineering, art and mathematics workforces (e.g., Ng, 2021; Ng & Chu, 2021; Zou, Wang, & Zhao, 2019). Knowing and using AI for future careers is only one aspect of teaching AI literacy for educators. Any technology as potent as AI would also bring new risks due to algorithmic bias and malicious uses of AI (Brundage et al., 2018). People often overlook the importance of the roles of AI ethics, which is considered as

extraneous or surplus to technical concerns in work settings (Hagendorff, 2020). Software developers usually feel a lack of accountability and moral significance of their work, especially when economic incentives are easily overriding commitment to ethical principles and values (Hagendorff, 2020). As such, educating both citizens and computer scientists AI ethics is essential to strengthen their social responsibility, and consider social inclusion and diversity to apply AI for societal good (Dignum, 2019). In this review, we examine the published studies to evaluate the ethical concerns in the domain of AI literacy.

Although a newer concept, AI literacy extends beyond understanding how to use technology and delves into the ability to understand, evaluate, and make informed decisions about AI technologies.

According to Google Scholar search, the number of literature searches by year shows a sharp increase in publications on artificial intelligence literacy from 2014 to 2023 (see Figure 2.1). As AI becomes more and more important in work settings and everyday life, researchers began to define AI literacy based on the term 'literacy' which has been applied to define skill sets in varied disciplines (Long & Magerko, 2020). However, few studies have provided comprehensive explanations on how to conceptualize AI literacy. To achieve a better understanding of the concept of AI literacy, researcher categorize how researchers define the term in four aspects, inspired from the cognitive domains in Bloom's taxonomy (Davy Tsz Kit Ng, 2021). Then, we evaluate how educators help learners develop AI literacy skills with emerging technological tools, and evaluate their assessment accordingly. To fill this gap, this study reviewed the relevant literature, and analysed how scholars define "AI literacy", how it can be learned, and what are the ethical concerns. Specifically, the present study poses the following four research questions:

1. How do researchers define the term "AI literacy"?

2. How do educators help learners develop AI literacy in terms of learning artefacts, pedagogical approaches and subject matters?

3. How do researchers evaluate students' AI literacy skills?

4. What are the ethical concerns in the domain of AI literacy?

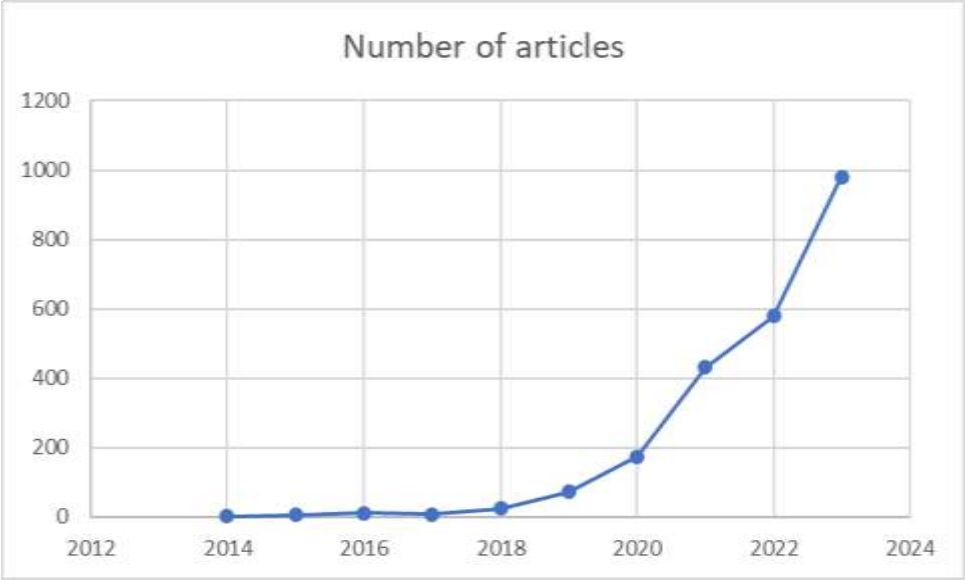



**Figure 2.1** AI literacy articles from google scholar published by year.

As Figure 2.1 shows, the research enthusiasm of scholars on the topic of artificial intelligence education has significantly increased.

Specifically, a definition for AI literacy learning is presented in the aforementioned three aspects. In fact, the abilities and skills involved in each aspect could be potentially mapped to the cognitive domains in Bloom's Taxonomy. Bloom's Taxonomy is an approach to categorize the levels of reasoning skills and ordered thinking required across different learning contexts. There are six levels in the taxonomy, each requiring a higher level of complexity and ordered thinking from the students. The levels are understood to be successive, so that one level must be mastered before the next level can be reached (Bloom, 1956; Huitt, 2011). The reason why we adopted the Bloom architecture is that AI literacy is novice to educators and a classification of levels of cognitive processes has not yet been developed in the context of AI learning. However, this model is a classic pedagogical theory that establishes the core foundation of AI taught to young learners. In our review, it is proposed to assign these three aspects (i.e., know and understand, use, and evaluate and create AI) into the cognitive levels of Bloom's Taxonomy. "Know

and understand AI" is assigned to the bottom two levels; "use and apply AI" in applying concepts and applications is assigned to the apply level; "evaluate and create AI" are assigned to the top three levels to analyse, evaluate and create AI (see Figure 2.2).

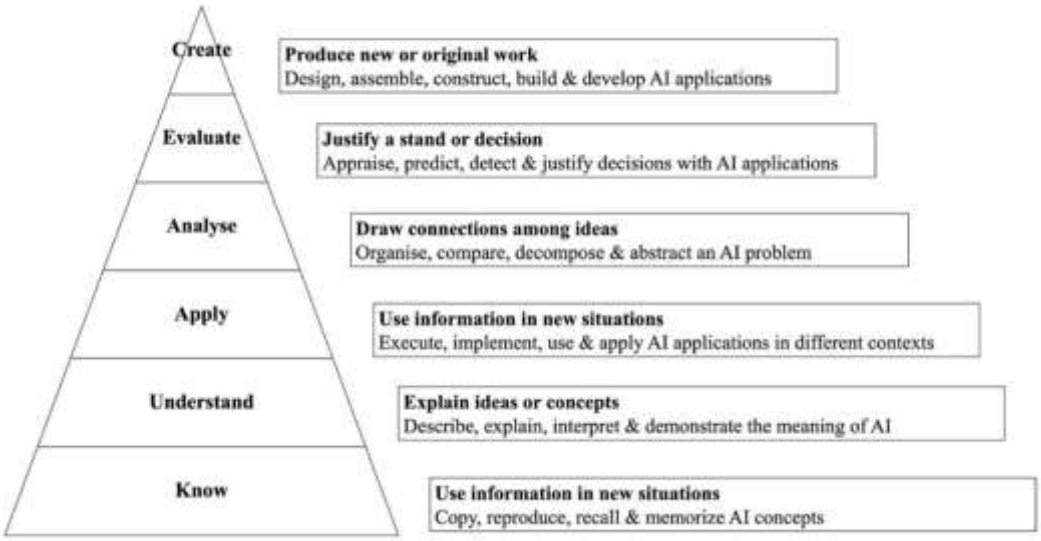



**Figure 2.2** Bloom's Taxonomy and AI literacy.

How do educators help learners develop AI literacy in terms of learning artefacts, pedagogical approaches and subject matters?

This review aims to fill recognized gaps in knowing the effective means to integrate AI literacy into school curricula and how educators help learners develop AI literacy. The elements found in our studies into the Technological, Pedagogical and Content Knowledge (TPACK) framework are categorized in terms of learning artefacts, pedagogical approaches, and subject matters (see Figure 2.3). The reason that we adopt the TPACK model is that it is widely used across studies to identify how teachers can incorporate technologies into their pedagogical methods and content knowledge, and conceptualizes their capacity and knowledge that is needed to integrate relevant technologies in AI literacy education (e.g., Graham, 2011; Koehler et al., 2013). It provides a map for understanding how to integrate AI literacy into classrooms effectively. For example, Kim et al. (2021, pp.1–13) based on AI learning

resources to conceptualize TPACK to improve teaching for K-12 AI education, which offers core foundations of AI taught to young learners.

Among the three knowledge, technological knowledge involves the affordances and use of domain-specific learning tools such as hardware and software in AI literacy education, AI-enabled tools (e.g., intelligent agents), and unplugged learning tools (e.g., role-playing). Second, pedagogical knowledge relates to teaching methods and their application to promote student AI literacy learning, which entails teaching strategies and scaffolding, feedbacking students' learning processes (Janssen et al., 2019). Third, content knowledge concerns knowledge about the AI literacy subject matter that specific subjects should be covered in the curriculum.

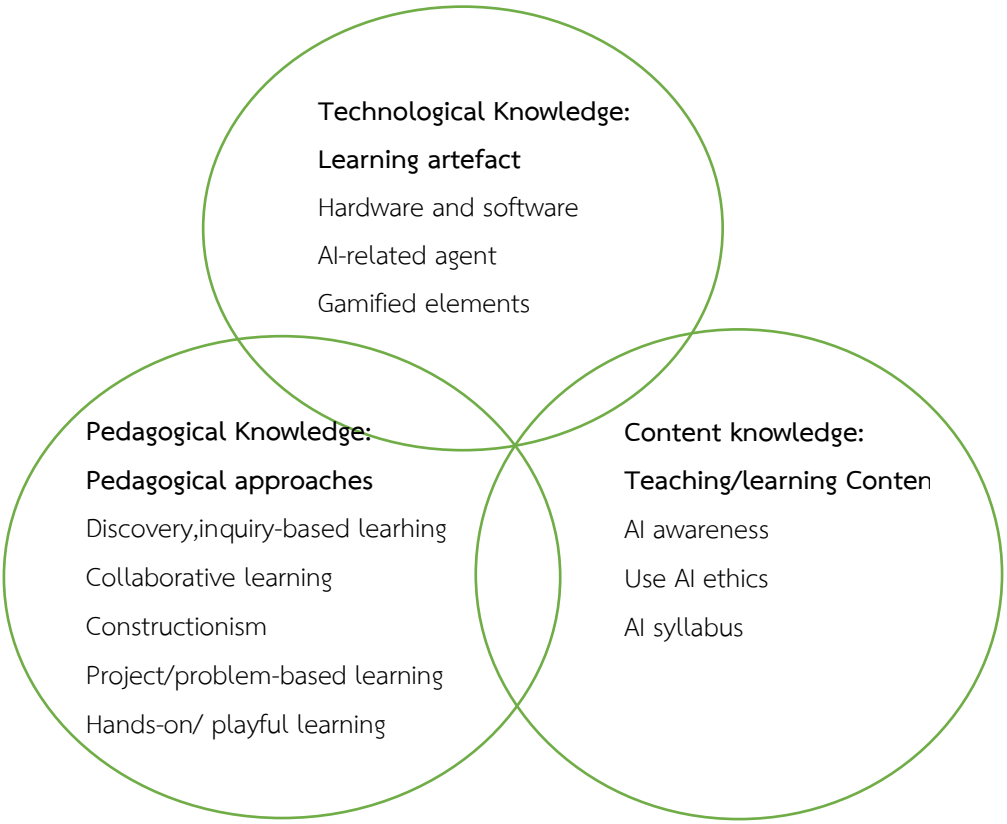



**Figure 2.3** AI Literacy TPACK Framework

The field of artificial intelligence has been a subject of academic investigation for decades, and its application in education has garnered increasing attention. According to Holmes, Bialik, and Fadel (2019), AI has the potential to revolutionize educational settings by personalizing learning experiences and freeing up teachers to focus on tasks requiring human empathy and judgment. Research by Luckin et al. (2016) supports this by indicating how AI can adapt educational content according to the learner's pace and level, allowing for a more tailored educational experience.

AI has also been used in administrative tasks, such as automating routine processes, thereby freeing up educational resources and time (Baker & Yacef, 2009). This automation allows teachers and administrators to focus on more complex and impactful tasks.

## Quality of Teaching

Teaching quality is a comprehensive evaluation of the degree of educational teaching activities to meet the prescribed needs and potential needs, reflecting the degree of teaching process and its results. It involves multiple levels and is a key indicator of the effectiveness of education.

### Definition

Teaching quality has a rich connotation, Covering the degree of realization of teaching objectives, Students are required to master solid knowledge and skills and improve their ability and accomplishment; Highlighting the effectiveness of the teaching process, Including the reasonable selection of teaching methods, scientific organization and management of teaching, and actively carry out the interaction between teachers and students; Pay attention to the utilization and integration of teaching resources, Not only to excavate the teaching materials and supplement the materials, And with the use of facilities and equipment to improve the effect; Focusing on the promotion of the overall development of students, Covering academic performance progress, moral and emotional cultivation and physical and mental quality development; Also need to adapt to social needs, To match the specifications of the talents trained with the requirements of the social industry, And

guide the students to establish the positive social values, Cultivate their sense of social responsibility, Become a force driving social progress.

Wei Tao and Fan Feifei (2025) believe that there are multiple principal-agent relationships in the process of talent training and education and teaching, which makes the school faced with two typical problems: adverse selection and insider control, which affects the effective operation of the teaching quality assurance system. Therefore, the school should effectively alleviate the agent problem and reduce the agency cost of, while enhance teaching information transparency, through the design incentive and constraint compatible mechanism, with full-time teachers and management agent as the key link, to optimize the principal-agent chain, and through the quality culture construction to build a good atmosphere, gradually make the teaching quality assurance system into closed loop cycle benign track.

Wang Shi, Yang Jing (2025) believes that the deepening plan of comprehensively promoting the reform of vocational undergraduate education quality evaluation. It mainly promotes the comprehensive implementation of the pilot reform of vocational undergraduate education evaluation by deepening the multiple evaluation of teachers, constructing the total factor evaluation and optimizing the evaluation of vocational undergraduate talents. In addition, it proposes to build a high-quality professional undergraduate teaching quality monitoring system, including teaching quality objectives, teaching management decision-making, teaching evaluation and improvement and other main contents. Such a system not only helps to accurately evaluate the teaching level, achieve the educational goal, and improve the overall teaching quality of vocational education, but also can strengthen the training level of vocational undergraduate talents, deepen the teaching reform of vocational undergraduate students, and provide feasible reference and guidance programs for similar colleges and universities.

Jiang Jin, Pei Xiaomei, Xu Baolin, Ouyang Xibiao and Tang Hailin (2024) believe that the automatic evaluation system of teaching quality has always been a system of school teachers and parents of students. In the past, the teaching quality evaluation system basically allowed students to fill in the questionnaire manually. In

the process of filling in, students are mainly based on perceptual memory, which is not accurate enough. Therefore, through expression recognition, instant memory, concentration definition, mean calculation to finally form students; concentration graphics, and then analyze the teaching effect, so as to achieve the purpose of teaching quality evaluation. The evaluation standard is the paving stone for quality improvement, and the implementation of this program will help to improve the teaching quality.

Zhang Chunquan (2024) believes that the construction objectives of the teaching quality management system should be clarified, including the establishment of teaching quality standards in line with the OBE concept, the formulation of measurable teaching quality management objectives, and the consistency with the overall strategic objectives of the school. Secondly, optimize the structure of teaching quality management system, including the establishment of a sound organizational structure, the improvement of teaching quality management process and the establishment of teaching quality information feedback mechanism. Thirdly, strengthen the resource guarantee of the teaching quality management system, including increasing the investment of teaching resources, strengthening the construction of the teaching staff and improving the student support service system. Finally, the monitoring and evaluation mechanism of teaching quality management system should be improved, including regular teaching quality evaluation, strengthening the supervision of teaching process and establishing the mechanism for continuous improvement of teaching quality.

Yichen (2024) believes that with the rapid development of information technology, artificial intelligence has become an important force to promote education reform, especially in the university education system shows unique value. Artificial intelligence in the significance and value of talent training in colleges and universities, through the bridge of combining theory with practice, explore the education under the background of digital teaching innovation strategy, put forward to promote the development of students' ability training and personalized path, in

order to provide new perspectives and strategies for the practice of talent training, provide reference for subsequent related research.

Fang Junqi, Chen Kaixuan and Chen Junying (2024) believe that teachers 'online teaching tools application and skill input factors have strong positive influence on teaching quality, differences of teaching subject cognition and wide regional identity, supporting factors of online teaching resources, students' online teaching learning input, interactive feedback and condition guarantee factors on teaching quality. Based on this, the paper puts forward suggestions on the future development of online teaching in China, such as consolidating the existing results, encouraging the participation of students, improving the platform construction, guiding the standardized learning and narrowing the basic gap.

Hong Dany (2024) believes that the design of AI teaching large unit based on AI open platform effectively integrates educational resources, optimizes the teaching process, stimulates students' learning motivation, and improves the teaching effect, which has high promotion and application value. Future research can further explore the deep integration of AI open platform and teaching content, expand teaching cases and practical activities, and constantly improve the construction of the framework, so as to better promote the cultivation of students' AI literacy.

Huang Xiaohui, Xia Bingxin and Lu Wei (2023) believe that with the development of digital technology, the combination of online and offline teaching mode has gradually become a trend. Through depth integration and system design network teaching, expand online cloud classroom, with the help of strong interactive learning software cloud notes, cloud homework and cloud evaluation, is conducive to achieve efficient digital teaching, at the same time with the help of online synergy and fusion interactive teaching, enrich teaching mode, improve teaching quality, optimize the learning experience, promote students; comprehensive quality.

Yang Qiuye, Liu Xiaodan (2023) believe that curriculum teaching is an important link in personnel training in higher vocational education and a decisive factor in the quality of educational personnel training. With expanding college enrollment, diversification of students type, students in learning foundation, learning

ability, learning habits, learning consciousness, learning motivation, interest, the current education for the aspects of different types of students using the same talent training scheme, the same curriculum standard, the same teaching objectives and methods, students adaptability has obvious difference, teaching effect cannot guarantee.

Xu Wanshan, Zhou Yanhua (2023) believe that strengthening the professional support for teaching quality, improving teachers' focus on classroom teaching, strengthening the construction of new education infrastructure, and creating a good ecological environment for school education are the requirements of The Times and important prerequisites for improving the teaching quality. The establishment of multi-level linkage teaching guidance system can provide important professional guidance for the improvement of teaching quality. Giving teachers have time and energy to concentrate on teaching is a practical problem that must be solved to improve the teaching quality. Digital enabling classroom teaching, enabling teaching research, teaching material construction, and the transformation and upgrading of enabling teaching management are important ways to improve school teaching quality.

Zhang Fuzhi, Pan Huailin (2023) that primary and secondary school classroom teaching quality is not high, the problem of insufficient teaching support system, after 20 years of exploration, we based on the implementation of khalid ents fundamental task, from the classroom teaching mode to the classroom teaching support system research, combined with the cultivation of students' core literacy, form the classroom teaching quality as the fundamental, with "1 + x" strategy for the teaching support system, based on the core quality of teaching quality improvement effective path.

Wang Wei (2023) believes that the evaluation vector value of the traditional intelligent teaching quality evaluation system is relatively low, and puts forward the construction method of the multi-dimensional intelligent teaching quality evaluation system based on artificial intelligence. Based on the third generation of activity theory, the teaching activities of cognitive thinking, emotional communication

between teachers and students, the achievement of teaching objectives and teaching organization and regulation are determined. On this basis, eight evaluation indicators are selected and quantified. Using artificial intelligence technology to decompose and examine each intelligent teaching activity, and calculate the actual value of each teaching activity. The empowerment method is used to determine the weight of intelligent teaching activities, and the quality coefficient of intelligent teaching is calculated by using the evaluation function, and the quality of intelligent teaching is qualitatively evaluated according to the department value, so as to realize the construction of multi-dimensional intelligent teaching quality evaluation system. The experiment proves that the evaluation vector value of this system is higher than that of the traditional system, and it has good feasibility and reliability.

He Fei (2023) believes that with the deepening of the education system reform, college English education and teaching has entered a new stage, and the combination of online and offline teaching mechanism has been popularized in the current education and teaching process. The popularization of the Internet has provided favorable conditions for the development of education and teaching work, and the specific performance of students in the learning process is also reflected, and the formative evaluation is more convenient, which is very beneficial to the benign development of the overall teaching work.

Guo Juan (2020) that artificial intelligence view of college teachers in urgent need of cross-border development thinking and teamwork spirit, improve education technology application and research ability, increasing data mining, processing and analysis ability, at the same time strengthen the teaching design and development, teaching organization and management, teaching evaluation and reflection ability, actively meet the arrival of the era of artificial intelligence. The improvement of university teachers; teaching ability from the perspective of artificial intelligence plays a good role in comprehensively improving the teaching quality of higher education in China.

Ma Yun (2019) believes that it is of great significance to cultivate students' lifelong learning awareness and ability, especially their high-level learning ability to construct and transfer knowledge through high-level cognitive behaviors such as reflection, criticism, integration and creation, to promote the construction of China from a populous country to a powerful country with talents. Classroom is not only the main position for teachers to teach and educate people, but also the main place for students to learn. How to optimize classroom learning resources and learning methods to promote high-level learning is an important research topic in the current education and teaching reform. It is an important research subject of the current education and teaching reform. High-order learning itself has rich connotations, and different scholars have made a lot of exploration and practice on the ways and methods of promoting high-order learning.

## Pelated Studies

Yichen (2024) believes that with the rapid development of information technology, artificial intelligence has become an important force to promote education reform, especially in the university education system shows unique value. Article discusses the significance and value of artificial intelligence in colleges and universities, by building the bridge of combining theory with practice, explore the education under the background of digital teaching innovation strategy, put forward the path of promote student ability training and personalized path, in order to provide new perspectives and strategies for the practice of talent training, provide reference for subsequent related research.

Tan Yan (2024) believes that the classroom teaching evaluation model supported by artificial intelligence requires the classroom teaching evaluation model to adapt to a variety of intelligent teaching scenarios, so as to promote the sustainable development of artificial intelligence technology in the field of education. The classroom teaching evaluation model with the support of artificial intelligence comprehensively takes into account the multiple dimensions of classroom teaching evaluation, and realizes the automation and intelligence of the

evaluation process through the intelligent algorithm, which provides strong support for the sustainable development of the field of education.

Sun Yanan (2024) believes that the in-depth discussion on the application of artificial intelligence, technology application in teaching, method innovation and practice, strategy optimization and deepening, construction of quality evaluation system and other aspects aims to further improve the effect of experimental teaching. According to the overview of the application of artificial intelligence in the experimental teaching of mobile communication in colleges and universities, it can be seen that artificial intelligence technology has brought new opportunities and challenges to the experimental teaching of mobile communication in colleges and universities. In the experimental teaching, the application of artificial intelligence technology has improved the teaching efficiency, expanded the teaching methods, and provided more learning opportunities for students.

Hirotian, Zhou Zheng, MERSHA Bemnet Wondimagegnehu, Dai Yaping (2024) believe that it is a challenging task to achieve automatic machine assessment of the classroom environment with the help of classroom teaching quality in artificial intelligent intelligence (AI) technology. According to the problem of teaching quality AI machine evaluation, introduce the traditional teaching quality evaluation method, analyzes the related AI technology used by machine evaluation, summarizes and analyzes the research progress of AI machine evaluation in the classroom environment, and points out the current challenges of machine evaluation.

Shu Bin (2024) believes that the integration of AI can optimize teaching content, improve teaching efficiency, promote personalized learning, and provide students with customized learning experience. The application of intelligent evaluation tools, the intelligent planning and organization of teaching activities, and the implementation of intelligent interaction mechanism have all produced significant positive effects on improving the quality of teaching and students; learning experience. These tools and strategies make the teaching process more efficient and targeted by providing precise analysis of students; learning needs and progress. However, AI technology still faces challenges in improving the accessibility of

educational resources, wide acceptance by teachers and students, and effective integration with traditional teaching methods, which need to be addressed through continuous innovation.

Hong Dany (2024) believes that with the rapid development of artificial intelligence technology, its application in the field of education is increasingly extensive. As a key stage for the formation of students 'knowledge system and thinking mode, how to effectively integrate into artificial intelligence education and improve students' artificial intelligence literacy has become an important topic of education reform. The design of artificial intelligence teaching unit in junior high school based on AI open platform effectively integrates educational resources, optimizes the teaching process, stimulates students' learning motivation, improves the teaching effect, and has high promotion and application value. Future research can further explore the in-depth integration of AI open platform and teaching content, expand teaching cases and practical activities, and constantly improve the construction of the framework, so as to better promote the cultivation of AI literacy of junior high school students.

Li Jicheng, Zhao Xiaoyan, Mary, li (2024) that the new era of artificial intelligence model technology in knowledge generation, knowledge acquisition, knowledge, knowledge, the recommendation of advanced is the university mathematics course teaching idea, teaching objectives, teaching requirements, teaching content, teaching methods, teaching mode, etc. In order to cope with the new opportunities, new challenges and new requirements brought by artificial intelligence model technology to university mathematics course teaching, the construction of university mathematics mathematics teachers and the teaching reform are the new trend of the current university mathematics teaching reform. In the teaching process, the scientific use of artificial intelligence large model technology to improve the course teaching quality is a new ability for university mathematics teachers in the new era.

Chen Yuandian, Chen Jing, Xu Sheng (2024) believed that by analyzing the importance of teaching quality evaluation system in the background of digital transformation of colleges and universities, they pointed out the shortcomings of the current teaching quality evaluation method, and put forward the ideas to solve the problems. Based on artificial intelligence technologies such as deep learning, the classroom concentration detection system design is carried out to grasp the information of students; facial expressions and head posture, and the fuzzy comprehensive evaluation algorithm is used to quantify the students; classroom concentration index. The system can effectively detect students; classroom concentration level and provide objective and accurate personalized data for teaching quality evaluation.

Gao Xuewei (2024) believes that with the global technological innovation bringing new breakthroughs every day, artificial intelligence (AI), as a strategic cutting-edge technology, has had a wide impact on all levels of social and economic activities. Especially in the field of education, with the continuous penetration of technology empowerment and the deep integration with teaching practice, the educational evaluation system is faced with the historic task of transforming to intelligence. Educational evaluation plays the role of baton and helmsman in promoting education reform and guiding the development direction. The practical problems faced by the reform of education evaluation in the new era are the practical strategy of artificial intelligence enabling education evaluation from the aspects of policy planning, scientific research breakthrough, application and implementation, education ecological construction and ethics, in order to provide strategic thinking and practical guidance for promoting the reform of education evaluation.

Wang Chuanlin (2024) that artificial intelligence can be in each link of the teaching process for teachers to provide personalized, interactive and real-time teaching support, help teachers timely grasp learning, optimize teaching strategy, provide convenient and efficient teaching auxiliary for teachers and students, realize

the classroom interaction, stimulate students' interest in learning, improve the teaching efficiency and teaching quality.

Wang Fang and Yu Ying (2023) believe that artificial intelligence has become one of the technologies that profoundly affect the development of today's society, and a new wave of artificial intelligence development and application is being launched around the world. Teachers also need to keep pace with The Times and constantly improve their professional ability to adapt to the changing times. Under the background of general artificial intelligence, teacher development has substitution, adaptability and values, as well as opportunities to improve teaching efficiency and quality, and enrich the connotation of teachers in terms of educational concept, educational content, teaching paradigm and teacher-student relationship.

Gao Jun (2021) believes that the organic integration of the new generation of artificial intelligence and today; s education has become an inevitable trend, indicating that in the process of primary education, traditional education should be transformed from intelligent education, and the evaluation of education quality needs to be improved accordingly.

Tang Gichen, Liang Ruiyu, Xie Yue (2021) believe that the correct and effective evaluation of teaching quality based on artificial intelligence technology to promote teaching work and improve the quality of talent training are in line with the national guidelines for current education. Based on the application status and existing problems of online teaching quality evaluation, a two-way teaching quality evaluation system is proposed based on artificial intelligence technology, and the evaluation indicators and evaluation methods are designed, in order to objectively and effectively evaluate the two-way activities of teaching and learning, so as to effectively improve the teaching quality.

Feng Rongrong (2020) believes that artificial intelligence + education and intelligent classroom are hot topics in education research, which is the crystallization of the in-depth integration of new technology with educational science in the new era. Focusing on the all-round teaching tracking before, during and after class, making full use of new technology to achieve new intelligent classroom, and designing the

teaching design mode of intelligent classroom. Smart classroom is the inevitable trend of education development, which needs to constantly explore problems, find problems and move forward.

Guo Juan (2020) believes that with the reform of the fourth generation of information technology represented by cloud computing, big data and artificial intelligence, higher education has gradually entered the stage of intelligent development, which puts forward higher requirements for the teaching ability of university teachers. Artificial intelligence under the horizon university teachers need cross-border development thinking and teamwork spirit, improve education technology application and research ability, increasing data mining, processing and analysis ability, at the same time strengthen the teaching design and development, teaching organization and management, teaching evaluation and reflection ability, actively meet the arrival of the era of artificial intelligence.

**Project portfolio analysis and artefact-based interview:**

Project portfolio analysis refers to a purposeful and systematic process of collecting and evaluating various types of students' learning artefacts such as products, projects and programs (McMillan, 2013). With students' project portfolios, researchers and educators can interview students to examine their AI concepts and practices. Five studies applied project portfolio analysis with a follow-up interview to examine the attainment of learning targets. For example, Kaspersen et al. (2021) evaluated students' AI models and user interface design through collecting and labelling data, and building, testing and evaluating models. After analyzing the artefacts in students' projects, researchers found that children were able to apply their new knowledge of machine learning (ML) to their own life and to think up personally meaningful applications using ML. Another study Watkins (2020) asked participants to create 2D visualization and related kiosk applications that were demonstrated in the makerspaces and libraries at universities, and further invited visitors to perceive their AI applications in Cosmology. Kandlhofer et al. (2021) studied students' picture taking, field notes, interaction and project demonstrations during each teaching unit. Then, they performed semi-structured interviews and

content analysis to examine how students foster their AI understandings. However, it is observed that researchers did not generate a grading rubric to indicate the levels of achievement for each dimension of AI learning performance and whether a criteria is met. Future research could design rubrics to analyses students' AI concepts that could be graded by human raters and/or AI education systems such as chatbots, expert systems and intelligent tutors (Zhang & Aslan, 2021).

Through artefact-based interviews, it is useful to understand which AI components students could understand and use more frequently through communication and students' projects. Since AI learning is novice to K-12 educators, the application of portfolio assessment and follow-up interviews could capture a holistic view of what extent of knowledge and skills students need to obtain, and how educators design and choose their learning materials and tools in their learning design. In addition, this also encourages educators to use in classrooms and across

Platforms to formatively assess students to offer them feedback that is potentially beneficial to their future AI learning. With the great potential of using artefact-based interviews, researchers usually employed interviews to support and elaborate on students' portfolio assessment by specifying their thinking processes of using AI skills to solve problems (e.g., how they got started, how the project evolved, what was important for them to know to make the project, what problems they encountered throughout the process, and how they dealt with those problems). Furthermore, students could reflect on themselves when working on the hands-on projects, such as what they were most confident of, what they might want to further improve, and what engaged them. However, the challenges of using interviews include its high cost and long time spent on interviewing and coding the data as well as its small distribution to students, which makes it difficult to be quantified (Tang et al., 2020).

Throughout artefact-based interviews, researchers were able to have detailed discussions about different AI elements in students' projects, and to develop rich descriptions of their development practices.

**Gaps in Existing Literature**

Despite the growing body of research in AI and education, there is a notable gap concerning AI literacy among secondary school teachers. Most studies focus on student outcomes or administrative efficiency, but the preparedness of teachers to guide students in an increasingly AI-driven world remains underexplored. This gap justifies the current research, which aims to develop and evaluate an AI literacy model specifically for secondary school teachers.

**Research methods**

**Literature research method**

Through Chinese Journal (CNKI), SpringerLink and other databases, search on the literature collection software around "CIPP model", "information technology courses" and "teaching evaluation", and through the Yanda Library,

Collect and organize relevant papers and core journals in the past ten years, search relevant literature, and integrate the data to enrich the theoretical basis of this study.

**Delphi method**

The Delphi method (Landeta 2006; Okoli and Pawlowski 2004) was chosen to construct the evaluation criteria in this study. The Delphi process was developed by the RAND Corporation during the Cold War to predict the impact of technology on warfare. It represents a systematic interactive forecasting approach based on independent input from selected experts. The Delphi process is defined as "a method of structuring a group communication process so that the process effectively allows a group of people to deal with a complex problem as a whole." This requires the construction of a reasonable evaluation index system and the development a Artificial Intelligence Literacy Model for Secondary Schools Teachers. Questionnaire for the evaluation index system of information technology blended teaching. Experts were asked to anonymously rate and submit suggestions, on the basis of which a second expert consultation questionnaire was created. After several rounds of "spiral upward" questionnaires, the design of the indicator system was completed until the experts' opinions were relatively unified.

**Analytic hierarchy process**

The analytic hierarchy process requires splitting the evaluation index elements, setting the target layer, criterion layer, program layer and other levels, and using qualitative and quantitative analysis methods to build the evaluation index system. This study needs to hierarchize the evaluation index system and use this method to calculate the index weight to determine the weight coefficients of the indicators at each level and the overall comprehensive coefficient. If the coefficient is qualified, the indicator will be retained. If the coefficient is unqualified, the indicator will be excluded., to construct a hybrid teaching evaluation system for information technology in junior high schools under the CIPP model.

**Questionnaire survey method**

Through the design and distribution of questionnaires, we took teachers and students of a secondary schools in Shenzhen as the research object, and conducted an investigation and research on the problems existing in the hybrid teaching of information technology courses in the secondary school. By sorting out information, statistical data and analyzing problems, the evaluation was obtained feedback information to provide decision-making information for teachers to improve their artificial intelligence literacy.

**CIPP Evaluation Model**

The CIPP Evaluation Model, developed by Daniel L. Stufflebeam, is a widely used framework for conducting program evaluations. CIPP stands for Context, Input, Process, and Product, which are the four main components or dimensions of the model. Each of these dimensions represents a different stage in the evaluation process, and the model helps evaluators systematically assess and improve programs and projects.

Here's an overview of each dimension:

**Context Evaluation:** This phase involves assessing the context or environment in which a program operates. Evaluators examine the needs, problems, and opportunities that led to the program's creation. They also consider the stakeholders involved, such as participants, funders, and policymakers. The goal is to

understand the broader context in which the program exists and determine its relevance and appropriateness.

**Input Evaluation:** In this phase, evaluators examine the resources and inputs that go into the program. This includes assessing the program's design, goals, objectives, curriculum, materials, staff qualifications, and budget. The focus is on whether the program has the necessary resources and inputs to achieve its intended outcomes.

**Process Evaluation:** Process evaluation looks at how the program is implemented. Evaluators assess the actual delivery of the program, including the methods and strategies used, the quality of program activities, and the fidelity to the program's design. This phase aims to identify strengths and weaknesses in program implementation.

**Product Evaluation:** Product evaluation focuses on the outcomes and impacts of the program. This involves assessing whether the program has achieved its intended goals and objectives and examining its overall effectiveness. Evaluators may use various methods to measure program outcomes, such as surveys, interviews, and data analysis.

The CIPP Evaluation Model is often used as a comprehensive and systematic approach to program evaluation. It allows evaluators to gather data and make judgments at each stage of the program's life cycle, from planning and implementation to assessment of outcomes. By doing so, organizations can make informed decisions about program improvement, expansion, or termination based on evidence and analysis.

To sum up, the rapid development of artificial intelligence education in primary and secondary schools has, on the one hand, improved teachers' relevant abilities and qualities, and on the other hand, it has laid the foundation for the cultivation of talents in the field of artificial intelligence in my country. However, the current artificial intelligence education in primary and secondary schools in my country, especially the artificial intelligence education for junior high schools and primary schools, faces the following problems in specific implementation:

**1. The course positioning is vague**

The subject of artificial intelligence itself covers a wide range of knowledge. Many subfields are highly theoretical and are still in the stage of rapid development and innovation. There is no consensus on many key issues. Even at the higher education stage, the establishment of artificial intelligence majors and the construction of curriculum systems are still in the early stages of development. In the practice of artificial intelligence education in primary and secondary schools, because educational managers and teachers generally lack a clear understanding of the subject of artificial intelligence, it is easy to confuse it with maker education, programming education, or robot education. The artificial intelligence courses offered by some schools are only slight modifications to the original robotics courses or programming courses, and the course content and practical activities are basically unchanged or even exactly the same. In addition to on-campus courses, various off-campus training institutions have launched training courses for various academic levels with the theme of artificial intelligence. Their courses also have similar problems, and due to being driven by commercial interests, they have even deviated from the original direction. The vague positioning of the curriculum directly causes the teaching content to be far away from the core content of the artificial intelligence subject itself, which is contrary to the original intention of artificial intelligence education.

**2. Differentiation of teaching content**

In terms of teaching content, some schools directly move models and theories of certain sub-fields of artificial intelligence into classrooms, and organize teaching mainly with technical knowledge. These contents are usually complex and abstract, and have high requirements on students' mathematical and logical abilities. They are difficult for primary and secondary school students to understand and are prone to resistance to the courses. For example, the "convolution" operation belongs to the category of functional analysis. If complex machine learning models such as "convolutional neural networks" based on this operation are directly explained in primary and secondary school artificial

intelligence classes, it will be difficult for students to have an in-depth knowledge and understanding of it. The teaching content of some schools only emphasizes students' experience and focuses on attracting students to carry out simple hands-on practice. Although students will feel novel and interesting in the classroom, the knowledge learning remains on the surface, making it difficult for students to understand and learn the power of artificial intelligence. Important concepts and ways of thinking.

**3. The curriculum system and resources are complex.**

At the junior high school and primary school levels, artificial intelligence courses are mostly elective or school-based courses, which belong to the school's "personalized courses". There is insufficient coherence in the curriculum between various academic stages, the teaching resources used are very different, and there is a general lack of overall curriculum system design and systematic teaching resource construction. At the same time, different schools have significant differences in teaching concepts, teacher training, and use of teaching materials. Since 2018, more than 20 artificial intelligence textbooks have been published nationwide. The textbook writers include university teachers, primary and secondary school teachers, research institutions, training institutions and other parties, covering multiple school stages from teachers to secondary school. However, a considerable number of teaching materials do not follow the characteristics of the artificial intelligence subject itself. Instead, they are oriented towards purchasing the software and hardware platforms required for practical links and write teaching content, which lacks basic scientificity and rationality.

Generally speaking, artificial intelligence education in primary and secondary schools currently faces good development opportunities, and great progress has been made in curriculum development and resource construction. However, because artificial intelligence education in domestic primary and secondary schools has not yet formed a clear, complete, and independent overall positioning and core content, it still faces problems such as vague curriculum positioning, differentiated teaching content, and complex curriculum

systems and resources. It is very necessary and important to develop and evaluate a set of artificial intelligence literacy improvement models based on secondary school teachers.

# Chapter 3
# Research Methodology

The purpose of the paper is to develop and evaluate a teachers' artificial intelligence literacy improvement model for secondary schools. Through the 3 research goals to achieve the research results.

1. To study the current level of knowledge of secondary schools teachers' artificial intelligence literacy.

2. To develop a teachers' artificial intelligence literacy improvement model for secondary schools.

3. To evaluate the teachers' artificial intelligence literacy improvement model.

There were three processes of research which were research proposal preparation, research procedures, and research report. The research procedures consisted of tow phases:

1. Employ the Delphi method to achieve objective 1 and objective 2.

2. Employ the focus groups to achieve objective 3.

The overall research process and steps can be summarized sa shown in the following figure.

**Symbol and Abbreviations**

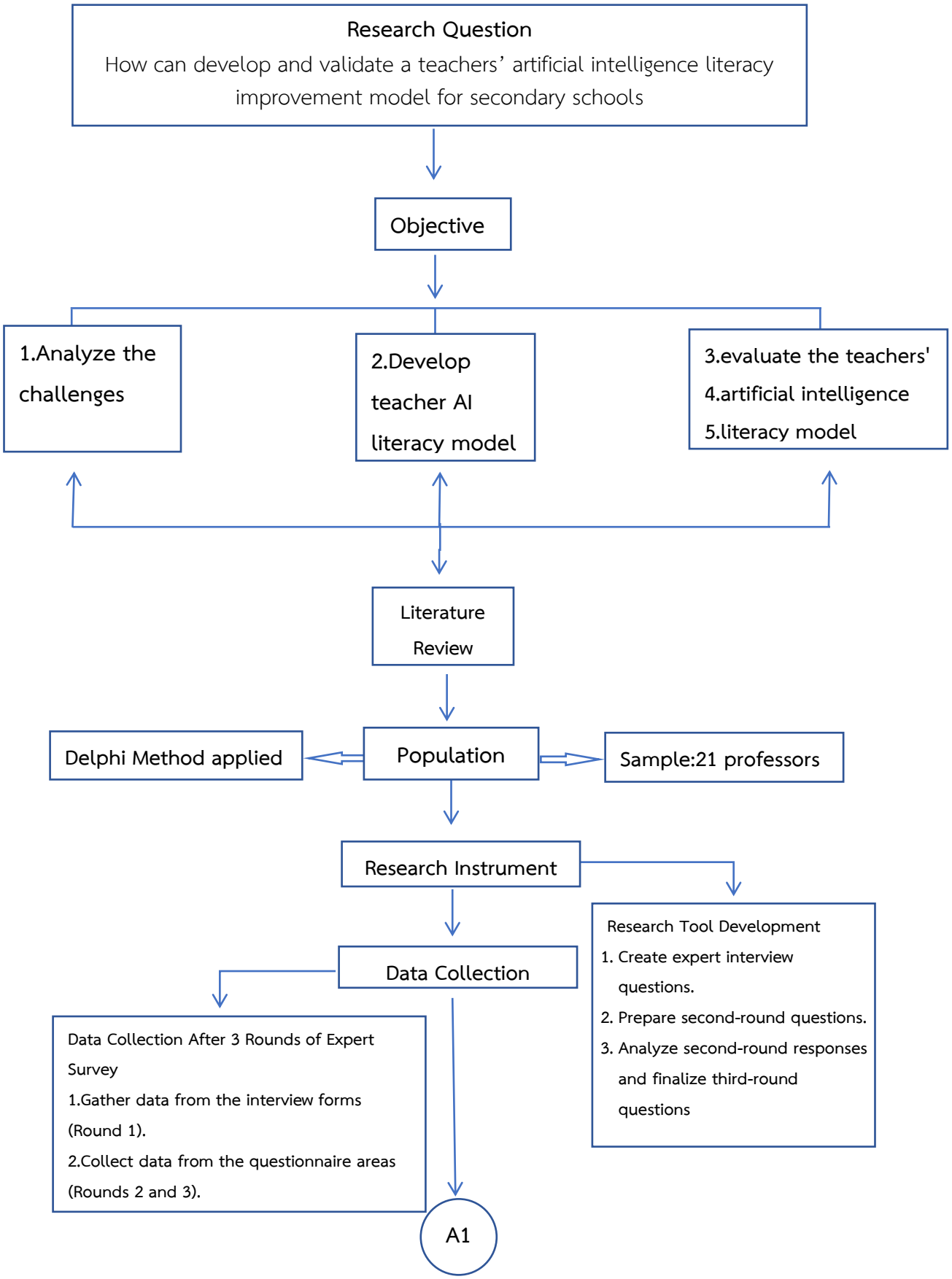
Represent data analysis results based on symbols and semantics. The details areas follows:

$\bar{X}$ means refers to mean

S.D. means standard deviation

N means number of persons

D scores of difference between pre and post class


Research Question
How can develop and validate a teachers' artificial intelligence literacy improvement model for secondary schools
Objective
1.Analyze the challenges
2.Develop teacher AI literacy model
3.evaluate the teachers'
4.artificial intelligence
5.literacy model
Literature Review
Delphi Method applied
Population
Sample:21 professors
Research Instrument
Research Tool Development
1. Create expert interview questions.
2. Prepare second-round questions.
3. Analyze second-round responses and finalize third-round questions
Data Collection
Data Collection After 3 Rounds of Expert Survey
1.Gather data from the interview forms (Round 1).
2.Collect data from the questionnaire areas (Rounds 2 and 3).
A1

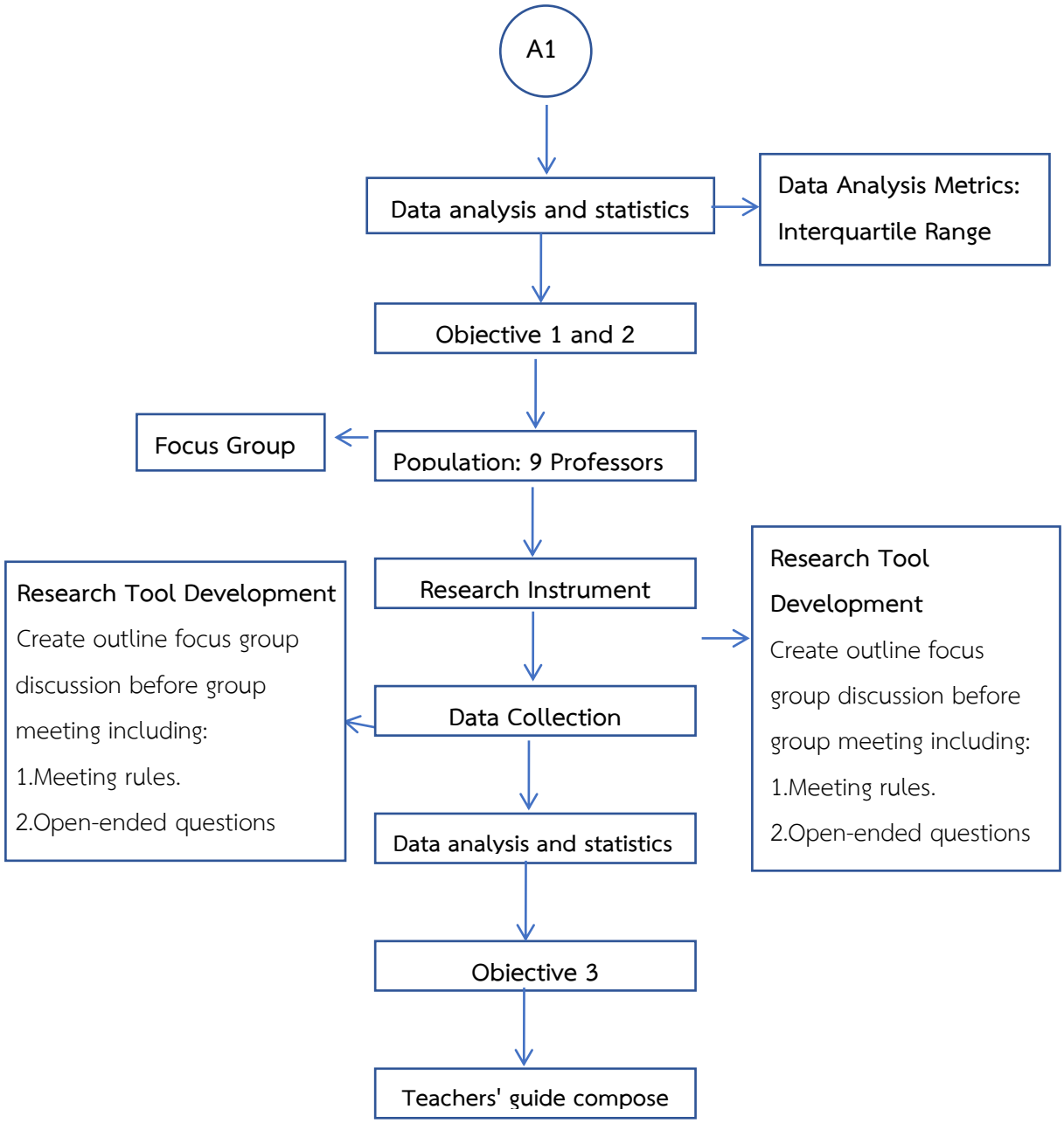



**Figure 3.1** Details of the research process step

The detailed content of the research method is as follows:

**Stage 1**

Employ the Delphi method to achieve objective 1 and objective 2

## The Population

1. Secondary school teachers: Personnel currently working in secondary schools in Shenzhen about 2500.

2. Normal college professors: This group is composed of educators responsible for teaching artificial intelligence technology in Shenzhen about 50.

3. Secondary school managers: This group is composed of the following personnel: Managers are responsible for the operation and strategic direction of school informatization and artificial intelligence. 412 administrators from 103 secondary schools in Shenzhen.

4. Artificial intelligence professionals and online education experts, 5 experts. The qualifications of the interviewees are as follows: 1) At least 5 years of working experience as a senior manager in primary and secondary schools, 2) Having extensive information leadership experience, 3) Master's degree or above.

## Research Instruments

1. Expert questionnaire content

There are three versions of the expert questionnaire, corresponding to three rounds of expert opinion consultation:

(1) The first version is an expert interview form. Researchers use a questionnaire consisting of three parts, as follows:

**Part I:** Demographic variables (Checklist), General information of the respondents, totaling 31 items,

**Part II:** Variables of Determining the variables of effective teachers' artificial intelligence literacy. (Five-point rating scale), totaling 31 items.

**Part III:** Suggestions and additional comments (Open Ended).

**Table 3.1** Measure on a 5-point Likert's scale

| Perception level | Score |
|---|---|
| Strongly Agree | 5 |
| Agree | 4 |
| Neutral | 3 |
| Disagree | 2 |
| Strongly Disagree | 1 |

The instrument, Propose effective teachers' artificial intelligence literacy model, required the respondents to determine the degree to which each statement reflecting the components of effectiveness. Each statement was to measure on a 5-point Likert's scale (1932);

5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, and 1 = Strongly Disagree. as shown in the table 3.1

(2) The second version is a five-level estimation questionnaire that combines the opinions of the first round of experts. The specific content is:

The characteristics of teachers' artificial intelligence literacy improvement model for secondary schools.

The third version is a five-level estimation questionnaire with the same content as the second round, and includes the corresponding indicator values (Quartile range, median) for the second round of scoring results.

**2. Construction process of expert questionnaire:**

**Step 1:** Construct the first-round of expert questionnaire;

**Step 2:** Invite 5 experts to test the target consistency index (IOC) of the expert questionnaire;

**Step 3:** Modify the expert questionnaire based on the expert's suggestions;

**Step 4:** Broadened Expert Consultation

Objective: Garner a wider range of expert opinions on the refined questionnaire. Distribute expert questionnaires to 21 experts;

Activities: Disseminate the revised questionnaire to an expanded panel of 21 domain-specific experts, aiming to gather comprehensive feedback and suggestions.

**Step 5:** Initiation of the Second-Round Questionnaire

Objective: Build on the insights obtained from the first round of feedback.

Activities: Collate and analyze the feedback received from the 21 experts. Utilizing this information, draft the first iteration of the second-round expert questionnaire.

**Step 6:** Iterative Refinement

Objective: Further hone the questionnaire through iterative feedback rounds.

Activities: Conduct two subsequent rounds of expert questionnaires. Each round will follow a similar methodology, incorporating feedback and refining the questionnaire based on insights gathered during the preceding round.

**Step 7:** Model Synthesis

Objective: Arrive at a consolidated model for teachers' artificial intelligence literacy supported by digital technology.

Activities: Aggregate the insights from all three rounds of expert opinions to derive a comprehensive model that integrates consensus views and addresses any divergences in expert opinion.

## Data Analysis

In the data analysis of this study, researchers analyzed the questionnaires provided by experts in the fist and second rounds using statistical indicators, as follows:

**Interquartile range (IQR)**

The Interquartile range can be used to analyze the concentration and distribution of expert opinions. This article adopts the consensus standard from Wu Jianxin's (2014) viewpoint, as follows:

**Table 3.2** Interquartile range and consensus degree

| Interquartile range | Consensus Degree |
|---|---|
| 0≤IQR≤1.8 | High |
| 1.8≤IQR≤2.0 | Medium |
| IQR≥2.0 | Low |

**Median (Md)**

The median is the score in the middle of the score data provided by all experts in order. It can describe the concentration trend of expert opinions, and then explain the meaning according to the standards set by the researcher as follows:

**Table 3.3** Median and Possibility

| Median | The possibility of this item |
|---|---|
| Md ≥ 4.50 | Most likely |
| 3.50 ≤ Md ≤ 4.49 | More likely |
| 2.50 ≤ Md ≤ 3.49 | Moderate likely |
| 1.50 ≤ Md ≤ 2.49 | Less likely |
| Md ≤ 1.50 | Least likely |

The median was obtained from the Answers from all experts, Then interpret the meaning according to the criteria set by the researcher as follows:

The median of 4.50 and above means that the group of experts considers that. The statement is most probable.

The median value is between 3.50-4.49, meaning that the group of experts considers that the statement is very likely.

The median value is between 2.50-3.49, meaning that the group of experts considers that the message is likely Moderately possible.

The median value is between 1.50-2.49, meaning that the group of experts agrees that the message is likely Less likely.

The median value is less than 1.50, indicating that the group of experts considers the message least likely.

This paper develops the questionnaire of Digital Technology Supported Model In teachers' artificial intelligence literacy, Shenzhen city, China, and determines the suitability and feasibility of the questionnaire answers through the results of the second and third rounds of questionnaire feedback. After the feedback of the third round of questionnaire, the median value is 3.5 or higher, which is considered as the high level agreed by experts. Experts believe that QR (Interquartile distance) is consistent at 1.50 and below.

**Stage 2**

Employ the focus groups to achieve objective 3.

**Research Instruments**

**Discussion Outline**

The researcher used each component of problem and resolution on effective teachers' artificial intelligence literacy, from phase (2) To evaluate the model by using Focus Group Discussion.

**Population and Sample**

The main personnel are composed of 9 experts.

Condition requirements for major personnel:

1. They were professionals with proposing the teachers' artificial intelligence literacy in secondary schools in Shenzhen city or using relevant management experience to carryout work.

2. They had reasonable experience or certain achievements in evaluating teachers' artificial intelligence literacy model in higher vocational colleges in Shenzhen city.

3. Their success in digital technology supported model on teachers' artificial intelligence literacy, had been widely recognized.

4. The key informants without relevant mature ability or experience were from ordinary instructors.

The key informants wereselec ted by purposive sampling technique with the above criteria.

**Discussion Outline**

Process for Focus Group Meetings

The methodology for data collection through focus group meetings is delineated in the following structured steps:

**Step 1:** Logistical Preparation:

Objective: Establish the foundational elements for the meeting.

Activities: Determine the optimal date and venue. Select a diverse group of 9 members ensuring varied perspectives on the model.

**Step 2:** Liaison and Preliminary Introduction:

Objective: Facilitate seamless coordination and establish credibility.

Activities: Maintain regular communication with key stakeholders. Clearly present the researcher's credentials, objectives, and intentions for the meeting. Assign designated roles, with a lead researcher acting as the facilitator to ensure structured proceedings.

**Step 3:** Crafting the Discussion Outline:

Objective: Design a detailed agenda for the focus group discussion.

Activities: Formulate guiding questions and discussion prompts based on research objectives. Ensure a balance between structure and flexibility to accommodate spontaneous insights.

**Step 4:** Conducting the Focus Group Meeting:

Objective: Garner detailed insights through interactive dialogue.

Activities: The facilitator initiates discussions, encouraging diverse viewpoints and fostering in-depth explorations of topics. Facilitate collaborative brainstorming, ensuring active participation and ideation from all members.

**Step 5:** Documentation and Reporting:

Objective: Ensure accurate capture of discussions for subsequent analysis.

Activities: Utilize audio recording devices to chronicle the entirety of the discussion. Post-meeting, transcribe the recordings and draft a comprehensive report detailing the insights, suggestions, and consensus points from the meeting.

**Data Analysis**

Data procured from the focus group meeting, through both voice recordings and documented reports, was critically examined to assess participants' perceptions regarding the feasibility of the proposed research model. The following details provide insights into the structure and findings of the focus group discussion:

**1. Facilitation of the Discussion:**

Objective: To steer the dialogue towards understanding the evaluation of the teachers' artificial intelligence literacy model within higher vocational colleges.

Activities: The focus group session was moderated by the primary researcher.

Emphasis was placed on facilitating an open platform for experts to share their insights, concerns, and suggestions regarding the model's viability.

**2. Uninhibited Expert Participation:**

Objective: To generate candid feedback and diverse perspectives on the proposed model.

Activities: Adhering to the principles of autonomy and voluntarism, the expert participants engaged in unrestrained discussions. Their dialogues largely revolved around the core direction of objective 2, aiming to conceptualize an effective digital technology-supported model for enhancing teachers' artificial intelligence literacy.

**3. Incorporating Previous Findings and Fresh Ideation:**

Objective: To meld prior research results with novel insights for a more comprehensive understanding.

Activities: Discussions were rooted in the findings obtained under researcher objective 1, which sought to identify primary challenges and solutions pertinent to effective teachers' artificial intelligence literacy. Expert participants further expanded upon these results, offering innovative ideas and perspectives on integrating digital technology to fortify the proposed model for teachers' artificial intelligence literacy enhancement.

**Summarize**

This research is systematically structured into two sequential stages, with each stage dedicated to achieving specific objectives:

Stage 1: Delphi Method Application

Objective: Address objectives 1 and 2 by discerning the viability of the factors influencing digital technology support within the context of a secondary school teachers' artificial intelligence literacy improvement model.

Approach: Utilize the Delphi method, a structured communication technique, to engage experts and gather consensus on pertinent factors. Incorporate insights from the literature review, harmonizing them with expert opinions to iteratively refine and develop the model.

Stage 2: Focus Group Implementation

Objective: Address objective 3, which aims to critically evaluate the developed teachers' artificial intelligence literacy improvement model for secondary schools.

Approach: Organize focus group sessions to facilitate in-depth discussions and gather feedback from relevant stakeholders. Analyze the collective insights to assess the model's strengths, areas for improvement, and overall feasibility in real-world secondary school settings.

# Chapter 4

# Results of Analysis

The purpose of the paper is to develop and evaluate a teachers' artificial intelligence literacy improvement model for secondary schools.

**The objectives of this study are:**

1. To study the current level of knowledge of secondary schools teachers' artificial intelligence literacy
2. To develop a teachers' artificial intelligence literacy improvement model for secondary schools
3. To evaluate the teachers' artificial intelligence literacy improvement model

**The data analysis results of the study are as follows:**

1. Symbols and Abbreviations.
2. Data Analysis.
3. Data Analysis Results.

## Symbol and Abbreviation

**IQR** Interquartile Range, which refers to the range between the first and third quartiles.

**Md** Median, which refers to the middle value in a dataset.

**Mo** Mode, which refers to the most frequently occurring value in a dataset.

## Data Analysis

**Part One**: Analysis of Respondents' Personal Information Classified by Gender and Educational Background. The researchers provided these data based on frequency and percentage.

**Part Two:** Analysis of Interview Data on Current Issues in Secondary Schools Teacher Training.

**Part Three:** Analysis of Questionnaire Data, Data analysis of the questionnaire on the artificial intelligence literacy training model for Secondary Schools in Shenzhen City, classified by median, mode, and interquartile range.

**Part Four:** Through qualitative analysis, teachers' artificial intelligence literacy improvement model for Secondary Schools of Shenzhen City.

**Part Five:** Description of the teachers' artificial intelligence literacy improvement model. for Secondary Schools of Shenzhen City.

## Data Analysis Results.

**Research Objectives** To discuss the problems existing in the current training mode of teachers' artificial intelligence literacy

The researchers divided the data into the following 5 sections for analysis:

**Part One:** Analysis of Respondents' Personal Information Classified by Gender and Educational Background. The researchers provided these data based on frequency and percentage.

**Table 4.1** Respon' personal of respondents

| Personal Information | | Frequency | % |
|---|---|---|---|
| Gender | Male | 13 | 62.0% |
| | Female | 8 | 38.0% |
| Age | Age 40-49 | 12 | 57.0% |
| | Over 50 years old | 9 | 43.0% |
| working life | 10-20 Years | 11 | 53.0% |
| | More than 20 years | 10 | 47.0% |
| Professional title | Secondary school teachers and administrators | 14 | 66.7% |
| | Professor | 7 | 33.3% |
| Educational background | Degree of Master | 16 | 76.0% |
| | Degree of Doctor | 5 | 24.0% |
| professional background | Secondary school teachers | 7 | 33.3% |
| | Professor of Normal College | 7 | 33.3% |
| | Secondary administrators | 7 | 33.3% |

According to Table 4.1, there were 13 male participants, accounting for 62.0%, and 8 female participants, accounting for 38.0%. In terms of age distribution, 9 participants were aged 40-49, representing 43.0%, while 12 participants were aged 50 and above, representing 57.0%. Regarding years of work experience, 11 participants had 10-20 years of experience, accounting for 53.0%, and 10 participants had over 20 years of experience, accounting for 47.0%. Additionally, there were 14 Secondary school teachers and administrators among the participants, making up 66.7%, and 7 professors, making up 33.3%. In terms of educational background, 16 participants had a master's degree, accounting for 76.0%, while 5 participants had a doctoral degree, accounting for 24.0%. In terms of professional background, 14 participants had experience in Secondary school education and teaching, accounting for 66.7%, while 7 participants were Professor of Normal College, accounting for 33.3%.

**Part Two:** Analysis of Interview Data on Current Issues in Secondary Schools Teachers' artificial intelligence literacy Training.

IOC was used as the evaluation criterion (For "Assessing the validity of the questionnaire")

Five experts were invited to assess the validity of the designed questionnaire and IOC (Index of Consistency) was used as the evaluation criterion. A threshold value of 0.65 was set to measure the statistical index of the degree of consistency of the experts on the questions of the questionnaire. When the IOC value reaches or exceeds 0.65, it indicates a high degree of agreement among the majority of experts on a particular questionnaire question, thus proving that the questionnaire question has good reliability and validity. If the IOC value is below 0.65, the questions in that questionnaire are adjusted.

Through data analysis and literature review, a discussion outline on current issues in secondary schools teacher training was developed, and five experts were invited to conduct an IOC test on the discussion outline. The five experts reached a consensus on the composition of the 8 elements related to current issues in secondary schools teacher training.

In order to study the elements of effective current issues in secondary schools teacher training, interviews were conducted with 21 experts, yielding the following results.

**Table 4.2** Current Situation Analysis of problems in secondary schools teacher Artificial Intelligence Literacy training

| Item | High/% | Middle/% | Low/% | Un specified/% |
|---|---|---|---|---|
| 1. Foundational AI knowledge and needs | 21/100% | 0/0.00% | 0/0.00% | 0/0.00% |
| 2. Pedagogical Integration of AI | 19/90.5% | 2/9.5% | 0/0.00% | 0/0.00% |
| 3. Computational Thinking and Problem-Solving | 18/85.7% | 3/14.3% | 0/0.00% | 0/0.00% |
| 4. Ethics and Responsible AI Use | 12/57.2% | 6/28.6% | 3/14.2% | 0/0.00% |
| 5. Professional Development and Lifelong Learning | 19/90.5% | 2/9.5% | 0/0.00% | 0/0.00% |
| 6. AI Tools and Resource Management | 21/100% | 0/0.00% | 0/0.00% | 0/0.00% |
| 7. AI-Supported Student Empowerment | 10/47.6% | 7/33.4% | 4/19.0% | 0/0.00% |
| 8. Systemic Challenges and Institutional Support | 18/85.7% | 3/14.3% | 0/0.00% | 0/0.00% |

According to Table 4.2, the survey results reflect the current status analysis of issues in secondary schools teacher training in terms of teachers' artificial intelligence literacy improvement model. What are the current problems in secondary schools teachers' training on teachers' artificial intelligence literacy improvement model? The investigation of current issues includes eight factors: Foundational AI knowledge and needs, Pedagogical Integration of AI, Computational Thinking and Problem-Solving, Ethics and Responsible AI Use, Professional Development and Lifelong Learning, AI Tools and Resource Management, AI-Supported Student Empowerment, and Systemic Challenges and Institutional Support. Each aspect is assessed at a high,

medium, low, or uncertain level. 100.0% of respondents consider the overall level of Foundational AI knowledge and needs to be high; 90.5% of respondents believe that the overall level of research on Pedagogical Integration of AI is high, with 9.5% rated as medium; 85.7% of respondents think the overall level of Computational Thinking and Problem-Solving is high, with 14.3% rated as medium; 57.2% of respondents believe the overall level of Ethics and Responsible AI Use is high, with 28.6% rated as medium, and 14.2% rated as low; 90.5% of respondents consider the overall level of Professional Development and Lifelong Learning to be high, with 9.5% rated as medium; 100% of respondents rate the overall level of AI Tools and Resource Management as high; 47.6% of respondents believe the overall level of AI-Supported Student Empowerment is high, with 33.43% rated as medium, and 19.0% rated as low; 85.7% of respondents think the overall level of Systemic Challenges and Institutional Support is high, with 14.3% rated as medium.

Data analysis results of the current issues in secondary schools teacher training, focusing on the dimension of Foundational AI knowledge and needs.

**Table 4.3** Current situation of problems in secondary schools teacher training: Dimensions of Foundational AI knowledge and needs

| NO. | Dimensions of Foundational AI knowledge and needs | Freq | % |
|---|---|---|---|
| 1 | Basic AI concepts (machine learning, neural networks, algorithms) | 21 | 100.0 |
| 2 | History and evolution of AI | 21 | 100.0 |
| 3 | Key AI applications in education | 20 | 95.2 |
| 4 | AI tools and platforms for teaching (e.g., ChatGPT, TensorFlow) | 19 | 90.4 |
| 5 | Limitations and challenges of AI | 18 | 85.7 |
| 6 | Understanding AI data structures and sources | 17 | 81.0 |
| 7 | Role of data in AI decision-making | 14 | 66.6 |
| 8 | AI's impact on society and economy | 13 | 64.9 |
| 9 | Comparison of AI and human intelligence | 12 | 57.1 |
| 10 | Privacy and security issues in AI use | 11 | 52.3 |

Based on the data analysis from Table 4.3, the dimensions of Foundational AI knowledge and needs defining the current status of issues in secondary schools teacher training were identified. The top three indicators are Basic AI concepts (100%), History and evolution of AI (100%), and Key AI applications in education (95.2%). The bottom three indicators are AI's impact on society and economy (64.9%), Comparison of AI and human intelligence (57.1%), and Privacy and security issues in AI use (52.3%).

For the data analysis results of the current status elements in secondary schools teacher training, the dimension of Pedagogical Integration of AI.

**Table 4.4** Current situation of problems in secondary schools teacher training: Dimension of Pedagogical Integration of AI

| NO. | Dimension of Pedagogical Integration of AI | Freq | % |
|---|---|---|---|
| 1 | Designing AI-supported lesson plans | 21 | 100.0 |
| 2 | Using AI for personalized learning | 20 | 95.2 |
| 3 | Implementing AI-driven formative assessments | 19 | 90.4 |
| 4 | Integrating AI in interdisciplinary curricula | 18 | 85.7 |
| 5 | Promoting active learning with AI tools | 17 | 81.0 |
| 6 | Conducting AI-supported student evaluations | 17 | 81.0 |
| 7 | Supporting collaborative learning with AI technologies | 15 | 71.4 |
| 8 | Using AI to enhance classroom engagement | 14 | 66.7 |
| 9 | AI-based adaptive learning techniques | 12 | 57.1 |
| 10 | Evaluating the effectiveness of AI tools in teaching | 11 | 52.3 |

Based on the data analysis from Table 4.4, the dimensions of Pedagogical Integration of AI defining the current status of issues in secondary schools teacher training were identified. The top three indicators are Designing AI-supported lesson plans (100%), Using AI for personalized learning (95.2%), and Implementing AI-driven formative assessments (90.4%). The bottom three indicators are Using AI to enhance classroom engagement (66.7%), AI-based adaptive learning techniques (57.1%), and Evaluating the effectiveness of AI tools in teaching (52.3%).

For the data analysis results of the current status elements in secondary schools teacher training, the dimension of Computational Thinking and Problem-Solving.

**Table 4.5** Current situation of problems in secondary schools teacher training: Dimension of Computational Thinking and Problem-Solving

| NO. | Dimension of Computational Thinking and Problem-Solving. | Freq | % |
|---|---|---|---|
| 1 | Algorithmic thinking and problem decomposition | 21 | 100.0 |
| 2 | Logical reasoning in AI problem-solving | 19 | 90.4 |
| 3 | Designing basic AI models for classroom use | 19 | 90.4 |
| 4 | Introducing programming concepts related to AI | 18 | 85.7 |
| 5 | Exploring data-driven decision-making processes | 16 | 76.1 |
| 6 | Engaging students in AI debugging and troubleshooting | 15 | 71.4 |
| 7 | Applying pattern recognition with datasets | 14 | 66.6 |
| 8 | Encouraging computational creativity | 12 | 57.1 |
| 9 | Gamification using AI tools | 12 | 57.1 |
| 10 | Exploring hands-on AI projects with students | 10 | 47.6 |

Based on the data analysis from Table 4.5, the dimensions of Computational Thinking and Problem-Solving defining the current status of issues in secondary schools teacher training were identified. The top three indicators are Algorithmic thinking and problem decomposition (100%), Logical reasoning in AI problem-solving (90.4%), and Designing basic AI models for classroom use (90.4%). The bottom three indicators are Encouraging computational creativity (66.6%), Gamification using AI tools (57.1%), and Exploring hands-on AI projects with students (47.6%).

For the data analysis results of the current status elements in secondary schools teacher training, the dimension of Ethics and Responsible AI Use.

**Table 4.6** Current Issues in secondary schools teacher training: Dimension of Ethics and Responsible AI Use

| NO. | Dimension of Ethics and Responsible AI Use | Freq | % |
|---|---|---|---|
| 1 | AI ethics fundamentals (bias, fairness, accountability) | 21 | 100.0 |
| 2 | Promoting inclusive and fair AI applications | 19 | 90.4 |
| 3 | Discussing AI's societal and environmental impact | 18 | 85.7 |
| 4 | Understanding regulatory frameworks and guidelines | 17 | 81.0 |
| 5 | Fostering student discussions on AI dilemmas | 17 | 81.0 |
| 6 | Promoting digital citizenship in AI usage | 16 | 76.1 |
| 7 | Teaching responsible AI content creation | 14 | 66.6 |
| 8 | Safeguarding student data with AI tools | 12 | 57.1 |
| 9 | Encouraging transparency in AI use | 12 | 57.1 |
| 10 | Balancing technology use and ethical considerations | 11 | 52.3 |

According to Table 4.6, the dimensions of Ethics and Responsible AI Use defining the current status of issues in secondary schools teacher training were identified. The top three indicators are AI ethics fundamentals (bias, fairness, accountability) (100%), Promoting inclusive and fair AI applications (90.4%), and Discussing AI's societal and environmental impact (85.7%). The bottom three indicators are Safeguarding student data with AI tools (57.1%), Encouraging transparency in AI use (57.1%), and Balancing technology use and ethical considerations (52.3%).

For the data analysis results of the current status elements in secondary schools teacher training, the dimension of Professional Development and Lifelong Learning.

**Table 4.7** Current Issues in secondary schools teacher training: Dimension of Professional Development and Lifelong Learning

| NO. | Dimension of Professional Development and Lifelong Learning. | Freq | % |
|---|---|---|---|
| 1 | Engaging in AI-focused professional training | 21 | 100.0 |
| 2 | Networking with peers for AI teaching strategies | 20 | 95.2 |
| 3 | Exploring global AI educational practices | 19 | 90.4 |
| 4 | Keeping up with emerging AI technologies | 18 | 85.7 |
| 5 | Utilizing online AI learning platforms | 17 | 81.0 |
| 6 | Participating in AI education conferences | 16 | 76.1 |
| 7 | Creating professional learning communities for AI | 12 | 57.1 |
| 8 | Conducting action research on AI in education | 11 | 52.3 |
| 9 | Evaluating personal AI teaching competencies | 9 | 42.8 |
| 10 | Advocating for policy reforms in AI education | 9 | 42.8 |

Based on the data analysis from Table 4.7, the dimensions of Professional Development and Lifelong Learning defining the current status of issues in secondary schools teacher training were identified. The top three indicators are Engaging in AI-focused professional training (100%), Networking with peers for AI teaching strategies (95.2%), and Exploring global AI educational practices (90.4%). The bottom three indicators are Conducting action research on AI in education (52.3%), Evaluating personal AI teaching competencies (42.8%), and Advocating for policy reforms in AI education (42.8%).

For the data analysis results of the current status elements in secondary schools teacher training, the dimension of AI Tools and Resource Management.

**Table 4.8** Current Issues in secondary schools teacher training: Dimension of AI Tools and Resource Management

| NO. | Dimension of AI Tools and Resource Management | Freq | % |
|---|---|---|---|
| 1 | Selecting appropriate AI tools for classroom use | 21 | 100.0 |
| 2 | Managing AI-driven administrative tasks | 21 | 100.0 |
| 3 | Developing teaching resources with AI assistance | 19 | 90.4 |
| 4 | Utilizing AI for classroom organization | 17 | 81.0 |
| 5 | Customizing AI tools to fit diverse learning needs | 15 | 71.4 |
| 6 | Sharing AI resources with the teaching community | 15 | 71.4 |
| 7 | Identifying cost-effective AI solutions | 14 | 66.6 |
| 8 | Analyzing the limitations of AI tools in teaching | 12 | 57.1 |
| 9 | Troubleshooting common AI tool challenges | 11 | 52.3 |
| 10 | Promoting open-source AI educational tools | 10 | 47.6 |

Data analysis from Table 4.8 revealed that the dimensions of AI Tools and Resource Management defining the current status of issues in secondary schools teacher training were Selecting appropriate AI tools for classroom use (100%), Managing AI-driven administrative tasks (100%), and Developing teaching resources with AI assistance (90.4%) as the top three indicators, while Analyzing the limitations of AI tools in teaching (57.1%), Troubleshooting common AI tool challenges (52.3%), and Promoting open-source AI educational tools (47.6%) were the bottom three indicators.

Data analysis of the elements of the current status of issues in secondary schools teacher training, AI-Supported Student Empowerment Dimension.

**Table 4.9** Current Issues in secondary schools teacher training: AI-Supported Student Empowerment Dimension

| NO. | Dimension of AI-Supported Student Empowerment | Freq | % |
|---|---|---|---|
| 1 | Encouraging students to design AI projects | 21 | 100.0 |
| 2 | Promoting computational creativity among students | 20 | 95.2 |
| 3 | Mentoring students in AI competitions | 19 | 90.4 |
| 4 | Supporting student-led AI research | 18 | 85.7 |
| 5 | Fostering critical thinking through AI activities | 17 | 81.0 |
| 6 | Teaching students about AI career paths | 16 | 76.1 |
| 7 | Developing AI-related extracurricular programs | 12 | 57.1 |
| 8 | Supporting students in responsible AI use | 11 | 52.3 |
| 9 | Inspiring students to address real-world problems with AI | 11 | 52.3 |
| 10 | Promoting collaboration in AI learning | 10 | 47.6 |

Data analysis from Table 4.9 revealed that the dimensions of AI-Supported Student Empowerment defining the current status of issues in secondary schools teacher training were Encouraging students to design AI projects (100%), Promoting computational creativity among students (95.2%), and Mentoring students in AI competitions (90.4%) as the top three indicators, while Supporting students in responsible AI use (52.3%), Inspiring students to address real-world problems with AI (52.3%), and Promoting collaboration in AI learning (47.6%) were the bottom three indicators.

Data analysis of the elements of the current status of issues in secondary schools teacher training, Systemic Challenges and Institutional Support Dimension.

**Table 4.10** Current Issues in secondary schools teacher training: Systemic Challenges and Institutional Support Dimension

| NO. | Dimension of Systemic Challenges and Institutional Support | Freq | % |
|---|---|---|---|
| 1 | Addressing Barriers to AI Adoption in Schools | 21 | 100.0 |
| 2 | Advocating for equitable AI access in education | 19 | 90.4 |
| 3 | Ensuring inclusive policies for AI integration | 18 | 85.7 |
| 4 | Accessing funding for AI tools and training | 17 | 81.0 |
| 5 | Building institutional capacity for AI education | 16 | 76.1 |
| 6 | Aligning AI practices with school goals | 15 | 71.4 |
| 7 | Engaging stakeholders in AI curriculum design | 12 | 57.1 |
| 8 | Establishing AI learning environments | 12 | 57.1 |
| 9 | Developing standards for AI literacy assessment | 10 | 47.6 |
| 10 | Encouraging innovation in AI pedagogy | 9 | 42.8 |

From Table 4.10, the data analysis results were used to define the dimensions of Systemic Challenges and Institutional Support that characterize the current issues in secondary schools teacher training. The top three indicators were Addressing Barriers to AI Adoption in Schools (100%), Advocating for equitable AI access in education (90.4%), and Ensuring inclusive policies for AI integration (85.7%), while the bottom three indicators were Establishing AI learning environments (57.1%), Developing standards for AI literacy assessment (47.6%), and Encouraging innovation in AI pedagogy (42.8%).

Prior to conducting the expert questionnaire survey, 5 experts were invited to confirm the Index of Objectivity Consistency (IOC) of the questionnaire. After analysis,

these five experts did not raise any consistency issues throughout the entire category.

**Research Objectives 2** To develop a teachers' artificial intelligence literacy improvement model for secondary schools

**Part Three:** Analysis of Questionnaire Data. Data analysis of the questionnaire on the artificial intelligence literacy training model for Secondary Schools in Shenzhen City, classified by median, mode, and interquartile range.

The basic process and results of the second round of expert consultation are as follows:

**(1) Basic Process.**

The research process of this round is divided into five steps.

**process 1:** Researchers invited experts via email, WeChat, phone calls, and other social media platforms. WeChat and phone calls were typically used to invite experts known personally to the researchers, while email was used to invite experts known unilaterally.

**process 2:** The data from the analysis of the current issues in secondary schools teacher training previously constructed were transformed into the "Questionnaire Standard Framework for Consultation on the Training Model of teachers' artificial intelligence literacy for Secondary Schools Teachers in Shenzhen City."

**process 3:** Based on the "Questionnaire Standard Framework for Consultation on the Training Model of teachers' artificial intelligence literacy for secondary schools Teachers in Shenzhen City," a "Research Expert Consultation Questionnaire on the Standard Framework of the Training Model of teachers' artificial intelligence literacy for secondary schools Teachers in Shenzhen City" was developed.

**process 4:** The questionnaire, along with its theoretical basis and relevant explanations, was sent directly, via email, or electronically to the selected 21 experts for assessment, seeking their opinions on the framework.

**process 5:** Collecting experts' opinions, tabulating, analyzing, and summarizing them.

(The process of the third round of expert consultation is as described above.)

**(2) Research findings.**

The results of the round 2 survey are as follows:

**Table 4.11** Second Round Survey Results: Elements of the Training Model of teachers' artificial intelligence literacy

| Item | Elements of the Training Model of teachers' artificial intelligence literacy | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1 | Foundational AI knowledge and needs | 5.0 | 5.0 | 0.0 | 95.24% |
| 2 | Pedagogical Integration of AI | 4.0 | 4.0 | 0.0 | 85.71% |
| 3 | Computational Thinking and Problem-Solving | 5.0 | 5.0 | 0.5 | 90.48% |
| 4 | Ethics and Responsible AI Use | 3.0 | 4.0 | 1.0 | 42.86% |
| 5 | Professional Development and Lifelong Learning | 5.0 | 5.0 | 0.5 | 90.48% |
| 6 | AI Tools and Resource Management | 5.0 | 5.0 | 0.0 | 95.24% |
| 7 | AI-Supported Student Empowerment | 3.0 | 4.0 | 1.0 | 42.86% |
| 8 | Systemic Challenges and Institutional Support | 5.0 | 5.0 | 0.5 | 90.48% |

According to Table 4.11, in the second round of research, 21 experts reached a consensus on 8 effective strategies for the elements of the training model of teachers' artificial intelligence literacy for Secondary Schools Teachers in Shenzhen City. The ranking from high to low is as follows:

Elements of the Foundational AI knowledge and needs (95.24%),

Elements of the AI Tools and Resource Management (95.24%), Computational Thinking and Problem-Solving (90.48%), Professional Development and Lifelong

Learning (90.48%), Systemic Challenges and Institutional Support (90.48%), Pedagogical Integration of AI (85.71%), Ethics and Responsible AI Use (42.86%), AI-Supported Student Empowerment (42.86%). Among these factors, Ethics and Responsible AI Use and AI-Supported Student Empowerment had a consensus level of less than 80%.

**Table 4.12** Results of the Round 2 Survey: Foundational AI knowledge and needs

| Item | Foundational AI knowledge and needs | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1 | Basic AI concepts | 5.0 | 5.0 | 0.0 | 95.24% |
| 2 | History and evolution of AI | 5.0 | 5.0 | 0.5 | 90.48% |
| 3 | Key AI applications in education | 3.0 | 4.0 | 1.0 | 42.86% |
| 4 | AI tools and platforms for teaching | 4.0 | 5.0 | 0.5 | 80.95% |
| 5 | Limitations and challenges of AI | 3.0 | 4.0 | 1.0 | 33.33% |
| 6 | Understanding AI data structures and sources | 3.0 | 4.0 | 1.0 | 42.86% |
| 7 | Role of data in AI decision-making | 3.0 | 4.0 | 1.0 | 42.86% |
| 8 | AI's impact on society and economy | 5.0 | 5.0 | 0.5 | 90.48% |
| 9 | Comparison of AI and human intelligence | 4.0 | 5.0 | 0.5 | 80.95% |
| 10 | Privacy and security issues in AI use | 5.0 | 5.0 | 0.5 | 90.48% |

According to Table 4.12, in the second round of research, 21 experts reached a consensus on 10 effective strategies for the elements of Foundational AI knowledge and needs. The ranking from high to low is as follows: Professional Basic AI concepts (Md=5.0, Mo=5.0, IQR=0.0), History and evolution of AI (Md=5.0, Mo=5.0, IQR=0.5), AI's impact on society and economy (Md=5.0, Mo=5.0, IQR=0.5) Privacy and security issues in AI use (Md=5.0, Mo=5.0, IQR=0.5), AI tools and platforms for teaching (Md=4.0, Mo=5.0, IQR=0.5), Comparison of AI and human intelligence

(Md=4.0, Mo=5.0, IQR=0.5), Key AI applications in education (Md=3.0, Mo=4.0, IQR=1.0), Understanding AI data structures and sources (Md=3.0, Mo=4.0, IQR=1.0), Role of data in AI decision-making (Md=3.0, Mo=4.0, IQR=1.0), Limitations and challenges of AI (Md=3.0, Mo=4.0, IQR=1.0).

Among these factors, Key AI applications in education, Limitations and challenges of AI, Understanding AI data structures and sources, and Role of data in AI decision-making had a consensus level of less than 80%.

**Table 4.13** Results of Round 2: Pedagogical Integration of AI

| Item | Pedagogical Integration of AI | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1 | Designing AI-supported lesson plans | 5.0 | 5.0 | 0.0 | 95.24% |
| 2 | Using AI for personalized learning | 5.0 | 5.0 | 0.5 | 85.71% |
| 3 | Implementing AI-driven formative assessments | 3.0 | 4.0 | 1.0 | 42.86% |
| 4 | Integrating AI in interdisciplinary curricula | 5.0 | 5.0 | 0.5 | 90.48% |
| 5 | Promoting active learning with AI tools | 5.0 | 5.0 | 0.0 | 95.24% |
| 6 | Conducting AI-supported student evaluations | 5.0 | 5.0 | 0.5 | 90.48% |
| 7 | Supporting collaborative learning with AI technologies | 3.0 | 4.0 | 1.0 | 47.62% |
| 8 | Using AI to enhance classroom engagement | 3.0 | 4.0 | 1.0 | 42.86% |
| 9 | AI-based adaptive learning techniques | 5.0 | 5.0 | 0.0 | 85.71% |
| 10 | Evaluating the effectiveness of AI tools in teaching | 3.0 | 4.0 | 1.0 | 42.86% |

According to Table 4.13, in the second round of the study, 21 experts reached a consensus on 10 effective strategies for training content elements. The rankings from highest to lowest are as follows:

Designing AI-supported lesson plans, Promoting active learning with AI tools (Md=5.0, Mo=5.0, IQR=0.0), Integrating AI in interdisciplinary curricula, Conducting AI-supported student evaluations (Md=5.0, Mo=5.0, IQR=0.5), Using AI for personalized learning, AI-based adaptive learning techniques (Md=5.0, Mo=5.0, IQR=0.5), Among these factors, Implementing AI-driven formative assessments, Supporting collaborative learning with AI technologies, Using AI to enhance classroom engagement, Evaluating the effectiveness of AI tools in teaching had a consensus level below 80%.

**Table 4.14** Results of Round 2: Computational Thinking and Problem-Solving

| Item | Computational Thinking and Problem-Solving | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1 | Algorithmic thinking and problem decomposition | 5.0 | 5.0 | 0.5 | 90.48% |
| 2 | Logical reasoning in AI problem-solving | 5.0 | 5.0 | 0.5 | 90.48% |
| 3 | Designing basic AI models for classroom use | 5.0 | 5.0 | 0.0 | 85.71% |
| 4 | Introducing programming concepts related to AI | 5.0 | 5.0 | 0.0 | 95.24% |
| 5 | Exploring data-driven decision-making processes | 3.0 | 4.0 | 1.0 | 33.33% |
| 6 | Engaging students in AI debugging and troubleshooting | 3.0 | 4.0 | 1.0 | 47.62% |
| 7 | Applying pattern recognition with datasets | 3.0 | 4.0 | 1.0 | 47.62% |
| 8 | Encouraging computational creativity | 4.0 | 5.0 | 0.5 | 80.95% |
| 9 | Gamification using AI tools | 3.0 | 4.0 | 1.0 | 47.62% |
| 10 | Exploring hands-on AI projects with students | 5.0 | 5.0 | 0.0 | 95.24% |

According to Table 4.14, in the second round of the study, 21 experts reached a consensus on 10 effective strategies for training content elements. The rankings from highest to lowest are as follows:

Introducing programming concepts related to AI, Exploring hands-on AI projects with students (Md=5.0, Mo=5.0, IQR=0.0), Algorithmic thinking and problem decomposition, Logical reasoning in AI problem-solving (Md=5.0, Mo=5.0, IQR=0.5), Designing basic AI models for classroom use, Encouraging computational creativity (Md=4.0, Mo=5.0, IQR=0.5), Among these factors, Exploring data-driven decision-

making processes, Engaging students in AI debugging and troubleshooting, Applying pattern recognition with datasets, Gamification using AI tools had a consensus level below 80%.

**Table 4.15** Results of Round 2: Ethics and Responsible AI Use

| Item | Ethics and Responsible AI Use | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1 | AI ethics fundamentals (bias, fairness, accountability) | 3.0 | 4.0 | 1.0 | 47.62% |
| 2 | Promoting inclusive and fair AI applications | 5.0 | 5.0 | 0.0 | 95.24% |
| 3 | Discussing AI's societal and environmental impact | 5.0 | 5.0 | 0.0 | 85.71% |
| 4 | Understanding regulatory frameworks and guidelines | 5.0 | 5.0 | 0.5 | 90.48% |
| 5 | Fostering student discussions on AI dilemmas | 5.0 | 5.0 | 0.5 | 90.48% |
| 6 | Promoting digital citizenship in AI usage | 3.0 | 4.0 | 1.0 | 33.33% |
| 7 | Teaching responsible AI content creation | 3.0 | 4.0 | 1.0 | 42.86% |
| 8 | Safeguarding student data with AI tools | 3.0 | 4.0 | 1.0 | 33.33% |
| 9 | Encouraging transparency in AI use | 4.0 | 5.0 | 0.5 | 80.95% |
| 10 | Balancing technology use and ethical considerations | 4.0 | 5.0 | 0.5 | 80.95% |

According to Table 4.15, in the second round of the study, 21 experts reached a consensus on 10 effective strategies for training content elements. The rankings from highest to lowest are as follows:

Promoting inclusive and fair AI applications, Discussing AI's societal and environmental impact (Md=5.0, Mo=5.0, IQR=0.0), Understanding regulatory frameworks and guidelines, Fostering student discussions on AI dilemmas (Md=5.0, Mo=5.0, IQR=0.5), Encouraging transparency in AI use, Balancing technology use and ethical considerations (Md=4.0, Mo=5.0, IQR=0.5), Among these factors, AI ethics fundamentals, Promoting digital citizenship in AI usage, Teaching responsible AI content creation, Safeguarding student data with AI tools had a consensus level below 80%.

**Table 4.16** Results of Round 2: Professional Development and Lifelong Learning

| Item | Professional Development and Lifelong Learning | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1 | Engaging in AI-focused professional training | 4.0 | 5.0 | 0.5 | 80.95% |
| 2 | Networking with peers for AI teaching strategies | 3.0 | 4.0 | 1.0 | 47.62% |
| 3 | Exploring global AI educational practices | 3.0 | 4.0 | 1.0 | 47.62% |
| 4 | Keeping up with emerging AI technologies | 5.0 | 5.0 | 0.0 | 95.24% |
| 5 | Utilizing online AI learning platforms | 5.0 | 5.0 | 0.5 | 90.48% |
| 6 | Participating in AI education conferences | 4.0 | 5.0 | 0.5 | 80.95% |
| 7 | Creating professional learning communities for AI | 3.0 | 4.0 | 1.0 | 42.86% |
| 8 | Conducting action research on AI in education | 3.0 | 4.0 | 1.0 | 42.86% |
| 9 | Evaluating personal AI teaching competencies | 5.0 | 5.0 | 0.0 | 95.24% |
| 10 | Advocating for policy reforms in AI education | 5.0 | 5.0 | 0.5 | 90.48% |

According to Table 4.16, in the second round of the study, 21 experts reached a consensus on 10 effective strategies for training content elements. The rankings from highest to lowest are as follows:

Keeping up with emerging AI technologies, Evaluating personal AI teaching competencies (Md=5.0, Mo=5.0, IQR=0.0), Utilizing online AI learning platforms, Advocating for policy reforms in AI education (Md=5.0, Mo=5.0, IQR=0.5), Engaging in AI-focused professional training, Participating in AI education conferences (Md=4.0, Mo=5.0, IQR=0.5), Among these factors, Networking with peers for AI teaching strategies, Exploring global AI educational practices, Creating professional learning communities for AI, Conducting action research on AI in education had a consensus level below 80%.

**Table 4.17** Results of Round 2: AI Tools and Resource Management

| Item | AI Tools and Resource Management | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1. | Selecting appropriate AI tools for classroom use | 5.0 | 5.0 | 0.0 | 95.24% |
| 2. | Managing AI-driven administrative tasks | 4.0 | 5.0 | 0.5 | 80.95% |
| 3. | Developing teaching resources with AI assistance | 3.0 | 4.0 | 1.0 | 33.33% |
| 4. | Utilizing AI for classroom organization | 5.0 | 5.0 | 0.5 | 90.48% |
| 5. | Customizing AI tools to fit diverse learning needs | 3.0 | 4.0 | 1.0 | 42.86% |
| 6. | Sharing AI resources with the teaching community | 5.0 | 5.0 | 0.5 | 90.48% |
| 7. | Identifying cost-effective AI solutions | 3.0 | 4.0 | 1.0 | 33.33% |
| 8. | Analyzing the limitations of AI tools in teaching | 3.0 | 4.0 | 1.0 | 42.86% |
| 9. | Troubleshooting common AI tool challenges | 4.0 | 5.0 | 0.5 | 80.95% |
| 10. | Promoting open-source AI educational tools | 5.0 | 5.0 | 0.5 | 90.48% |

According to Table 4.17, in the second round of the study, 21 experts reached a consensus on 10 effective strategies for training content elements. The rankings from highest to lowest are as follows:

Selecting appropriate AI tools for classroom use (Md=5.0, Mo=5.0, IQR=0.0), Utilizing AI for classroom organization, Sharing AI resources with the teaching community, Promoting open-source AI educational tools (Md=5.0, Mo=5.0, IQR=0.5), Managing AI-driven administrative tasks, Troubleshooting common AI tool challenges (Md=4.0, Mo=5.0, IQR=0.5), Among these factors, Developing teaching resources with AI assistance, Customizing AI tools to fit diverse learning needs, Identifying cost-effective AI solutions, Analyzing the limitations of AI tools in teaching had a consensus level below 80%.

**Table 4.18** Results of Round 2: AI-Supported Student Empowerment

| Item | AI-Supported Student Empowerment | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1. | Encouraging students to design AI projects | 3.0 | 4.0 | 1.0 | 42.86% |
| 2. | Promoting computational creativity among students | 4.0 | 5.0 | 0.5 | 80.95% |
| 3. | Mentoring students in AI competitions | 5.0 | 5.0 | 0.5 | 90.48% |
| 4. | Supporting student-led AI research | 5.0 | 5.0 | 0.0 | 95.24% |
| 5. | Fostering critical thinking through AI activities | 4.0 | 5.0 | 0.5 | 80.95% |
| 6. | Teaching students about AI career paths | 3.0 | 4.0 | 1.0 | 33.33% |
| 7. | Developing AI-related extracurricular programs | 5.0 | 5.0 | 0.5 | 90.48% |
| 8. | Supporting students in responsible AI use | 3.0 | 4.0 | 1.0 | 42.86% |
| 9. | Inspiring students to address real-world problems with AI | 4.0 | 5.0 | 0.5 | 80.95% |
| 10. | Promoting collaboration in AI learning | 3.0 | 4.0 | 1.0 | 42.86% |

According to Table 4.18, in the second round of the study, 21 experts reached a consensus on 10 effective strategies for training content elements. The rankings from highest to lowest are as follows:

Supporting student-led AI research (Md=5.0, Mo=5.0, IQR=0.0), Mentoring students in AI competitions, Developing AI-related extracurricular programs (Md=5.0, Mo=5.0, IQR=0.5), Promoting computational creativity among students, Fostering critical thinking through AI activities, Inspiring students to address real-world problems with AI (Md=4.0, Mo=5.0, IQR=0.5), Among these factors, Encouraging students to design AI projects, Teaching students about AI career paths, Supporting students in responsible AI use, Promoting collaboration in AI learning had a consensus level below 80%.

**Table 4.19** Results of Round 2: Systemic Challenges and Institutional Support

| Item | Systemic Challenges and Institutional Support | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1. | Addressing Barriers to AI Adoption in Schools | 3.0 | 4.0 | 1.0 | 42.86% |
| 2. | Advocating for equitable AI access in education | 5.0 | 5.0 | 0.0 | 95.24% |
| 3. | Ensuring inclusive policies for AI integration | 4.0 | 5.0 | 0.5 | 80.95% |
| 4. | Accessing funding for AI tools and training | 5.0 | 5.0 | 0.5 | 90.48% |
| 5. | Building institutional capacity for AI education | 3.0 | 4.0 | 1.0 | 42.86% |
| 6. | Aligning AI practices with school goals | 3.0 | 4.0 | 1.0 | 42.86% |
| 7. | Engaging stakeholders in AI curriculum design | 4.0 | 5.0 | 0.5 | 80.95% |
| 8. | Establishing AI learning environments | 3.0 | 4.0 | 1.0 | 33.33% |
| 9. | Developing standards for AI literacy assessment | 4.0 | 5.0 | 0.5 | 80.95% |
| 10. | Encouraging innovation in AI pedagogy | 4.0 | 5.0 | 0.5 | 80.95% |

According to Table 4.19, in the second round of the study, 21 experts reached a consensus on 10 effective strategies for training content elements. The rankings from highest to lowest are as follows:

Advocating for equitable AI access in education (Md=5.0, Mo=5.0, IQR=0.0), Accessing funding for AI tools and training (Md=5.0, Mo=5.0, IQR=0.5), Ensuring inclusive policies for AI integration (Md=4.0, Mo=5.0, IQR=0.5), Engaging stakeholders in AI curriculum design (Md=4.0, Mo=5.0, IQR=0.5), Developing standards for AI literacy assessment (Md=4.0, Mo=5.0, IQR=0.5), Encouraging innovation in AI pedagogy (Md=4.0, Mo=5.0, IQR=0.5), Addressing Barriers to AI Adoption in Schools(Md=3.0,

Mo=4.0, IQR=1.0), Building institutional capacity for AI education(Md=3.0, Mo=4.0, IQR=1.0), Aligning AI practices with school goals(Md=3.0, Mo=4.0, IQR=1.0), Establishing AI learning environments(Md=3.0, Mo=4.0, IQR=1.0).

Among these factors, Addressing Barriers to AI Adoption in Schools, Building institutional capacity for AI education, Aligning AI practices with school goals, Establishing AI learning environments had a consensus level below 80%.

Based on the statistical analysis of expert opinions from the previous round, modifications were made to the questionnaire for the third round of research.

The results of the third round survey are as follows:

**Table 4.20** Results of the third round: training model elements of teachers' artificial intelligence literacy for Secondary Schools Teachers

| Item | Training model elements of teachers' artificial intelligence literacy for Secondary Schools Teachers | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1. | Cognition | 5.0 | 5.0 | 0.0 | 95.24% |
| 2. | Ethics | 5.0 | 5.0 | 0.5 | 90.48% |
| 3. | AI-Apps | 5.0 | 5.0 | 0.0 | 95.24% |
| 4. | AI-Pedagogy | 5.0 | 5.0 | 0.5 | 90.48% |
| 5. | Development | 5.0 | 5.0 | 0.0 | 95.24% |
| 6. | Evaluation | 5.0 | 5.0 | 0.5 | 90.48% |

According to Table 4.20, in the third round of research, 21 experts reached a consensus on the 6 effective strategies for the elements of the artificial intelligence technology teaching model for Secondary Schools Teachers in Shenzhen Secondary Schools.

The ranking from highest to lowest is as follows: Cognition (Md=5.0, Mo=5.0, IQR=0.0), AI-Apps (Md=5.0, Mo=5.0, IQR=0.0), Development (Md=5.0, Mo=5.0, IQR=0.0), Ethics (Md=5.0, Mo=5.0, IQR=0.5), AI-Pedagogy (Md=5.0, Mo=5.0, IQR=0.5), Evaluation (Md=5.0, Mo=5.0, IQR=0.5).

**Table 4.21** Round 3 Survey Results: Cognition

| Item | Cognition (Foundational AI knowledge and needs) | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1. | Basic AI concepts | 5.0 | 5.0 | 0.0 | 95.24% |
| 2. | Key AI applications in education | 5.0 | 5.0 | 0.5 | 90.48% |
| 3. | Limitations and challenges of AI | 4.0 | 5.0 | 0.5 | 95.24% |
| 4. | Understanding AI data structures and sources | 5.0 | 5.0 | 0.5 | 90.48% |
| 5. | AI's impact on society and economy | 5.0 | 5.0 | 0.0 | 95.24% |
| 6. | Privacy and security issues in AI use | 5.0 | 5.0 | 0.5 | 90.48% |

According to Table 4.21, in the second round of research, 21 experts reached a consensus on the 6 effective strategies for the elements of training needs. They are as follows:

Basic AI concepts (Md=5.0, Mo=5.0, IQR=0.0), Privacy and security issues in AI use (Md=5.0, Mo=5.0, IQR=0.5), Key AI applications in education (Md=5.0, Mo=5.0, IQR=0.5), Understanding AI data structures and sources (Md=5.0, Mo=5.0, IQR=0.5), Limitations and challenges of AI (Md=4.0, Mo=5.0, IQR=0.5), AI's impact on society and economy (Md=5.0, Mo=5.0, IQR=0.0).

**Table 4.22** Round 3 Survey Results: Ethics

| Item | Ethics | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1. | AI ethics fundamentals | 5.0 | 5.0 | 0.5 | 85.71% |
| 2. | Understanding regulatory frameworks and guidelines | 5.0 | 5.0 | 0.5 | 90.48% |
| 3. | Promoting digital citizenship in AI usage | 5.0 | 5.0 | 0.0 | 95.24% |
| 4. | Safeguarding student data with AI tools | 5.0 | 5.0 | 0.5 | 90.48% |
| 5. | Balancing technology use and ethical considerations | 5.0 | 5.0 | 0.0 | 85.71% |

According to Table 4.22, in the second round of research, 21 experts reached a consensus on the 5 effective strategies for the Ethics elements. The rankings from highest to lowest are as follows:

Promoting digital citizenship in AI usage (Md=5.0, Mo=5.0, IQR=0.0), , Understanding regulatory frameworks and guidelines(Md=5.0, Mo=5.0, IQR=0.5), Safeguarding student data with AI tools (Md=5.0, Mo=5.0, IQR=0.5), AI ethics fundamentals (Md=5.0, Mo=5.0, IQR=0.5), Balancing technology use and ethical considerations (Md=5.0, Mo=5.0, IQR=0.0).

**Table 4.23** Round 3 Survey Results: AI-Apps

| Item | AI-Apps | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1. | Using AI for personalized learning | 5.0 | 5.0 | 0.5 | 90.48% |
| 2. | Promoting active learning with AI tools | 5.0 | 5.0 | 0.5 | 90.48% |
| 3. | AI-based adaptive learning techniques | 5.0 | 5.0 | 0.0 | 85.71% |
| 4. | Selecting appropriate AI tools for classroom use | 5.0 | 5.0 | 0.0 | 95.24% |
| 5. | Developing teaching resources with AI assistance | 5.0 | 5.0 | 0.5 | 90.48% |
| 6. | Customizing AI tools to fit diverse learning needs | 5.0 | 5.0 | 0.0 | 95.24% |

According to Table 4.23, in the second round of research, 21 experts reached a consensus on the 6 effective strategies for the AI-Apps elements. The rankings from highest to lowest are as follows:

Selecting appropriate AI tools for classroom use (Md=5.0, Mo=5.0, IQR=0.0), Customizing AI tools to fit diverse learning needs (Md=5.0, Mo=5.0, IQR=0.0), Using AI for personalized learning (Md=5.0, Mo=5.0, IQR=0.5), Promoting active learning with AI tools(Md=5.0, Mo=5.0, IQR=0.5), Developing teaching resources with AI assistance (Md=5.0, Mo=5.0, IQR=0.5), AI-based adaptive learning techniques (Md=5.0, Mo=5.0, IQR=0.0).

**Table 4.24** Round 3 Survey Results: AI-Pedagogy

| Item | AI-Pedagogy | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1. | Designing AI-supported lesson plans | 5.0 | 5.0 | 0.0 | 95.24% |
| 2. | Implementing AI-driven formative assessments | 5.0 | 5.0 | 0.0 | 95.24% |
| 3. | Algorithmic thinking and problem decomposition | 5.0 | 5.0 | 0.5 | 90.48% |
| 4. | Designing basic AI models for classroom use | 5.0 | 5.0 | 0.5 | 90.48% |
| 5. | Exploring data-driven decision-making processes | 5.0 | 5.0 | 0.0 | 95.24% |
| 6. | Applying pattern recognition with datasets | 5.0 | 5.0 | 0.5 | 90.48% |

According to Table 4.24, in the second round of research, 21 experts reached a consensus on the 6 effective strategies for the AI-Pedagogy elements. The rankings from highest to lowest are as follows:

Designing AI-supported lesson plans, Implementing AI-driven formative assessments, Exploring data-driven decision-making processes, Algorithmic thinking and problem decomposition, Designing basic AI models for classroom use, Applying pattern recognition with datasets.

**Table 4.25** Round 3 Survey Results: Development

| Item | Development | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1. | Engaging in AI-focused professional training | 5.0 | 5.0 | 0.0 | 95.24% |
| 2. | Exploring global AI educational practices | 5.0 | 5.0 | 0.5 | 90.48% |
| 3. | Utilizing online AI learning platforms | 5.0 | 5.0 | 0.5 | 90.48% |
| 4. | Creating professional learning communities for AI | 5.0 | 5.0 | 0.5 | 90.48% |
| 5. | Participating in AI education conferences | 5.0 | 5.0 | 0.0 | 95.24% |
| 6. | Advocating for AI policy reforms in education | 5.0 | 5.0 | 0.5 | 90.48% |

According to Table 4.25, in the second round of research, 21 experts reached a consensus on the 6 effective strategies for the elements of Development. The rankings from highest to lowest are as follows:

Engaging in AI-focused professional training (Md=5.0, Mo=5.0, IQR=0.0), Participating in AI education conferences (Md=5.0, Mo=5.0, IQR=0.0), Exploring global AI educational practices (Md=5.0, Mo=5.0, IQR=0.5), Utilizing online AI learning platforms(Md=5.0, Mo=5.0, IQR=0.5), Creating professional learning communities for AI (Md=5.0, Mo=5.0, IQR=0.5), Advocating for AI policy reforms in education (Md=5.0, Mo=5.0, IQR=0.5).

**Table 4.26** Round 3 Survey Results: Evaluation

| Item | Evaluation | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1. | Evaluating the effectiveness of AI tools in teaching | 5.0 | 5.0 | 0.5 | 90.48% |
| 2. | Troubleshooting common AI tool challenges | 5.0 | 5.0 | 0.0 | 95.24% |
| 3. | Encouraging students to design AI projects | 5.0 | 5.0 | 0.5 | 90.48% |
| 4. | Teaching students about AI career paths | 5.0 | 5.0 | 0.5 | 90.48% |
| 5. | Addressing barriers to AI adoption in schools | 4.0 | 5.0 | 0.5 | 80.95% |
| 6. | Developing standards for AI literacy assessment | 5.0 | 5.0 | 0.5 | 90.48% |
| 7. | Aligning AI practices with school goals | 5.0 | 5.0 | 0.0 | 95.24% |

According to Table 4.26, in the second round of research, 21 experts reached a consensus on the 6 effective strategies for the elements of Evaluation. The rankings from highest to lowest are as follows:

Troubleshooting common AI tool challenges (Md=5.0, Mo=5.0, IQR=0.0), Aligning AI practices with school goals (Md=5.0, Mo=5.0, IQR=0.0), Evaluating the effectiveness of AI tools in teaching (Md=5.0, Mo=5.0, IQR=0.0), Encouraging students to design AI projects (Md=5.0, Mo=5.0, IQR=0.5), Teaching students about AI career paths (Md=5.0, Mo=5.0, IQR=0.5), Developing standards for AI literacy assessment (Md=5.0, Mo=5.0, IQR=0.5), Addressing barriers to AI adoption in schools (Md=4.0, Mo=5.0, IQR=0.5).

Based on the relevant opinions and suggestions put forward by experts on the selection of indicators, the influencing factors of the AI literacy model for middle school teachers in Shenzhen were modified, merged, and supplemented. The AI

literacy model for teachers was finally determined. Compared with the original selected indicators, 8 indicator factors were modified to 6 indicator factors, ranked in order of importance: foundation and cognition, ethics and social responsibility, AI applications, AI-Pedagogy, Development, and Evaluation. The secondary indicators were reduced from 80 to 36, and 44 were deleted.

The final study shows that the teachers' artificial intelligence literacy model consists of 6 main indicator factors and 36 secondary indicator factors (Table 3). The specific contents are as follows: foundation and cognition, ethics and social responsibility, AI applications, AI-Pedagogy, Development, and Evaluation.

In summary, Artificial Intelligence Literacy Model for Secondary Schools Teachers (Figure 4.1) consists of 6 main indicator factors and 36 secondary indicator factors. See *Teachers' Artificial Intelligence Literacy Improvement Model (TAILM) User Manual* at Appendix B (p.210).

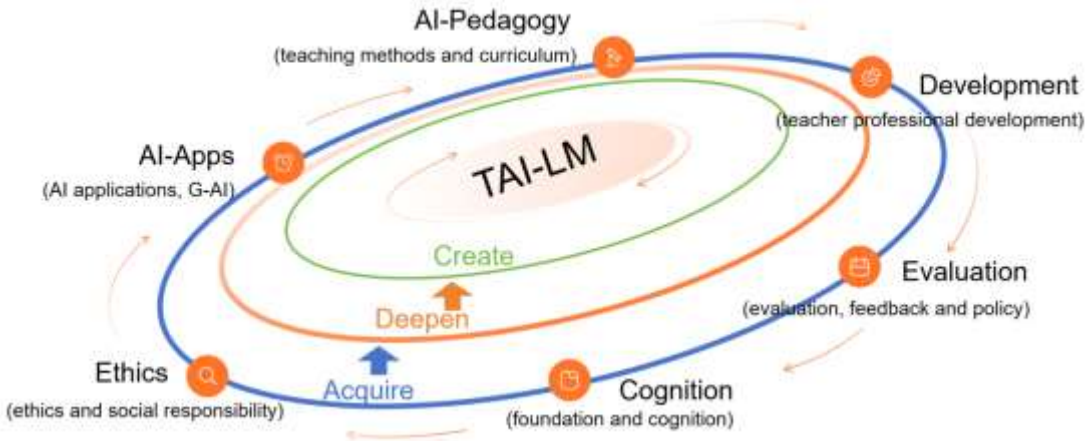



**Figure 4.1** Teachers' Artificial Intelligence Literacy Model (TAILM)

The 6 effective strategies for Cognition (Foundational AI knowledge and needs) element are: Basic AI concepts, Key AI applications in education, Limitations and challenges of AI, Understanding AI data structures and sources, AI's impact on society and economy, and Privacy and security issues in AI use.

The 5 effective strategies for the Ethics (Ethics and Social Responsibility) element are: AI ethics fundamentals, Understanding regulatory frameworks and guidelines, Promoting digital citizenship in AI usage, Safeguarding student data with AI tools, and Balancing technology use and ethical considerations.

The 6 effective strategies for the AI-Apps (AI Applications, Especially Generative AI) element are: Using AI for personalized learning, Promoting active learning with AI tools, AI-based adaptive learning techniques, Selecting appropriate AI tools for classroom use, Developing teaching resources with AI assistance, and Customizing AI tools to fit diverse learning needs.

The 6 effective strategies for the AI-Pedagogy (Teaching Methods and Curriculum) element are: Designing AI-supported lesson plans, Implementing AI-driven formative assessments, Algorithmic thinking and problem decomposition, Designing basic AI models for classroom use, Exploring data-driven decision-making processes, and Applying pattern recognition with datasets.

The 6 effective strategies for the Development (Teacher Professional Development) element are: Engaging in AI-focused professional training, Exploring global AI educational practices, Utilizing online AI learning platforms, Creating professional learning communities for AI, Participating in AI education conferences, and Advocating for AI policy reforms in education.

The 7 effective strategies for the Evaluation (Evaluation, Feedback, and Policy) element are: Evaluating the effectiveness of AI tools in teaching, Troubleshooting common AI tool challenges, Encouraging students to design AI projects, Teaching students about AI career paths, Addressing barriers to AI adoption in schools, Developing standards for AI literacy assessment, and Aligning AI practices with school goals.

**Research Objectives 3** To evaluate the teachers' artificial intelligence literacy improvement model (TAILM)

**Part Four:** Constructing the AI literacy model of middle school teachers in Shenzhen through qualitative analysis.

**Data analysis results**

30 teachers from 5 middle schools in Shenzhen were randomly selected, and their ages were divided into three age groups: 20-25 years old, 25-30 years old, and over 30 years old, with 10 teachers in each age group. 30 teachers from three teaching experience groups of 1-5 years, 5-10 years, and over 10 years were randomly selected, with 10 teachers in each experience group. Through the different teacher training results before and after the implementation of the built model, training content is provided for teachers to verify the training effect. The implementation of the training is based on the scores obtained by the selection of each element of the model. The specific process is as follows:

**Implementation plan for AI literacy training for middle school teachers:**

**Training Theme:**

Courage in the Face of AI literacy Challenges.

**Training Objectives:**

1. Enhance the information technology application level of middle schoolteachers and strengthen their teaching abilities in information technology.

2. Help teachers understand the importance of AI technology in ducation and be able to flexibly apply it in their daily teaching practices.

3. Cultivate teachers' innovative awareness of information technology teaching methods, promote overall improvement in the level of information technology teaching.

**Training Content:**

1. Popularization of Basic AI Technology Knowledge: Including basic computer operations, AI knowledge, commonly used office software, etc.

2. Application of Information Technology in Education: Introducing the acquisition and utilization of AI teaching resources, multimedia teaching design, virtual laboratories, etc.

3. AI Technology Teaching Methods: Discussing how AI technology can be integrated into teaching various subjects to improve teaching effectiveness.

4. Practical Operation Segment: Organizing teachers to engage in practical operations to reinforce the knowledge learned.

**Training Formats:**

1. Theoretical Lectures: Inviting professionals to explain AI technology teaching methods, allowing teachers to understand the latest teaching concepts and methods.

2. Practical Operations: Setting up laboratories or computer classrooms for teachers to operate hands-on and master AI skills.

3. Group Discussions: Organizing teachers into groups for discussions to share experiences and insights, promoting communication and cooperation.

4. Case Studies: Guiding teachers to think about the application of AI technology in teaching through real case studies.

**Training Evaluation:**

1. Conduct pre- and post-training surveys to understand the changes in teachers' understanding and attitudes towards AI technology teaching.

2. Observe the application of AI technology by teachers in actual teaching to evaluate the effectiveness of the training.

3. Regularly track the teaching outcomes of teachers in AI technology, providing necessary guidance and support.

**Post-Training Support:**

1. Establish an AI technology teaching exchange platform where teachers can share resources and experiences.

2. Organize regular AI technology teaching seminars to promote communication and learning among teachers.

3. Provide personalized coaching and guidance to help teachers address issues encountered in AI technology teaching.

**Training Effectiveness Evaluation**

The effectiveness of teacher training will be evaluated from the following two aspects:

Firstly, based on the AI technology teaching method training model for teachers in Shenzhen City, the training itself will be evaluated. This evaluation will primarily focus on the satisfaction of the trainees with the training outcomes after completing the training. It includes assessing the satisfaction levels of Cognition, Ethics, AI-Apps, AI-Pedagogy, Development, and Evaluation.

Secondly, the evaluation will focus on the model itself, allowing participants to pay attention to the established comprehensive AI technology teaching method training model for teachers in Shenzhen City. Participants will assess whether the model implementation process effectively achieved the training objectives, values, and significance. Before and after the training implementation, the effectiveness of the training will be measured through pre-training and post-training assessments of the participants to confirm the effectiveness of the AI technology teaching method training model for teachers in Shenzhen City.

**Development of Testing Tool**

In this study, based on the established AI technology teaching method training model for teachers in Shenzhen City, a satisfaction questionnaire for the comprehensive AI technology teaching method training model was developed. After the preliminary formation of the questionnaire, it was submitted to five experts for feedback to examine the language applicability, completeness, and comprehensiveness, and improvements were made based on their suggestions. Following the revisions, the “Teacher AI Technology Teaching Method Training Model Satisfaction Questionnaire” was validated by the five experts using the IOC method. They believed that the instrument demonstrated good consistency and could be used for course satisfaction testing. The consistency test between the expert satisfaction questionnaire and this course is shown in Table 4.27.

**Table 4.27** Data analysis of consistency evaluation of teachers' AI Technology Teaching Methods

| NO. | Elements of teacher AI technology teaching method training model | Consistency |
|---|---|---|
| **Cognition (Foundation and Cognition)** | | |
| 1 | Basic AI concepts | 1.0 |
| 2 | Key AI applications in education | 0.8 |
| 3 | Limitations and challenges of AI | 1.0 |
| 4 | Understanding AI data structures and sources | 1.0 |
| 5 | AI's impact on society and economy | 1.0 |
| 6 | Privacy and security issues in AI use | 1.0 |
| **Ethics (Ethics and Social Responsibility)** | | |
| 7 | AI ethics fundamentals | 1.0 |
| 8 | Understanding regulatory frameworks and guidelines | 1.0 |
| 9 | Promoting digital citizenship in AI usage | 1.0 |
| 10 | Safeguarding student data with AI tools | 0.8 |
| 11 | Balancing technology use and ethical considerations | 1.0 |
| **AI-Apps (AI Applications, Generative AI)** | | |
| 12 | Using AI for personalized learning | 1.0 |
| 13 | Promoting active learning with AI tools | 1.0 |
| 14 | AI-based adaptive learning techniques | 0.8 |
| 15 | Selecting appropriate AI tools for classroom use | 1.0 |
| 16 | Developing teaching resources with AI assistance | 0.8 |
| 17 | Customizing AI tools to fit diverse learning needs | 1.0 |
| **AI-Pedagogy (Teaching Methods and Curriculum)** | | |
| 18 | Designing AI-supported lesson plans | 1.0 |
| 19 | Implementing AI-driven formative assessments | 1.0 |
| 20 | Algorithmic thinking and problem decomposition | 1.0 |
| 21 | Designing basic AI models for classroom use | 1.0 |

**Table 4.27** (Continued)

| NO. | Elements of teacher AI technology teaching method training model | Consistency |
|---|---|---|
| 22 | Exploring data-driven decision-making processes | 1.0 |
| 23 | Applying pattern recognition with datasets | 1.0 |
| **Development (Teacher Professional Development)** | | |
| 24 | Engaging in AI-focused professional training | 0.8 |
| 25 | Exploring global AI educational practices | 1.0 |
| 26 | Utilizing online AI learning platforms | 1.0 |
| 27 | Creating professional learning communities for AI | 1.0 |
| 28 | Participating in AI education conferences | 0.8 |
| 29 | Advocating for AI policy reforms in education | 1.0 |
| **Evaluation (Evaluation, Feedback, and Policy)** | | |
| 30 | Evaluating the effectiveness of AI tools in teaching | 1.0 |
| 31 | Troubleshooting common AI tool challenges | 1.0 |
| 32 | Encouraging students to design AI projects | 0.8 |
| 33 | Teaching students about AI career paths | 1.0 |
| 34 | Addressing barriers to AI adoption in schools | 1.0 |
| 35 | Developing standards for AI literacy assessment | 1.0 |
| 36 | Aligning AI practices with school goals | 1.0 |

To evaluate the effectiveness of the model, this study, in conjunction with the established artificial intelligence technology teaching method training model for teachers, developed pre-test and post-test questionnaires to assess changes in teacher training satisfaction and evaluate the artificial intelligence technology teaching method training model. After the preliminary formation of the questionnaire, it was submitted to five experts for their feedback to examine the language applicability, completeness, and comprehensiveness, and improvements were made based on their suggestions. Following the revisions, the innovative

entrepreneurship ability test questionnaire was validated by the five experts using the IOC method, who believed that the questionnaire demonstrated good consistency and could be used for course satisfaction testing.

**Data Analysis**

The satisfaction questionnaire for the artificial intelligence technology teaching method training model for teachers was used to assess the satisfaction of teachers participating in the training. A total of 30 teachers participated in this test, and responses to 36 factor indicators in the model were collected, all of which were considered valid. The data analysis of teacher satisfaction with the artificial intelligence technology teaching method training model during the training process is shown in Table 4.28.

**Table 4.28** Analysis of satisfaction data of teachers

| NO. | Assess the project | $\bar{X}$ | S.D. | Suitable |
|---|---|---|---|---|
| **Cognition (Foundation and Cognition)** | | | | |
| 1 | Basic AI concepts | 3.48 | 0.90 | Very high |
| 2 | Key AI applications in education | 3.83 | 0.88 | Very high |
| 3 | Limitations and challenges of AI | 3.53 | 0.89 | high |
| 4 | Understanding AI data structures and sources | 3.49 | 0.98 | Very high |
| 5 | AI's impact on society and economy | 3.74 | 0.91 | high |
| 6 | Privacy and security issues in AI use | 3.70 | 0.89 | high |
| **Ethics (Ethics and Social Responsibility)** | | | | |
| 7 | AI ethics fundamentals | 3.45 | 0.89 | Very high |
| 8 | Understanding regulatory frameworks and guidelines | 3.73 | 0.90 | high |
| 9 | Promoting digital citizenship in AI usage | 3.63 | 0.89 | high |
| 10 | Safeguarding student data with AI tools | 3.47 | 0.92 | high |
| 11 | Balancing technology use and ethical considerations | 4.13 | 1.01 | Very high |

**Table 4.28** (Continued)

| NO. | Assess the project | $\overline{X}$ | S.D. | Suitable |
|---|---|---|---|---|
| **AI-Apps (AI Applications, Generative AI)** | | | | |
| 12 | Using AI for personalized learning | 4.06 | 0.99 | Very high |
| 13 | Promoting active learning with AI tools | 3.64 | 0.95 | Very high |
| 14 | AI-based adaptive learning techniques | 3.48 | 1.02 | high |
| 15 | Selecting appropriate AI tools for classroom use | 3.85 | 0.88 | Very high |
| 16 | Developing teaching resources with AI assistance | 3.50 | 0.85 | Very high |
| 17 | Customizing AI tools to fit diverse learning needs | 3.80 | 0.89 | high |
| **AI-Pedagogy (Teaching Methods and Curriculum)** | | | | |
| 18 | Designing AI-supported lesson plans | 3.49 | 0.94 | high |
| 19 | Implementing AI-driven formative assessments | 3.62 | 1.02 | high |
| 20 | Algorithmic thinking and problem decomposition | 3.54 | 0.88 | high |
| 21 | Designing basic AI models for classroom use | 4.15 | 0.78 | Very high |
| 22 | Exploring data-driven decision-making processes | 3.94 | 0.94 | high |
| 23 | Applying pattern recognition with datasets | 3.83 | 0.89 | High |
| **Development (Teacher Professional Development)** | | | | |
| 24 | Engaging in AI-focused professional training | 3.63 | 0.79 | Very high |
| 25 | Exploring global AI educational practices | 3.59 | 0.78 | Very high |
| 26 | Utilizing online AI learning platforms | 3.81 | 1.02 | Very high |
| 27 | Creating professional learning communities for AI | 3.47 | 1.03 | Very high |

**Table 4.28** (Continued)

| NO. | Assess the project | $\bar{X}$ | S.D. | Suitable |
|---|---|---|---|---|
| 28 | Participating in AI education conferences | 3.55 | 1.01 | Very high |
| 29 | Advocating for AI policy reforms in education | 3.98 | 0.89 | high |
| **Evaluation (Evaluation, Feedback, and Policy)** | | | | |
| 30 | Evaluating the effectiveness of AI tools in teaching | 3.82 | 0.88 | high |
| 31 | Troubleshooting common AI tool challenges | 3.83 | 0.92 | Very high |
| 32 | Encouraging students to design AI projects | 3.53 | 1.02 | Very high |
| 33 | Teaching students about AI career paths | 3.94 | 0.94 | high |
| 34 | Addressing barriers to AI adoption in schools | 3.82 | 0.88 | high |
| 35 | Developing standards for AI literacy assessment | 3.55 | 1.01 | Very high |
| 36 | Aligning AI practices with school goals | 3.74 | 0.91 | Very high |

Analysis of Pre-test and Post-test Changes Based on the Model for Teacher Training

The use of the artificial intelligence technology teaching method training model has had a significant impact on addressing issues in Secondary School Teacher training. Refer to Table 4.28.

**Table 4.29** Analysis of pre-test and post-test comparison data of changes in teacher training

| NO. | Test item | N | Before evaluation $\overline{X}$ | After evaluation $\overline{X}$ | T | P | D-value |
|---|---|---|---|---|---|---|---|
| 1 | Whether the six factors of Cognition (Foundation and Cognition) have an impact on teacher training. | 30 | 6.43 | 8.38 | -7.440 | <0.05 | 1.83 |
| 2 | Whether the five factors of the Ethics (Ethics and Social Responsibility) have an influence on the teacher training. | 30 | 6.60 | 7.28 | -7.696 | <0.05 | 1.87 |
| 3 | Whether the six factors of AI-Apps (AI Applications, Generative AI) have an impact on teacher training. | 30 | 6.36 | 8.68 | -6.413 | <0.05 | 1.60 |
| 4 | Whether the six factors of the AI-Pedagogy (Teaching Methods and Curriculum) had an influence on teacher training. | 30 | 6.83 | 8.15 | -7.160 | <0.05 | 2.05 |
| 5 | Whether the six factors of the Development (Teacher Professional Development) have an influence on the teacher training. | 30 | 6.83 | 7.59 | -6.846 | <0.05 | 2.03 |
| 6 | Whether the seven factors of the Evaluation (Evaluation, Feedback, and Policy) had an impact on teacher training. | 30 | 6.75 | 8.18 | -6.432 | <0.05 | 1.78 |

Based on Table 4.29, it can be observed from the data that in all six test items, the average scores after evaluation were higher than the average scores before evaluation. Furthermore, based on the results with a p-value less than 0.05, we can conclude that the score changes after evaluation in these test items are significant, indicating a positive impact of the training on teacher development. By comparing the D-values, we can see that the magnitude of score changes after evaluation varies slightly across different test items. For example, in the AI-Pedagogy (Teaching Methods and Curriculum) item, the score increased by 2.05 points, while in the Development (Teacher Professional Development) item, the score increased by 2.03 points.

Overall, these data indicate that the use of the artificial intelligence technology teaching method training model is effective in enhancing teachers' abilities and performance, and positive outcomes have been achieved in various aspects of the training.

Nine experts were invited to evaluate the model, and the final model was determined from it. Requirements for expert qualification: 1) More than 10 years of education experience, familiar with the integration of AI technology in Secondary School Teacher training related business.2) Experts with master's degree or above, associate professor or above.3) Have more than 10 years of teaching experience, familiar with the integrated AI technology methods of Secondary School Teacher training related business, with education master's degree or above and senior professional title.

**Table 4.30** Model evaluation of expert personal information

| | **Personal Information** | **Frequency** | **%** |
|---|---|---|---|
| Gender | Male | 7 | 78.0% |
| | Female | 2 | 22.0% |
| | **Total** | **9** | |
| Age | Age 40-49 | 8 | 89.0% |
| | Over 50 years old | 1 | 11.0% |
| | **Total** | **9** | |
| working life | 10-20 Years | 7 | 78.0% |
| | More than 20 years | 2 | 22.0% |
| | **Total** | **9** | |
| Professional title | Secondary School Senior Teacher (Associate Senior Professional) | 6 | 66.0% |
| | Professor | 3 | 34.0% |
| | **Total** | **9** | |
| Educational background | Degree of Master | 5 | 56.0% |
| | Degree of Doctor | 4 | 44.0% |
| | **Total** | **9** | |
| professional background | Education and teaching experience | 7 | 78.0% |
| | Information technology | 2 | 22.0% |
| | **Total** | **9** | |

Table 4.30 shows that 2 males, accounting for 22.0% and 7 females, accounting for 78.0%. In terms of age distribution, 8 people were aged 40-49, accounting for 89.0%, and 1 person was aged 50 and above, accounting for 11.0%. In terms of many years of work experience, 7 participants had 10-20 years of work experience, or 78.0%, and two participants had more than 20 years of work

experience, accounting for 22.0%. Among them, there were six associate professors, accounting for 66.0%, and there were three professors, accounting for 34.0%. In terms of educational background, there are 5 master's degrees, accounting for 56.0%, and 4 doctor's degrees, accounting for 44.0%. In terms of professional background, 7 people have education and teaching experience, accounting for 78.0%, and 2 people have information technology experience, accounting for 22.0%.

**Table 4.31** Discussion Results of Training Model of artificial intelligence Technology Teaching Methods for Secondary School Teachers in Shenzhen City (Main Project Factors)

| Item | Training model elements of artificial intelligence technology teaching methods for Secondary School Teachers | Result |
|---|---|---|
| 1 | Cognition | Agree |
| 2 | Ethics | Agree |
| 3 | AI-Apps | Agree |
| 4 | AI-Pedagogy | Agree |
| 5 | Development | Agree |
| 6 | Evaluation | Agree |

Based on Table 4.31, after discussions on the six items mentioned above, the project received unanimous approval from 9 experts. This indicates that the main indicators of the artificial intelligence technology teaching method training model for Secondary School Teachers in Shenzhen City have high reliability.

**Table 4.32** Discussion Results of Training Model of artificial intelligence Technology Teaching Methods for Secondary School Teachers in Shenzhen City (Secondary project factors)

| Item | Training model elements of artificial intelligence technology teaching methods for Secondary School Teachers | Result |
|---|---|---|
| **Cognition** | | |
| 1 | Basic AI concepts | Agree |
| 2 | Key AI applications in education | Agree |
| 3 | Limitations and challenges of AI | Agree |
| 4 | Understanding AI data structures and sources | Agree |
| 5 | AI's impact on society and economy | Agree |
| 6 | Privacy and security issues in AI use | Agree |
| **Ethics** | | |
| 7 | AI ethics fundamentals | Agree |
| 8 | Understanding regulatory frameworks and guidelines | Agree |
| 9 | Promoting digital citizenship in AI usage | Agree |
| 10 | Safeguarding student data with AI tools | Agree |
| 11 | Balancing technology use and ethical considerations | Agree |
| **AI-Apps** | | |
| 12 | Using AI for personalized learning | Agree |
| 13 | Promoting active learning with AI tools | Agree |
| 14 | AI-based adaptive learning techniques | Agree |
| 15 | Selecting appropriate AI tools for classroom use | Agree |
| 16 | Developing teaching resources with AI assistance | Agree |
| 17 | Customizing AI tools to fit diverse learning needs | Agree |
| **AI-Pedagogy** | | |
| 18 | Designing AI-supported lesson plans | Agree |
| 19 | Implementing AI-driven formative assessments | Agree |

**Table 4.32** (Continued)

| Item | Training model elements of artificial intelligence technology teaching methods for Secondary School Teachers | Result |
|---|---|---|
| 20 | Algorithmic thinking and problem decomposition | Agree |
| 21 | Designing basic AI models for classroom use | Agree |
| 22 | Exploring data-driven decision-making processes | Agree |
| 23 | Applying pattern recognition with datasets | Agree |
| **Development** | | |
| 24 | Engaging in AI-focused professional training | Agree |
| 25 | Exploring global AI educational practices | Agree |
| 26 | Utilizing online AI learning platforms | Agree |
| 27 | Creating professional learning communities for AI | Agree |
| 28 | Participating in AI education conferences | Agree |
| 29 | Advocating for AI policy reforms in education | Agree |
| **Evaluation** | | |
| 30 | Financial Support | Agree |
| 31 | Evaluation Content | |
| 32 | Formative Assessment | Agree |
| 33 | Training Effectiveness Evaluation | Agree |
| 34 | Participation Assessment | Agree |
| 35 | Continuous Monitoring Evaluation | Agree |
| 36 | Satisfaction Assessment | Agree |

According to Table 4.32, after discussing the above 36 items, this project was unanimously recognized by 9 experts. Based on the feedback from the experts, the guiding principles of the model were modified. Compared with the second round of impact indicators, 6 key indicators remained unchanged. They are: Cognition, Ethics, AI-Apps, AI-Pedagogy, Development, and Evaluation.

There are 36 minor indicators. The Cognition element includes: Basic AI concepts, Key AI applications in education, Limitations and challenges of AI, Understanding AI data structures and sources, AI's impact on society and economy, and Privacy and security issues in AI use.

The Ethics element includes: AI ethics fundamentals, Understanding regulatory frameworks and guidelines, Promoting digital citizenship in AI usage, Safeguarding student data with AI tools, and Balancing technology use and ethical considerations.

The AI-Apps element includes: Using AI for personalized learning, Promoting active learning with AI tools, AI-based adaptive learning techniques, Selecting appropriate AI tools for classroom use, Developing teaching resources with AI assistance, and Customizing AI tools to fit diverse learning needs.

The AI-Pedagogy element includes: Designing AI-supported lesson plans, Implementing AI-driven formative assessments, Algorithmic thinking and problem decomposition, Designing basic AI models for classroom use, Exploring data-driven decision-making processes, and Applying pattern recognition with datasets.

The Development element includes: Engaging in AI-focused professional training, Exploring global AI educational practices, Utilizing online AI learning platforms, Creating professional learning communities for AI, Participating in AI education conferences, and Advocating for AI policy reforms in education.

The Evaluation element includes: Evaluating the effectiveness of AI tools in teaching, Troubleshooting common AI tool challenges, Encouraging students to design AI projects, Teaching students about AI career paths, Addressing barriers to AI adoption in schools, Developing standards for AI literacy assessment, and Aligning AI practices with school goals.

Through this study, the Secondary School Teacher artificial intelligence technology teaching method training model was further confirmed. The evaluation results of the project indicate that the model has a significant effect. The model was also validated by expert interviews using the focus group interview method. Subsequently, the model was designed and explained. The final revised version

generated the Secondary School Teacher artificial intelligence technology teaching method training model (Figure 4.2). See *Teachers' Artificial Intelligence Literacy Improvement Model (TAILM) User Manual* at Appendix B (P.210).

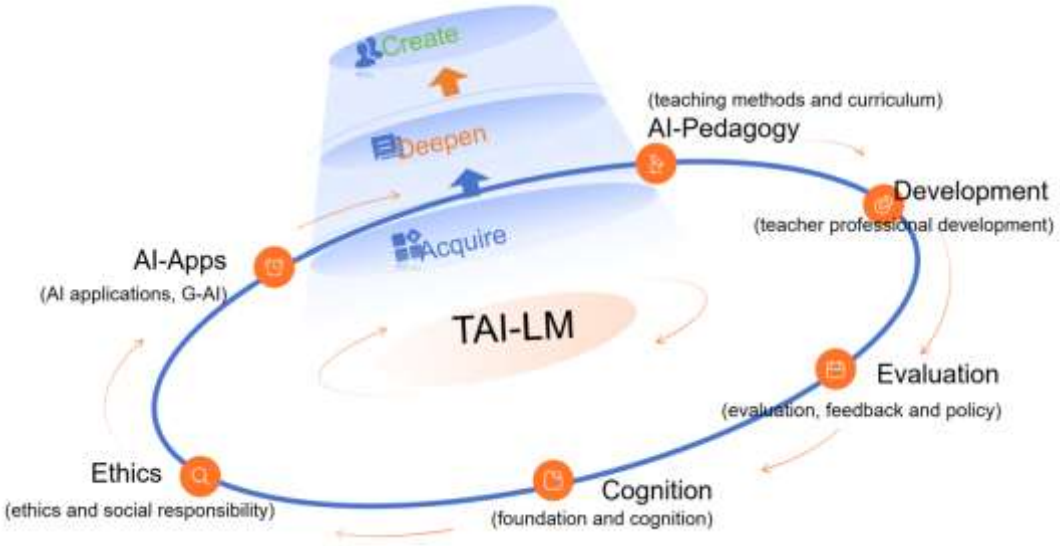



**Figure 4.2** teachers' Artificial Intelligence Literacy Model
(TAILM modified version)

**Part Five:** Description of the teachers' Artificial Intelligence Literacy Model (TAILM modified version) for the Secondary School of Shenzhen City.

Through interviews and literature reviews, researchers identified the current six main issues in Secondary School Teacher training and corresponding strategies. These issues include: Cognition, Ethics, AI-Apps, AI-Pedagogy, Development, Evaluation. Thirty-six corresponding strategies were proposed, as shown in Tables 4.21 to 4.26.

Based on the research results of research objective 1, a artificial intelligence technology teaching method training model for Secondary School Teachers was designed. Through three rounds of expert interviews, a model consisting of 6 main indicator factors and 36 minor indicator factors was established, as shown in Figure 4.1.

# Chapter 5
# Conclusion Discussion and Recommendations

The purpose of this study is to develop a teachers' artificial intelligence literacy improvement model for secondary schools in Shenzhen City. To achieve this, three specific objectives are proposed: 1) To study the current level of knowledge of secondary schools teachers' artificial intelligence literacy. 2) To develop a teachers' artificial intelligence literacy improvement model for secondary schools. 3) To evaluate the teachers' artificial intelligence literacy improvement model (TAILM).

## Conclusion

**Research Objectives 1** To discuss the problems existing in the current training mode in secondary schools teachers' artificial intelligence literacy.

This study systematically investigates AI literacy training deficiencies among secondary school teachers through mixed-methods research involving literature analysis, expert interviews (N=21), and survey assessments. The analysis reveals five systemic limitations in current training frameworks: (1) disconnection between theoretical content and classroom applications, (2) inadequate resource allocation, (3) reliance on obsolete pedagogical approaches, (4) absence of differentiated training pathways, and (5) deficient outcome tracking mechanisms. These shortcomings were examined through an eight-dimensional competency model encompassing foundational knowledge, pedagogical integration, computational thinking, ethical considerations, professional development, tool management, student empowerment, and institutional support.

The findings demonstrate significant disparities between theoretical understanding and practical implementation. While foundational AI concepts and tool administration achieved universal expert consensus (100%), critical gaps emerged in contextual application areas: only 64.9% proficiency in societal impact analysis and 47.6% competency in open-source tool adoption. Instructional competencies exhibited similar dichotomies, with lesson design receiving full

endorsement but tool efficacy evaluation scoring merely 52.3%. Systemic analysis identified ethical training (57.2% consensus) and student empowerment (47.6%) as primary vulnerability areas, particularly in data protection (57.1%) and authentic problem-solving applications (52.3%). Median frequency prioritization (Md=3.0) confirmed these components as the least addressed, falling below 80% consensus thresholds.

To address these challenges, the proposed teachers' artificial intelligence literacy improvement model advocates a framework: (1) strengthening core technical-pedagogical competencies, (2) implementing ethical guidelines for responsible AI integration, (3) developing student-centered innovation protocols, and (4) establishing institutional support mechanisms for resource allocation and policy alignment. The model emphasizes cross-sector collaboration, hands-on tool training, and robust evaluation systems as critical enablers for sustainable AI education reform. These interventions collectively aim to bridge the identified theory-practice divide while fostering ethically grounded, student-driven AI applications in modern pedagogical contexts.

Based on the frequency of appearance of the main factors, a Artificial Intelligence Literacy Model for Secondary Schools Teachers in Shenzhen City was developed. The results show that the primary goal of this study has been achieved. Through interviewing and grading the main problems existing in the training of teachers, a Artificial Intelligence Literacy Model for Secondary Schools Teachers including 8 main factors is established, which provides the basis for developing the questionnaire structure of the training model. The resulting AI Literacy Model, structured around these eight dimensions, provides a framework for targeted training programs. Future efforts must prioritize ethical guidelines, student-driven learning, and hands-on tool training, alongside strengthened policy support and evaluation systems, to advance AI’s transformative role in education through systemic reform.

**Research Objectives 2** To design a Artificial Intelligence Literacy Model for Secondary Schools Teachers

**Design Process:** Building on identified deficiencies (8 core factors, 80 sub-factors), a questionnaire-based framework integrating teacher training theories was developed. Iterative expert consultations (N=21) validated components, with two Delphi rounds refining the model. A third-round analysis finalized the structure.

**Outcomes:** Initial factors (median rankings: Md=3.0–5.0) revealed low consensus (<80%) in Key AI Applications, Data Roles, and AI Limitations. Post-revision, these were eliminated, consolidating the model into 6 prioritized domains: Cognition (foundational concepts, societal impacts), Ethics (privacy/security), AI-Apps (educational tools), AI-Pedagogy (integration strategies), Development (lifelong learning), and Evaluation (systemic metrics). Sub-factors were streamlined from 80 to 36, enhancing focus on actionable competencies.

**Validation:** Expert consensus ensured alignment with practical needs, emphasizing ethical AI use, pedagogical relevance, and measurable outcomes. The final model addresses critical gaps in teacher training while optimizing resource efficiency.

**Research Objectives 3** To evaluate the Teachers Artificial Intelligence Literacy Model for Secondary Schools

In the research Objectives 3, first, through qualitative analysis, the Artificial Intelligence technology teaching method training model for teachers in Shenzhen City was tested, analyzed, and compared. The training content was delivered to teachers, and the effectiveness of the training model created was validated by comparing the abilities of different teachers before and after implementation. In all six test projects, the average scores after evaluation were higher than the average scores before evaluation. Furthermore, based on the results with a P-value less than 0.05, we can conclude that the score changes after evaluation in these test projects are significant, indicating a positive impact of the training on teacher development. By comparing the D-values, we can see that the magnitude of score changes after evaluation varies slightly in different test projects. For example, in the AI-Pedagogy

(Teaching Methods and Curriculum) project, the score increased by 2.05 points, while in the Development (Teacher Professional Development) project, the score increased by 2.03 points. These data indicate that using the Artificial Intelligence technology teaching method training model is effective in enhancing teachers' abilities and effectiveness, and positive results have been achieved in various aspects of training.

Furthermore, through expert interviews, an evaluation was conducted on the design of the Artificial Intelligence technology teaching method training model for Secondary School Teachers. After discussions on the above 6 main indicators and 36 minor indicators, the project received unanimous approval from 9 experts.

Based on expert opinions, revisions were made to the guiding principles of the model. Compared to the second round of impact indicators, 6 key indicators remained unchanged. They are: Cognition, Ethics, AI-Apps, AI-Pedagogy, Development, Evaluation. There are 36 minor indicators. The 6 effective strategies for Cognition (Foundational AI knowledge and needs) element are: Basic AI concepts, Key AI applications in education, Limitations and challenges of AI, Understanding AI data structures and sources, AI’s impact on society and economy, and Privacy and security issues in AI use. The 5 effective strategies for the Ethics (Ethics and Social Responsibility) element are: AI ethics fundamentals, Understanding regulatory frameworks and guidelines, Promoting digital citizenship in AI usage, Safeguarding student data with AI tools, and Balancing technology use and ethical considerations. The 6 effective strategies for the AI-Apps (AI Applications, Especially Generative AI) element are: Using AI for personalized learning, Promoting active learning with AI tools, AI-based adaptive learning techniques, Selecting appropriate AI tools for classroom use, Developing teaching resources with AI assistance, and Customizing AI tools to fit diverse learning needs. The 6 effective strategies for the AI-Pedagogy (Teaching Methods and Curriculum) element are: Designing AI-supported lesson plans, Implementing AI-driven formative assessments, Algorithmic thinking and problem decomposition, Designing basic AI models for classroom use, Exploring data-driven decision-making processes, and Applying pattern recognition with datasets. The 6 effective strategies for the Development (Teacher Professional Development)

element are: Engaging in AI-focused professional training, Exploring global AI educational practices, Utilizing online AI learning platforms, Creating professional learning communities for AI, Participating in AI education conferences, and Advocating for AI policy reforms in education. The 7 effective strategies for the Evaluation (Evaluation, Feedback, and Policy) element are: Evaluating the effectiveness of AI tools in teaching, Troubleshooting common AI tool challenges, Encouraging students to design AI projects, Teaching students about AI career paths, Addressing barriers to AI adoption in schools, Developing standards for AI literacy assessment, and Aligning AI practices with school goals.

After in-depth research, the Artificial Intelligence technology teaching method training model for Secondary School Teachers was finally determined. Project evaluation results show that this model has a significant impact. In addition, the patterns were validated through focus group interviews with experts. Finally, a modified version of the model is produced, thus forming a Artificial Intelligence technology teaching method training model for Secondary School Teachers.

## Discussion

In the model of Artificial Intelligence technology teaching method training for Secondary School Teachers, the ranking of the main indicator factors from high to low is as follows: Cognition, AI-Apps, Development, Ethics, AI-Pedagogy, Evaluation.

In the relevant factors of Cognition, the ranking from high to low is as follows: Basic AI concepts, Privacy and security issues in AI use, Key AI applications in education, Understanding AI data structures and sources, Limitations and challenges of AI, AI's impact on society and economy.

In the relevant factors of AI-Apps, the ranking from high to low is as follows: Selecting appropriate AI tools for classroom use, Customizing AI tools to fit diverse learning needs, Using AI for personalized learning, Promoting active learning with AI tools, Developing teaching resources with AI assistance, AI-based adaptive learning techniques.

In the relevant factors of Development, the ranking from high to low is as follows: Engaging in AI-focused professional training, Participating in AI education conferences, Exploring global AI educational practices, Utilizing online AI learning platforms, Creating professional learning communities for AI, Advocating for AI policy reforms in education.

In the relevant factors of Ethics, the ranking from high to low is as follows: Promoting digital citizenship in AI usage, Understanding regulatory frameworks and guidelines, Safeguarding student data with AI tools, AI ethics fundamentals, Balancing technology use and ethical considerations.

In the relevant factors of AI-Pedagogy, the ranking from high to low is as follows: Designing AI-supported lesson plans, Implementing AI-driven formative assessments, Exploring data-driven decision-making processes, Algorithmic thinking and problem decomposition, Designing basic AI models for classroom use, Applying pattern recognition with datasets.

In the relevant factors of Evaluation, the ranking from high to low is as follows: Troubleshooting common AI tool challenges, Aligning AI practices with school goals, Evaluating the effectiveness of AI tools in teaching, Encouraging students to design AI projects, Teaching students about AI career paths, Developing standards for AI literacy assessment, Addressing barriers to AI adoption in schools.

As the primary and most critical factor, the training demand plays the role of cornerstone and compass in the training model of artificial intelligence technology teaching method. It stems from an accurate insight into the gap between the existing capabilities and the desired level of the target audience. This gap analysis not only involves a comprehensive assessment of the knowledge, skills and attitudes of educators in different educational scenarios (such as basic education, higher education, vocational training, etc.), but also considers the development trend of the education field and the new needs of the society for talent training.

AI training organizations have become the core link of transforming training concepts into practical actions. It involves the comprehensive planning of training activities and the integration of resources, and is a key hub to ensure the orderly

development of training. The training organization covers multiple levels, including determining the subject of the training, which requires the authority of the professional organization, the academic resources of the university and the pertinence of the internal training team; planning the time and space layout to ensure the continuity and effectiveness of the training time, and allocate material resources, such as teaching sites, advanced artificial intelligence equipment and software platform, to provide solid material guarantee for the training.

As a comprehensive test and feedback mechanism for training effect, training evaluation has an indispensable role in the training model. It through a variety of evaluation indicators and methods, such as knowledge test, skills field assessment, behavior observation, students self-evaluation and mutual evaluation and track the effect of teaching practice after training, comprehensive and objective understanding of students grasp the degree of training content and in the actual teaching situation of application knowledge and skills.

Training methods and tools, as the specific paths and means to achieve the training objectives, play an important position in the model. With the continuous innovation of artificial intelligence technology, the training methods and tools show a development trend of diversification and personalization. From traditional teaching teaching and case analysis to online live teaching, virtual simulation experiment and intelligent learning platform based on modern information technology, different training methods and tools are applicable to different training contents and groups of students.

Basic education classroom, with efficient classroom construction as an opportunity, from the perspective of artificial intelligence can assign education, research of artificial intelligence can assign basic education classroom teaching concept, intelligent technology teaching ability, students' digital learning ability, homework design status, put forward the teaching concept into the forerunner, teaching ability as the cornerstone, learning style change as fundamental, homework quality optimization as the key "double reduction" under the background of artificial intelligence can assign basic education efficient classroom construction strategy. Li

Hui (2023) point of view The reform of intelligent education is based on emphasizing the core position of self in intelligent technology and the coexistence of man and machine. The important value of intelligent education reform mainly includes three aspects: highlighting the subjective value of people in intelligent education, highlighting the necessity of education in intelligence, and paying attention to the creative position of labor in intelligent education. In view of this, it is necessary to return to the origin of education, reshape the concept of educational technology, examine the existing relationship between teachers and students, rebuild the ethics of teachers and students in intelligent technology, attach importance to the value of labor in intelligent education, excavate the social production power of educational reform, so as to strengthen the effect of intelligent education reform from the perspective of human science.

The training strategy is the macro planning and layout of the whole training process, aiming to improve the overall effect and efficiency of the training by optimizing the teaching order, rhythm and interactive mode. It should be flexibly adjusted according to the characteristics of the training object (such as age, learning style, knowledge base, etc.) and the nature of the training content (such as theoretical, practical, innovative, etc.).

Era of artificial intelligence innovation entrepreneurship education facing the challenge, including the change of talent training demand, the role of teachers and the challenge of teaching method transformation, to adapt to the future trend of education transformation, put forward the training of college students advanced compound literacy, interdisciplinary integration, the importance of integration, the era of artificial intelligence innovative entrepreneurship education development key strategy: build AI (artificial intelligence) core interdisciplinary curriculum system, build man-machine collaborative teaching mode and open at teaching environment, and the development of growth evaluation tools. These strategies aim to cultivate students; innovative ability and critical thinking, and to cultivate high-level compound talents for the era of artificial intelligence. This is consistent with the views of Chen Wenli and Liu Shutting (2024). The application of artificial intelligence

in chemistry education and teaching should combine the teaching concept of chemistry education, and reflect the value one by one from the curriculum content system and teaching mode, the mutual consideration of chemistry education and teaching, and students; innovation ability. The targeted analysis of the three elements of teaching evaluation, combined with the five dimensions of chemical core literacy, reflects the role of artificial intelligence in cultivating students; core literacy and teachers; education and teaching.

Although the training content is relatively low in the ranking of importance, it does not mean that its value and significance can be ignored. It is a specific knowledge and skill system determined on the basis of comprehensive consideration of training needs, organizational forms, method tools, strategies and evaluation requirements. The training content should cover the basic theoretical knowledge of artificial intelligence technology, such as the core concepts and principles of machine learning, natural language processing, computer vision and other fields; the application skills closely integrated with education and teaching, such as the operation and application of intelligent teaching tools, AI-based learning analysis and personalized teaching scheme design, and relevant knowledge to ensure that the students follow the ethics and legal norms when applying artificial intelligence technology.

Era of artificial intelligence innovation entrepreneurship education facing the challenge, including the change of talent training demand, the role of teachers and the challenge of teaching method transformation, to adapt to the future trend of education transformation, put forward the training of college students advanced compound literacy, interdisciplinary integration, the importance of integration, the era of artificial intelligence innovative entrepreneurship education development key strategy: build AI (artificial intelligence) core interdisciplinary curriculum system, build man-machine collaborative teaching mode and open at teaching environment, and the development of growth evaluation tools. These strategies aim to cultivate students; innovative ability and critical thinking, and to cultivate high-level compound talents for the era of artificial intelligence. This is consistent with the

views of Chen Wenli and Liu Shuting (2024). The application of artificial intelligence in chemistry education and teaching should combine the teaching concept of chemistry education, and reflect the value one by one from the curriculum content system and teaching mode, the mutual consideration of chemistry education and teaching, and students; innovation ability. The targeted analysis of the three elements of teaching evaluation, combined with the five dimensions of chemical core literacy, reflects the enabling role of artificial intelligence in cultivating students; core literacy and teachers; education and teaching.

With the gradual realization of information technology, the upgrading of intelligent education and the form of teacher education has realized major changes. And the innovation of teachers; intelligent education literacy under the background of emerging technology change has become the key and difficult point in the application process of artificial intelligence in basic education. This and zhi-yong zheng, Song Naiqing (2023) view, formed including intelligent education consciousness, intelligent education knowledge, intelligent education skills, intelligent education ethics four level indicators, 13 secondary indicators and 44 observation points of primary and secondary school teachers intelligent education literacy evaluation index system, and determine the weight coefficient of evaluation index at all levels.

**Propose**

**Deep insight and accurate prediction**

The understanding of training needs should be further deepened, not only to the group characteristics of educators, but also to the individual level. With the help of big data analysis, artificial intelligence diagnosis and other technologies, we can accurately depict each educator's knowledge map, skill shortcomings and career development goals, so as to provide highly personalized training needs analysis. At the same time, different educational scenarios (such as online teaching, offline teaching, mixed teaching), characteristics of different disciplines (such as humanities and social science, science and engineering, art and sports, etc.) and differences in educational development levels in different regions should be fully considered, so as

to make the analysis of training needs more situational and targeted. Actively follow the cutting-edge research and application trend of artificial intelligence technology in the field of education, combine the direction of education reform and the long-term demand of the society for talent training, and prospectively predict the challenges and skills that educators may face in the future. For example, with the integration development of artificial intelligence, the Internet of Things, blockchain and other technologies, the potential needs of educators in cross-technology integration teaching can be predicted in advance to provide forward-looking guidance for the optimization of training models.

**Intelligent collaboration and ecological construction**

Use the artificial intelligence technology to realize the intelligent management of the training organization. Through the intelligent course scheduling system, the optimal training schedule is generated by comprehensively considering the multi-dimensional factors such as training teachers, students' time, teaching venues and equipment resources, etc. At the same time, with the help of the intelligent resource allocation system, material resources are dynamically allocated in real time according to the training needs, such as automatically assigning appropriate laboratories and online learning platform accounts to different training projects, so as to improve the utilization efficiency of training resources. Break the boundaries of traditional training organizations and build an open and collaborative training ecosystem. We will encourage educational institutions, universities, enterprises, research institutes and other parties to participate in it and form a cooperation network of sharing resources and complementary advantages. For example, enterprises can provide the latest AI application cases and practical projects, universities can export cutting-edge academic research results, and scientific research institutes can carry out special technical training to jointly provide all-round and multi-level training services for educators.

**Innovation, integration and intelligent interaction**

Continue to explore the integration of emerging technologies such as virtual reality (VR), augmented reality (AR), and meta-universe into training methods and

tools. VR / AR technology is used to create immersive training scenarios, so that educators can personally experience the application of ARTIFICIAL intelligence in different teaching scenarios, such as virtual classroom, virtual laboratory, etc., to enhance the intuition and interest of training. With the help of meta-universe technology to build a virtual training community, educators can communicate, cooperate and practice in the virtual space, break the limitation of time and space, and expand the interactivity and participation of training. Strengthen the intelligent interactive function of training tools, and develop intelligent learning assistants with natural language processing and emotion recognition capabilities. These assistants are able to have a natural and smooth dialogue with educators in real time, answer questions, provide personalized learning advice, and adjust teaching strategies according to educators' learning status and emotional changes. At the same time, the adaptive learning system based on artificial intelligence can automatically push the most suitable learning content and practice topics according to the learning progress and knowledge mastery of educators, so as to realize personalized learning in a real sense.

**Multiple innovation and lifelong learning orientation**

In addition to existing strategies such as hierarchical classification teaching and project drive, diversified training strategies should be further explored in the future. For example, the "micro-authentication" strategy is adopted to decompose the training content into a series of small but fine modules. Educators can complete the learning of each module and pass the assessment and obtain the corresponding micro-certification, so as to encourage educators to gradually accumulate knowledge and skills. The strategy of "mentoring system" is implemented to enable experienced educators to pair up with novices, provide one-to-one guidance and assistance, and inherit teaching experience and practical wisdom. With the rapid development of AI technology and the continuous changes in education, educators need to keep learning to keep up with The Times. The training model should strengthen lifelong learning support strategies to provide educators with long-term learning resources and learning path planning. For example, establish lifelong learning files to record the

learning process and achievements of educators, and provide reference for their career development; provide regular knowledge update courses and online learning community to facilitate educators to learn and communicate at any time, and cultivate educators' lifelong learning awareness and ability.

**Comprehensive intelligence and continuous improvement**

Build a more comprehensive and intelligent training and evaluation system. In addition to the traditional evaluation of knowledge and skills, the evaluation indexes of educators; innovation ability, critical thinking and digital literacy are introduced. Using artificial intelligence technology, such as the intelligent analysis of teaching design documents and teaching videos, to evaluate the teaching innovation ability and application level of the learning time, participation, interaction and data in the training process, so as to fully understand the learning process and effect. The training evaluation results are used as an important basis for the continuous improvement of the training model. Establish a rapid feedback mechanism, timely feedback the evaluation results to the training organizers, training teachers and educators themselves, all parties to jointly analyze the existing problems and deficiencies, and put forward targeted improvement measures. At the same time, the machine learning algorithm is used to analyze the historical evaluation data, predict the possible problems and trends in the training process, optimize the training program and teaching strategies in advance, and realize the dynamic optimization and continuous improvement of the training model.

**Frontier expansion and interdisciplinary integration**

Constantly update and expand the training content, and timely incorporate the cutting-edge technologies and application achievements in the field of artificial intelligence. For example, it pays attention to the latest applications of generative artificial intelligence, reinforcement learning, transfer learning and other technologies in the field of education, and introduces how to use these technologies to develop personalized learning resources and optimize teaching evaluation. At the same time, it will explain the application of AI in educational decision-making, educational management and other aspects, so as to improve educators; all-round cognition and

application ability of AI technology. Emphasis on the interdisciplinary integration of the training content. With the increasing importance of AI technology in interdisciplinary education, the training content should cover the cross-cutting knowledge and application methods of AI and other disciplines. For example, for science and engineering educators, introduce the application of artificial intelligence in physics and chemistry experiment simulation; for liberal arts educators, explain how to use artificial intelligence for text analysis and historical research, etc., to cultivate the ability of interdisciplinary teaching and application artificial intelligence technology to solve complex problems.

## Further Advice

**1. Establish National AI Literacy Training System**

Construct a tiered curriculum framework integrating UNESCO guidelines, encompassing technical principles, pedagogical applications, ethics, and innovation. Implement hybrid certification combining online micro-credentials and offline workshops to standardize teacher competencies nationwide.

**2. Strengthen AI Ethics and Data Governance**

Develop ethical frameworks aligned with UNESCO recommendations, emphasizing data privacy, algorithmic fairness, and human oversight. Establish school-level ethics committees and standardized training on data security protocols (e.g., ISO/IEC 29134, TLS encryption), ensuring compliance in sensitive AI applications.

**3. Formulate Classroom AI Implementation Standards**

Define four operational boundaries: age thresholds (≥13 years), functional constraints (excluding value judgments), usage limits (≤25% class time), and human oversight mechanisms. Develop discipline-specific guidelines using Delphi consensus methods, supported by case repositories and risk assessment databases.

**4. Build AI Education Practice Communities**

Foster tripartite collaboration (academia-industry-schools) through professional learning networks. Create case-sharing platforms and interdisciplinary

toolkits, prioritizing humanities integration and dual evaluation metrics (technical efficacy vs. humanistic impact) to balance innovation with pedagogical values.

**5. Ensure Equitable AI Resource Allocation**

Standardize infrastructure (computing power, connectivity, device coverage) per UNESCO benchmarks. Implement federated learning for data sharing and Gini coefficient monitoring (≤0.3) to optimize resource distribution. Establish compensation mechanisms for underserved populations, embedding equity metrics in AI adoption evaluations.

This research framework systematically constructs a national-level teachers' artificial intelligence literacy training system from five aspects: teacher training, ethical governance, application norms, practice community construction, and resource equity. In the future, with the continuous development of artificial intelligence technology, we should continue to develop and optimize the AI intervention model in educational scenarios, strengthen interdisciplinary collaboration, and ensure that AI technology can effectively promote educational equity and teaching innovation.

## Foreground

**1. Improve the design and planning of teacher training**

This research is based on the understanding of real-life challenges. Teacher training is one of the important resources for the development of teacher education and teaching. Emphasizing and conducting research on teacher training, by improving the design of teacher training, fully leveraging the important role of teacher training, aims to achieve effective learning and professional development for teachers, ultimately realizing the long-term development of education and teaching.

**2. Changes in technology-led teacher training**

In the era of rapid development of modern information technology, teacher training based solely on text as a carrier is no longer able to fulfill all training tasks. People’s understanding of the concept of teacher training has long surpassed the scope of textual materials, and now includes audio-visual and electronic materials as well as information processed and organized on the internet. The development of

teacher training has gradually begun to incorporate dynamic and interactive information. With the continuous development of modern information technology, teacher training based on integrated design will become increasingly popular among teachers. After specific training objectives are determined, a comprehensive and carefully designed approach should be taken for different media based on specific training targets, establishing logical connections between various forms of information and integrating a system that is both diverse and integrated, interactive and controllable. Only in this way can the advantages of integrating multiple media be better utilized and the limitations of a single medium be avoided.

**3. Development of digital teacher training**

In the current situation of burgeoning digital teacher training in China, it is necessary to recognize that teacher training methods are not singular. There is a need to change the notion of relying solely on course resources and to delve into the modern digital teacher training and learning methods based on the internet environment, and to construct the structure and function of teacher training course resources rationally. Therefore, a new trend will be the integrated design of teacher training, combining multiple media and complementary advantages.

# References


Austrailian Department of Education, Skill and Employment, Foundation Skills for Your Future Program. Online Available https://www.dewr.gov.au/, 2020.

CIEEM, The Different Levels of Competence https://cieem.net/, 2019. https://cieem.net/i-am/continuingprofessional-development/competency-framework/the-different-levels-of-competence/

Education and Training Foundation, Digital Teaching Professional Framework. Online Available: http://etfoundation.co.uk, 2019.

European Parliament. (2006). Key Competences for Lifelong Learning.

Hu, D. Z. (2019). Study on the problems and countermeasures of Teachers Artificial Intelligence Literacy in Guizhou Province—Based on adult learning theory. **Journal of Anshun University**, (04), 66-69.

Huang, J., & Zhang, Z. J. (2018). Research on the efficacy of preschool teacher training based on Pedagogical Content Knowledge (PCK). **Education Development Research,** (Z2), 27-34.

Huang, W. J. (2021). Application of "Internet + Education" platform in the in-service training of preschool English teachers in Yangjiang City. **English Squar**e, (09), 90-92.

Jiang, L. Q. (2021). Case study on in-house training for public Secondary School Teachers in Chengdu **(Master's thesis, Chengdu University).**

Jiang, Y. T. (2022). Case study on the training needs of backbone Secondary School Teachers. **Asia-Pacific Education**, (20), 41-44.

Jin, Y. B., Zhang, Y. G., Yang, Y., & Liu, H. C. (2024). The value implications, real challenges, and breakthrough paths of "AI+ teacher training" in the era of strong artificial intelligence. **Modern Educational Technology,** (03), 63-70.

Jing,x.l., & Wang,w.h. (2019). Motivation for vocational school teachers' training and its related factors analysis - Based on the survey in Chongqing. **Vocational and technical education**.44-48.

Li, S. M., & Wang, H. (2013). Research on the design and development of video teaching case courses for Teachers Artificial Intelligence Literacy. **China Distance Education**, (11), 88-92.

Liang, X. T. (2019). Research on a participatory teacher training model based on the UMU interactive platform. **New Curriculum Research**, (16), 121-122.

Liang, Y. J. (2022). Current situation and promotion strategies for post-training of Secondary School Teachers under the "Internet+" context. **Teaching Materials of Culture and Education,** (17), 187-190.

Liu, H. Q., & Zhang, S. (2009). Research on the content of continuing education courses for preschool teachers. Journal of Higher Correspondence Education **(Philosophy and Social Sciences),** (01), 25-28.

Luo, B. (2018). From teaching ability to curriculum educational ability—Understanding and use of the "Guidance Standards for Secondary School Teachers Training Courses". **China Teachers**, (06), 31-34.

Ma, F. C. (2022). Design and application of micro-courses based on teacher training. **Journal of Hebei Tourism Vocational College**, (03), 96-101.

Mao,N.J., & lin,F., (2010). Constructing a Teacher Training Evaluation System Based on the CIPP Model and Kirkpatrick Model. **Journal of Beijing Normal University (Education)**.15-17.

Ministry of Education, China. (2023). Digital Education 2.0 Action Plan. Appendices.

Ng, D. T. K., et al. (2021). AI Literacy in K-12: A Review of Competencies and Pedagogies.

Ng, D. T. K., et al. (2021). AI Literacy in K-12: A Review of Competencies and Pedagogies.

P. Mishra and M. J. Koehler, “Technological pedagogical content knowledge: a framework for teacher knowledge,” **Teachers College Record, vol.** 108, no. 6. pp. 1017-1054, 2006.

Pei, M., & Li, X. Y. (2014). Interpretation of teacher learning from the perspective of adult learning theory: Regressing teachers' identity as adults. **Teacher Education Research**, (06), 16-21.

Peng, G. (2020). The value orientation and practical paths of standardized teacher training courses. **Journal of Fujian College of Education,** (10), 104-106+124.

Pingfan, Liu, L. N., & Li, Z. Z. (2013). Study on the online training needs and countermeasures of rural preschool teachers in Tianjin. **China Distance Education,** (01), 52-57+73+95.

Qi, Q. L. (2019). Innovation in the on-site training model for Secondary School Teachers. **New Curriculum Research**, (26), 126-127.

Qiao, Z. (2013). Study on the training needs of Secondary School Teachers **(Master's thesis, East China Normal University).**

Ren, Y. (2015). Practical study on the content and methods of professional development training for new Secondary School Teachers—Case study of Secondary School 93886. **Journal of Xinjiang Education Institut**e, (03), 21-26.

Song, B. (2022). Practical application of the blended training model based on the Rain Classroom in pre-service training for university teachers. **Education Observation**, (19), 35-37.

Song, Z. K. (2013). Research on the "National Training" model for Secondary School Teachers based on problem-based learning **(Master's thesis, Harbin Normal University)**.

Su, X. J. (2015). Survey of training needs of rural Secondary School Teachers in Xinjiang—Based on the 2014 "National Training Plan" replacement off-job training project. **Journal of Suzhou Education Institute,** (04), 93-95.

T. K. Ng, J. K. L. Leung, J. Su, R. C. W. Ng, and S. K. W. Chu, “teachers' AI digital competencies and twentyfirst century skills in the post-pandemic world,” **Educational Technology Research and Development, vol.** 71, pp. 137-161, 2023.

Tan, M. Q. (2022). Exploration of the "Three Stages Seven Steps" training model for new Secondary School Teachers. **Today's Education (Preschool Golden Edition),** (06), 20-23.

Tang, J. X. (2014). Survey study on the effectiveness of the "National Training Plan" curriculum implementation **(Master's thesis, Northeast Normal University).**

Tang, X. H. (2022). Reforms in university teacher training from the perspective of adult learning theory. **Xue Yuan (Garden),** (28), 24-26.

Tian, D. D. (2024). Issues and solutions in the construction of a training system for primary, secondary, and Secondary School Teachers. **Liaoning Education,** (08), 47-49.

Tian, D. D. (2024). Issues and solutions in the construction of a training system for primary, secondary, and Secondary School Teachers. **Liaoning Education**, (08), 47-49.

Tian, J. Z., & Li, W. T. (2022). Three-dimensional perspective on the training content needs of rural Secondary School Teachers. **Journal of Fujian College of Education,** (10), 102-104.

Touretzky, D., et al. (2019). AI Curriculum Integration in K-12.

UNESCO, ICT Competency Framework for Teachers V3. **Online Available** https://unevoc.unesco.org/, 2018.

UNESCO. (2019). Artificial Intelligence in Education: **Challenges and Opportunities**.

UNESCO. (2024). AI competency framework for teachers. https://www.unesco.org/en/articles/ai-competency-framework-teachers

Wang, G. X. (2023). Current situation and improvement strategies for the application of information technology by Secondary School Teachers in Yunnan Province. **China Training**, (12), 103-105.

Wang, J. J., & Wu, S. N. (2020). Improvement strategies for teacher training methods based on the theory of transformative adult learning. **Journal of Higher Continuing Education,** (06), 48-52.

Wang, S. H., & Cheng, H. (2018). Study on the issues and countermeasures in the professional development of Secondary School Teachers from an online training narrative analysis. **Educational Guide, (Second Half of the Month Edition)**, (03), 63-67.

Wang, T. (2021). Creating a Teachers Artificial Intelligence Literacy content screening system based on the "OTP" model—Taking municipal-level training of Secondary School Teachers in Dongguan City as an example. **Education Observation,** (04), 109-111+130.

Wang, Y. H. (2014). Survey on the current situation of on-the-job training for new Secondary School Teachers in Dalian **(Master's thesis, Liaoning Normal University).**

Wu, F. (2017). A review of research on the training needs of Secondary School Teachers in China over the past decade. **Journal of Ningbo Education Institute**, (02), 13-16.

Wu, Q., & Du, Y. X. (2018). Micro-course development strategies for teacher training. **Teaching and Management,** (06), 63-65.

Wu, Q., Wang, G. X., & Li, C. (2023). The impact of teacher training and teaching research activities on child development: The mediating role of Secondary School curriculum implementation quality. **Preschool Education Research**, (04), 47-56.

Xu, L. L. (2012). Characteristics and inspirations of preschool teacher training in developed countries: Examples from the USA, UK, Japan, and South Korea. **Journal of Higher Correspondence Education (Philosophy and Social Sciences),** (11), 11-13+37.

Xun,G.H, & cHao,H. (2016). Factors influencing and management strategies for teacher training migration. **Elementary and middle school teacher training**.5-7.

Yan, Y. J. (2023). Problem-solving strategies in Teachers Artificial Intelligence Literacy—Taking "Indoor Physical Games Development and Implementation" as an example. **Journal of Ningbo Education Institute,** (02), 61-64.

Yang, M. Y., Wang, S. H., Zhou, Q., & Wei, Y. G. (2023). Latent profile analysis of the training effects of inclusive education for Secondary School Teachers and its influencing factors. **China Special Education**, (10), 72-81.

Yin, L. (2018). Teacher training dilemmas and solutions from the perspective of transformative learning theory**. Chinese Education Journal,** (10), 87-91.

Yu, X. (2012). Role characteristics and professional responsibilities of teacher trainers. **Teacher Training in Primary and Secondary Schools**, (05), 11-13.

Zhang, W. G. (2017). Research on curriculum settings for Teachers Artificial Intelligence Literacy **(Doctoral dissertation, Nanjing Normal University).**

Zhang, X. M., & Xie, X. R. (2023). Real challenges and countermeasures of online training for preschool teachers in the post-pandemic era. **Journal of Daqing Normal University**, (03), 89-100.

Zhao, D. C., Liang, Y. Z., & Zhu, Y. L. (2010). Review and reflection on the research of teacher training needs analysis. **Educational Science,** *26*(5), 64-68.

Zhe, Y. N. (2023). Exploration and practice of problem-oriented Secondary School Teacher on-the-job training. **Hua Xia Teachers,** (23), 37-39.

Zhou, D. E., & Feng, G. L. (2015). Research on training strategies to improve the practical teaching ability of transfer teachers: Taking preschool transfer teachers as an example. **China Vocational and Technical Education,** (09), 71-73.

Zhou, D., & Zhai, M. J. (2023). Exploration of the "Four Integrations" training model for Secondary School Teachers based on job competency. **Science, Education, and Culture Integration**, (18), 16-23.

Zhou, X. D. (2017). Study on the effectiveness of national-level Teachers Artificial Intelligence Literacy policies **(Master's thesis, Fujian Normal University)**.

# Appendices

# Appendix A

## List of Specialists and Letters of Specialists Invitation for IOC Verification

# Lists of experts in Delphi

| NO. | Experts | Working years | Professional Title/Degree | Work unit |
|---|---|---|---|---|
| 1 | Interviewe 11 | 25 | Professor | Shenzhen University |
| 2 | Interviewe 11 | 20 | Professor | Shenzhen University |
| 3 | Interviewe 3 | 11 | Associat Professor | Shenzhen University |
| 4 | Interviewe 4 | 13 | Associat Professor | Shenzhen University |
| 5 | Interviewe 5 | 16 | Professor | Southern University of Science and Technology |
| 6 | Interviewe 6 | 12 | Associat Professor | South China Normal University |
| 7 | Interviewe 7 | 12 | Associat Professor | Huizhou College |
| 8 | Interviewe 8 | 11 | Vice-Principal | Shenzhen Middle School |
| 9 | Interviewe 9 | 16 | Director | Shenzhen Middle School |
| 10 | Interviewe 10 | 13 | Vice-Principal | Shenzhen Second Experimental School |
| 11 | Interviewe 11 | 20 | Director | Shenzhen Second Experimental School |
| 12 | Interviewe 12 | 12 | Vice-Principal | Shenzhen Foreign Language School Longhua School |
| 13 | Interviewe 13 | 11 | Director | Shenzhen Foreign Language School Longhua School |
| 14 | Interviewe 14 | 15 | Senior Teacher | Shenzhen Foreign Language School Longhua School |
| 15 | Interviewe 15 | 11 | Senior Teacher | Shenzhen Foreign Language School Longhua School |

| NO. | Experts | Working years | Professional Title/Degree | Work unit |
|---|---|---|---|---|
| 16 | Interviewe 16 | 19 | Vice-Principal | Shenzhen Gezhi Middle School |
| 17 | Interviewe 17 | 13 | Director | Shenzhen Gezhi Middle School |
| 18 | Interviewe 18 | 12 | Senior Teacher | Shenzhen Gezhi Middle School |
| 19 | Interviewe 19 | 20 | Vice-Principal | Shenzhen Hongshan Middle School |
| 20 | Interviewe 20 | 13 | Director | Shenzhen Hongshan Middle School |
| 21 | Interviewe 21 | 14 | Senior Teacher | Shenzhen Hongshan Middle School |

# Lists of experts in Focus group

| NO. | Experts | Working years | Professional Title/Degree | Work unit |
|---|---|---|---|---|
| 1 | Interviewe 1 | 25 | Professor | Shenzhen University |
| 2 | Interviewe 2 | 20 | Professor | Shenzhen University |
| 3 | Interviewe 3 | 15 | Professor | Shenzhen University |
| 4 | Interviewe 4 | 13 | Associat Professor | Shenzhen Polytechnic University |
| 5 | Interviewe 5 | 14 | Professor | Southern University of Science and Technology |
| 6 | Interviewe 6 | 14 | Professor | South China Normal University |
| 7 | Interviewe 7 | 12 | Associat Professor | South China Normal University |
| 8 | Interviewe 8 | 13 | Associat Professor | Huizhou College |
| 9 | Interviewe 9 | 15 | Professor | Huizhou College |

# Appendix B

## Official Letter

Ref.No.MHESI 0643.14/1026

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

15 August 2024

Subject: Invitation to validate research instrument

Dear Professor Dr.Zhang Wenjun, Shenzhen University

Mr.Wu Zhaobin is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. He is undertaking research entitled “Development of Artificial Intelligence Literacy Model for Secondary Schools Teachers in Shenzhen”

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 ould 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. Nukul Sarawong

(Vice Dean of Graduate School for Dean of Graduate School)

Bansomdejchaopraya Rajabhat University Tel.+662-473-7000
www.bsru.ac.th
Email: gradabsru.ac.th

Ref.No.MHESI 0643.14/1026

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

15 August 2024

Subject: Invitation to validate research instrument

Dear Professor Dr.Cao Xiaoming, Shenzhen University

Mr.Wu Zhaobin is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. He is undertaking research entitled “Development of Artificial Intelligence Literacy Model for Secondary Schools Teachers in Shenzhen”

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Yours faithfully,

Assistant Professor Dr. Nukul Sarawong

(Vice Dean of Graduate School for Dean of Graduate School)

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Ref.No.MHESI 0643.14/1026

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

15 August 2024

Subject: Invitation to validate research instrument

Dear Dr.He Quantao, Shenzhen University

Mr.Wu Zhaobin is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. He is undertaking research entitled “Development of Artificial Intelligence Literacy Model for Secondary Schools Teachers in Shenzhen”

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.

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Ref.No.MHESI 0643.14/1026

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

15 August 2024

Subject: Invitation to validate research instrument

Dear Associat Professor Dr.Xie Fengran, Shenzhen Polytechnic University

Mr.Wu Zhaobin is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. He is undertaking research entitled “Development of Artificial Intelligence Literacy Model for Secondary Schools Teachers in Shenzhen”

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.

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Yours faithfully,

Assistant Professor Dr. Nukul Sarawong

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Ref.No.MHESI 0643.14/1026

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

15 August 2024

Subject: Invitation to validate research instrument

Dear Professor Dr.Wang Xianwen, Huizhou College

Mr.Wu Zhaobin is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. He is undertaking research entitled “Development of Artificial Intelligence Literacy Model for Secondary Schools Teachers in Shenzhen”

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 ould 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. Nukul Sarawong

(Vice Dean of Graduate School for Dean of Graduate School)

Bansomdejchaopraya Rajabhat University Tel.+662-473-7000
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Email: gradabsru.ac.th

# Appendix C

## Research Instrument

# Participant Recruitment E-mail

Dear _____,

I am a student at Bansomdejchaopraya Rajabhat University, currently working on a paper about the comprehensive IT teaching methods in Teachers Artificial Intelligence Literacy models. You have been identified as someone with experience and expertise in this area.

I am conducting a study to understand your views on the comprehensive teaching methods training model for Secondary School Teachers. Please note that this research is from a curriculum design perspective rather than a direct evaluation of supervision. It is important to include your perspectives in this study to ensure that the research results are representative of experts in the field.

In this study, I am using a qualitative Delphi method, which includes at least three rounds of interview questions. Your participation in the study will require at least two interviews, and I estimate that it may take up to 1 hour of your time. I will maintain confidentiality, and I will use pseudonyms or discuss the survey results of the group. There are no known risks associated with this study. The main inconvenience will be the time required to complete the study. If you are willing to participate in this study, please reply to this email. I will send you a formal consent form, and then we can proceed with the research. I am happy to answer any questions you may have before you agree to participate. If you have any questions, you can also contact my supervisor.

Sincerely,

Mr. Wu Zhaobin
Candidate for PhD in digital technology management for education
Bansomdejchaopraya Rajabhat University

## Round One Interview Questions

## Subject

## Discuss the current level of knowledge of secondary school teachers' artificial intelligence literacy

**Research objective**

To study the current level of knowledge of secondary school teachers' artificial intelligence literacy.

**Explanation**

This round of interview questions is part of a research paper. The information obtained will be kept confidential. The analysis and presentation will only provide an overall picture and will not cause any harm to your business. Please answer the interview questions as truthfully as possible.

**The interview is divided into 5 parts:**

Part 1: General information about the interviewer

Part 2: Concept of Teachers Artificial Intelligence Literacy

Part 3: Artificial Intelligence Literacy teaching methods into teacher training

Part 4: The concept of learning theory

**Note :** Definitions of terms are at the end of the interview form.

**Part 1: General information of the interviewee.**

1.Name.....

2.Age.....years

3.Highest educational qualification.....

4.Work experience.....years

5.Current job position.....

6.Professional technical title.....

**Part 2: The concept of Teachers Artificial Intelligence Literacy**

1.The impact of digital technology on Teachers Artificial Intelligence Literacy. How important do you think it is in the impact of Foundational AI knowledge and needs? What are the main aspects of reflecting it? How do you think develops and improve the impact of Foundational AI knowledge and needs? Write down the answer.

2.The impact of digital technology on Teachers Artificial Intelligence Literacy. How important do you think in the impact of Pedagogical Integration of AI? What are the main aspects of reflecting it? How do you think of the development and improvement of the Pedagogical Integration of AI? Write down the answer.

3. The impact of digital technology on Teachers Artificial Intelligence Literacy, how important do you think in the impact of Computational Thinking and Problem-Solving? What are the main aspects of reflecting it? How do you consider the development and improvement of Computational Thinking and Problem-Solving? Write down the answer.

4. The impact of digital technology on Teachers Artificial Intelligence Literacy. How important do you think is in the impact of Ethics and Responsible AI Use? What are the main aspects of reflecting it? How do you consider the impact of the development and improving of Ethics and Responsible AI Use? Write down the answer.

5. The impact of digital technology on Teachers Artificial Intelligence Literacy. How important do you think is in the impact of Professional Development and Lifelong Learning? What are the main aspects of reflecting it? What do you think of the impact of developing and improving Professional Development and Lifelong Learning? Write down the answer.

6. The impact of digital technology on Teachers Artificial Intelligence Literacy. How important do you think is in the impact of AI Tools and Resource Management? What are the main aspects of reflecting it? How do you think develop and improve the impact of AI Tools and Resource Managements? Write down the answer.

7. The impact of digital technology on Teachers Artificial Intelligence Literacy. How important do you think is in the impact of training operation? What are the main aspects of reflecting it? How do you think develops and improve the impact of AI-Supported Student Empowerment? Write down the answer.

8. The impact of digital technology on Teachers Artificial Intelligence Literacy, how important do you think in the impact of Evaluation? What are the main aspects of reflecting it? How do you think develop and improve the impact of the Evaluation? Write down the answer.

**Part 3: Artificial Intelligence Literacy teaching method for teacher training**

1. The influence of digital technology on the teaching method of Artificial Intelligence Literacy for training teachers. How important do you think it is in the influence of training characteristics? What are the main aspects of reflecting it? How do you think develop and improve the impact of training characteristics? Write down the answer.

2. The influence of digital technology on the teaching method of Artificial Intelligence Literacy for training teachers. How important do you think it is in the influence of the Pedagogical Integration of AI? What are the main aspects of reflecting it? How do you think of the development and improvement of the Pedagogical Integration of AI? Write down the answer.

3. The influence of digital technology on the teaching method of Artificial Intelligence Literacy for training teachers. How important do you think it is in the influence of training methods? What are the main aspects of reflecting it? How do you consider the impact of developing and improving training methods? Write down the answer.

4. The impact of digital technology on the teaching method of Artificial Intelligence Literacy for training teachers. How important do you think it is in the impact of Ethics and Responsible AI Use? What are the main aspects of reflecting it? How do you consider the impact of the development and improving of Ethics and Responsible AI Use? Write down the answer.

5. The impact of digital technology on the teaching method of Artificial Intelligence Literacy for training teachers. How important do you think it is in the impact of Evaluation? What are the main aspects of reflecting it? What do you think develops and improves the impact of the Evaluation? Write down the answer.

6. The impact of digital technology on the teaching method of Artificial Intelligence Literacy for training teachers. How important do you think it is in the impact of training technology? What are the main aspects of reflecting it? How do you see the impact of developing and improving training techniques? Write down the answer.

**Part 4: Learning the concept of the theory**

1. The influence of digital technology on learning theory, how important do people think in the influence of self-experience? What are the main aspects of reflecting it? How do you think to develop and improve the impact of self-experience? Write down the answer.

2. The influence of digital technology on learning theory. How important do you think it is in the influence of problem orientation? What are the main aspects of reflecting it? How do you think develop and improve the impact of problem orientation? Write down the answer.

3. The influence of digital technology on learning theory. How important do people think it is in the influence of autonomous learning? What are the main aspects of reflecting it? How do you think of the development and improvement of autonomous learning effects? Write down the answer.

4. The influence of digital technology on learning theory. How important do you think it is in the influence of practice oriented? What are the main aspects of reflecting it? How do you think develop and improve the practice-oriented impact? Write down the answer.

5. The impact of digital technology on learning theory. How important do you think it is in the impact of cooperative learning? What are the main aspects of reflecting it? How do you think to develop and improve the impact of collaborative learning? Write down the answer.

6. The impact of digital technology on learning theory. How important do you think is the impact of continuous learning goals? What are the main aspects of reflecting it? How do you think develop and improve the impact of continuous learning goals? Write down the answer.

**Assessment of the guideline tables**

**Training mode of Artificial Intelligence Literacy teaching method for Secondary School Teachers**

**Research objectives**

The design is suitable for design a Teachers' Artificial Intelligence Literacy Model (TAILM) for the Secondary School of Shenzhen City.

**Explanation**

The researcher therefore asked for assistance from experts. Please check the questions in the Interview regarding suitability and consistency with the content.

Please mark "√".

| Mark | Channel | Opinion |
|---|---|---|
| √ | +1 | Consistent |
| | 0 | Unsure |
| | -1 | Not consistent |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| Foundational AI knowledge and needs | | | | | | | | | | |
| 1. | Professional knowledge and skills: including expertise in Secondary School Education theory, psychology, teaching methods, curriculum design, as well as practical skills in teaching, communication, and management. | | | | | | | | | |
| 2. | Teaching resources and tools: providing resources such as textbooks, teaching aids, teaching equipment suitable for Secondary School teaching, as well as training in teaching techniques and information technology tools to help teachers better conduct teaching activities. | | | | | | | | | |
| 3. | Education policies and regulations: Understanding relevant education policies, laws, and standards to ensure that teachers comply with regulations during the teaching process, safeguarding the rights and safety of student. | | | | | | | | | |
| 4. | Professional development and career planning: Assisting teachers in career planning, providing opportunities for professional development and training programs to promote | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | teachers' growth and advancement. | | | | | | | | | |
| 5. | student development and educational theories: Teachers need to understand the latest theories on student development and education, grasp knowledge in areas such as psychology, cognition, emotions, etc., to guide practical teaching activities. | | | | | | | | | |
| 6. | Updating teaching methods and strategies: Teachers need to learn and master a variety of teaching methods and strategies to enhance teaching effectiveness and meet the learning needs of different student. | | | | | | | | | |
| 7. | Curriculum design and assessment skills: Teachers need to enhance their ability in curriculum design and assessment, develop teaching plans that align with the characteristics and needs of student, and effectively evaluate teaching outcomes. | | | | | | | | | |
| 8. | Personal development needs: Individual differences in teachers' personal development needs are also important factors; some teachers may wish to pursue further studies, while others may need to | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | enhance specific skills or knowledge. | | | | | | | | | |
| 9. | Social needs: Teachers need to understand the changes in social needs, adapt to social development, and enhance the quality and effectiveness of educational services. | | | | | | | | | |
| 10. | Individual differences and feedback: There are differences among teachers as individuals, and personalized training plans should be developed based on individual needs and feedback to enhance the specificity and effectiveness of training. | | | | | | | | | |
| Pedagogical Integration of AI | | | | | | | | | | |
| 11. | Secondary School Education Theories: Introduce the basic theories of Secondary School Education, including student development stages, learning theories, educational psychology, and other related content, to help teachers better understand the characteristics of student growth and learning. | | | | | | | | | |
| 12. | Teaching Methods and Techniques: Training teachers to use a variety of teaching methods and techniques, | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | such as heuristic teaching, situational teaching, game-based teaching, as well as skills in classroom management, student assessment, and other aspects. | | | | | | | | | |
| 13. | Curriculum Design and Teaching Plans: Guide teachers in developing curriculum designs and teaching plans that meet the needs of student, including goal setting, content arrangement, and instructional activity design. | | | | | | | | | |
| 14. | student Psychological Health and Behavior Management: Training teachers to understand issues related to student psychological health, learn how to establish good relationships with student, and effectively manage their behavior. | | | | | | | | | |
| 15. | student to unleash their potential, and fostering student artistic expression abilities and creativity. | | | | | | | | | |
| 16. | Principles of Secondary School Education: Teachers need to grasp the principles and methods of Secondary School Education, understand how to promote the | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | holistic development of student through games, experiences, and other means. | | | | | | | | | |
| 17. | Curriculum Design and Assessment: Teachers need to learn how to design curriculum that meets the characteristics and needs of student, and master effective assessment methods to enhance teaching quality. | | | | | | | | | |
| 18. | Multicultural Education: Teachers need to understand the importance of multicultural education, and learn how to promote cross-cultural communication and understanding among student in their teaching practices. | | | | | | | | | |
| 19. | Special Education Needs: Teachers should also receive training on special education needs to understand how to support and educate student with special needs, promoting their development. | | | | | | | | | |
| 20. | Professional Development: Pedagogical Integration of AI should also include enhancing teachers' professional competence and ethical | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | standards, cultivating their sense of responsibility, innovative spirit, and ability to work collaboratively in a team. | | | | | | | | | |
| Computational Thinking and Problem-Solving | | | | | | | | | | |
| 21. | Practical Teaching: Training teachers through practical teaching experiences, allowing them to apply the knowledge and skills they have learned in real classroom settings, enhancing their practical teaching abilities. | | | | | | | | | |
| 22. | Training Manuals and Teaching Materials: Providing specially designed training manuals, textbooks, or teaching resources to assist teachers in systematically learning and mastering relevant knowledge and skills. | | | | | | | | | |
| 23. | Video Teaching and Demonstrations: Utilizing video teaching and demonstrations to showcase teaching techniques, case studies, and other content, helping teachers to visually understand and learn. | | | | | | | | | |
| 24. | Learning Community and Discussion Platform: Establishing a learning | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | community and discussion platform for teachers to engage in communication, share experiences and resources, and facilitate collaborative learning and growth. | | | | | | | | | |
| 25. | Peer Support: Establishing a teacher communication platform or professional community to facilitate experience sharing, collaborative learning, and mutual support among teachers. | | | | | | | | | |
| 26. | Assistive Technology: Utilizing modern technology to support teacher training, such as virtual reality technology, intelligent teaching systems, online assessment tools, etc., to enhance training effectiveness and teaching efficiency. | | | | | | | | | |
| 27. | Workshops and Lectures: By organizing specialized workshops and lectures, inviting experts and scholars to share the latest educational theories and practical experiences, we aim to help teachers broaden their knowledge horizons. | | | | | | | | | |
| 28. | Case Studies and Sharing: By conducting case studies and sharing | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | teaching practices, we aim to help teachers learn from others' successful experiences and lessons, inspire reflection, and improve teaching methods. | | | | | | | | | |
| 29. | Practical Activities and Observation Classes: Organizing practical activities and observation classes to allow teachers to actively participate in and observe excellent teaching practices, enhancing their practical skills and teaching abilities. | | | | | | | | | |
| 30. | Group Discussions and Collaboration: Through group discussions and collaboration, we aim to facilitate communication and interaction among teachers, collectively explore educational issues, promote idea exchange, and foster mutual growth. | | | | | | | | | |
| Ethics and Responsible AI Use | | | | | | | | | | |
| 31. | Teaching Materials and Tools: Providing resources such as suitable teaching materials, tools, and instructional equipment for Secondary School education to assist teachers in conducting teaching activities, enriching teaching content, | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | and enhancing teaching effectiveness. | | | | | | | | | |
| 32. | Online Platform and Resource Repository: Establishing an online learning platform or resource repository to provide teachers with access to teaching videos, materials, lesson plans, case studies, and other resources that can be accessed anytime and anywhere, facilitating teacher learning and communication. | | | | | | | | | |
| 33. | Learning Community and Interactive Platform: Establishing a teacher learning community or online forum to facilitate communication and interaction among teachers, enabling them to share experiences, resources, and teaching achievements. | | | | | | | | | |
| 34. | Assessment and Feedback: Providing regular assessment and feedback mechanisms to help teachers understand their learning progress, adjust their learning direction in a timely manner, and continuously enhance their capabilities. | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| 35. | Educational Institutions and Professional Organizations: Educational institutions and professional organizations typically provide various teacher Ethics and Responsible AI Use, including seminars, workshops, professional courses, etc., to help teachers continuously learn and grow. | | | | | | | | | |
| 36. | Experts, Scholars, and Lecturers: Inviting experts, scholars, and lecturers to participate in teacher training, share the latest educational theories and practical experiences, and help teachers enhance their professional knowledge and skills. | | | | | | | | | |
| 37. | Educational Books and Journals: Providing a wide range of educational books and journals for teachers to reference, enabling them to understand the latest educational theories, research findings, and practical case studies. | | | | | | | | | |
| 38. | Teaching Resource Repository: Establishing a teaching resource repository to collect and organize various teaching resources, such as | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | instructional videos, lesson plan examples, teaching tools, etc., to provide teachers with a wealth of teaching materials and reference materials. | | | | | | | | | |
| 39. | Pedagogical Technology Support: Providing pedagogical technology support to help teachers master the application of teaching technologies and tools, enhancing teaching effectiveness and innovation capabilities. | | | | | | | | | |
| 40. | Practice Bases and Observation Opportunities: Providing practice bases and observation opportunities for teachers to actively participate in practical activities and observe excellent teaching practices, promoting experience accumulation and enhancing teaching capabilities. | | | | | | | | | |
| Professional Development and Lifelong Learning | | | | | | | | | | |
| 41. | Needs Analysis: Understanding teachers' Foundational AI knowledge and needs and learning objectives, and customizing training plans tailored to the backgrounds and requirements of individual teachers. | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| 42. | Targeted Curriculum Design: Designing curriculum content that meets the practical needs of Secondary School Teachers, covering aspects such as teaching theory, practical skills, and curriculum design. | | | | | | | | | |
| 43. | Practice-Oriented: Emphasizing practical exercises and case studies to help teachers apply their knowledge and skills to real-world scenarios, enhancing their practical abilities. | | | | | | | | | |
| 44. | Feedback and Evaluation: Establishing an effective feedback mechanism to promptly collect teachers' learning feedback and performance evaluations, in order to provide personalized guidance and support to teachers. | | | | | | | | | |
| 45. | Peer Support and Sharing: Encouraging teachers to communicate and share experiences with each other, establishing professional communities and collaborative networks to facilitate mutual learning and growth. | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| 46. | Diversified Training Formats: Utilizing a variety of formats such as online, offline, practical, and peer exchanges to cater to different teachers' learning styles and needs. | | | | | | | | | |
| 47. | Progressive Training: Adopting a phased and progressive training approach, starting from basic knowledge to professional skills and then to practical abilities development, gradually enhancing teachers' overall competency. | | | | | | | | | |
| 48. | Participatory Training: Encouraging teachers to engage in classroom interactions, group discussions, case studies, and other activities to promote active participation and communication among learners, enhancing the effectiveness of learning. | | | | | | | | | |
| 48. | Incentive Mechanism: Establishing reward systems or certification recognition to incentivize teachers to actively participate in training, enhancing learning motivation and effectiveness. | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| 50. | Ongoing Monitoring: Conducting follow-up evaluations after training, collecting feedback to understand the training effectiveness, and providing further support and guidance to teachers. | | | | | | | | | |
| AI Tools and Resource Management | | | | | | | | | | |
| 51. | Training Plan and Objectives: Establishing clear training plans and objectives, outlining the Pedagogical Integration of AI, format, schedule, etc., to ensure the systematic and continuous nature of the training. | | | | | | | | | |
| 52. | Training Facilities: Providing suitable training venues and facilities, including classrooms, laboratories, multimedia equipment, etc., to ensure a comfortable and convenient training environment. | | | | | | | | | |
| 53. | Systemic Challenges and Institutional Support: Establishing an effective training evaluation mechanism to assess teachers' learning progress and performance, making timely adjustments to the training direction and methods to ensure training effectiveness. | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| 54. | Management Mechanism: Establishing a comprehensive training management mechanism, including training information management, student management, course management, etc., to ensure the orderly and efficient operation of the training program. | | | | | | | | | |
| 55. | Incentive Mechanism: Establishing reward systems or certification programs to motivate teachers to actively participate in training, enhancing learning motivation and effectiveness. | | | | | | | | | |
| 56. | Training Faculty: Having a team of experienced and highly qualified training professionals, including education experts, psychologists, instructional designers, etc., to provide professional guidance and support. | | | | | | | | | |
| 57. | Ethics and Responsible AI Use: Providing a wide range of teaching resources and tools, such as textbooks, teaching aids, teaching equipment, educational software, etc., to support teachers' learning | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | and teaching activities. | | | | | | | | | |
| 58. | Training Courses: Designing course content that meets the needs of teachers and training objectives, covering aspects such as Secondary School Education theory, teaching methods, student psychological well-being, home-school cooperation, etc. | | | | | | | | | |
| 59. | Training Activities: Organizing various training activities, such as lectures, seminars, workshops, field visits, hands-on guidance, etc., to provide different forms of learning opportunities. | | | | | | | | | |
| 60. | Financial Support: Providing necessary funding support for teacher training to ensure the smooth progress and quality assurance of training activities. | | | | | | | | | |
| AI-Supported Student Empowerment | | | | | | | | | | |
| 61. | Foundational AI knowledge and needs Assessment: Conducting targeted needs assessment before the start of training to understand teachers' Foundational AI knowledge and needs and expectations, providing a basis for the design of | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | subsequent training content and formats. | | | | | | | | | |
| 62. | Developing Training Plan: Based on the results of the needs assessment, creating a detailed training plan that includes training content, schedule, training formats, etc., to ensure clear and targeted training objectives. | | | | | | | | | |
| 63. | Sharing and Communication: Encouraging teachers to share training experiences and teaching practices with each other to promote mutual learning and growth, and to establish a collaborative and learning-oriented teacher team. | | | | | | | | | |
| 64. | Faculty Preparation: Providing necessary training materials and teaching aids for trainers to ensure that they possess professional knowledge and training skills, enabling them to effectively impart knowledge. | | | | | | | | | |
| 65. | Practical Guidance: Providing practical opportunities and guidance to help teachers apply the knowledge they have learned to actual teaching, enhancing their | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | practical skills and teaching abilities. | | | | | | | | | |
| 66. | Follow-up Coaching: Conducting follow-up coaching after training to continuously monitor the learning and growth of teachers, providing necessary support and guidance to help teachers continually improve. | | | | | | | | | |
| 67. | Feedback Evaluation: Establishing an effective feedback mechanism to collect teachers' feedback and training effectiveness evaluations, making timely adjustments and improvements to training programs to enhance training outcomes. | | | | | | | | | |
| 68. | Ongoing Monitoring: Conducting follow-up assessments after training to understand teachers' learning outcomes and practical application, and providing further support and guidance to teachers. | | | | | | | | | |
| 69. | Selecting Training Formats: Based on the training content and teachers' specific circumstances, choosing appropriate training formats such as online courses, offline seminars, practical guidance, etc., to enhance teachers' learning effectiveness. | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| 70. | Continuous Support: Providing ongoing support and guidance to teachers after the training, encouraging them to continue learning and improving, and promoting their professional development. | | | | | | | | | |
| Systemic Challenges and Institutional Support | | | | | | | | | | |
| 71. | Goals and Standards: Clearly define the training objectives and assessment criteria to ensure that the evaluation targets and content are aligned with the training goals. | | | | | | | | | |
| 72. | Assessment Content: The assessment content should include aspects such as knowledge mastery, skill application abilities, teaching effectiveness, etc., to comprehensively evaluate the training outcomes of teachers. | | | | | | | | | |
| 73. | Assessment Schedule: Determine the timing and frequency of assessments, which can be conducted before, during, and after the training, as well as follow-up assessments at certain intervals after the training. | | | | | | | | | |
| 74. | Feedback and Improvement: Provide | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | feedback based on the assessment results to guide teachers in improving teaching methods and practical skills, promoting their professional development. | | | | | | | | | |
| 75. | Formative Assessment: Evaluate the diversity, flexibility, and effectiveness of training formats, including assessments of online courses, offline seminars, practical guidance, and other forms of evaluation. | | | | | | | | | |
| 76. | Engagement Assessment: Evaluate teachers' engagement and enthusiasm, including attendance rates, classroom interactions, completion of assignments, etc., to understand the level of acceptance and involvement of teachers in the training. | | | | | | | | | |
| 77. | Satisfaction Assessment: Evaluate teachers' satisfaction and feedback on the training program, collect constructive opinions and suggestions to improve and optimize the training plan. | | | | | | | | | |
| 78. | Ongoing Monitoring and Evaluation: Conduct continuous tracking and | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | evaluation after the training to understand the application and effectiveness of the training content in teachers' work, promoting sustained improvement in training outcomes. | | | | | | | | | |
| 79. | Training Effectiveness Evaluation: Taking into account the above elements, assess the overall training effectiveness and impact, analyze the strengths and weaknesses of the training program, and provide improvement suggestions and directions for future training. | | | | | | | | | |
| 80. | Teaching Effectiveness Evaluation: Evaluate the effects demonstrated by teachers in actual teaching after training, including improvements in teaching methods and enhancements in teaching quality. | | | | | | | | | |
| About other comments or suggestions. | | | | | | | | | | |

# Assessment of the guideline tables

## Experts evaluate the consistency of the training model of teachers' Artificial Intelligence Literacy teaching methods

**Research objectives**

The evaluate the Teachers Artificial Intelligence Literacy Model (TAILM) for Secondary School of Shenzhen City.

**Explanation**

The researcher therefore asked for assistance from experts. Please check the questions in the Interview regarding suitability and consistency with the content.

Please mark “√”.

| Mark | Channel | Opinion |
|---|---|---|
| √ | +1 | Consistent |
| | 0 | Unsure |
| | -1 | Not consistent |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| Foundational AI knowledge and needs | | | | | | | | | | |
| 1. | Professional Knowledge and Skills: This includes expertise in Secondary School Education theory, psychology, teaching methods, curriculum design, as well as practical skills in teaching, communication, and management. | | | | | | | | | |
| 2. | Teaching Resources and Tools: Provide resources such as teaching materials, teaching aids, teaching equipment suitable for Secondary School education, as well as training in teaching techniques and information technology tools to help teachers better conduct teaching activities. | | | | | | | | | |
| 3. | Updating Teaching Methods and Strategies: Teachers need to learn and master a variety of teaching methods and strategies to enhance teaching effectiveness and meet the learning needs of different student. | | | | | | | | | |
| 4. | Personal Development Needs: The differences in teachers' personal development needs are also important factors. Some teachers may wish to pursue further studies, while | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | others may need to enhance specific skills or knowledge. | | | | | | | | | |
| 5. | Social Needs: Teachers need to understand the changes in social needs, adapt to social development, and improve the quality and effectiveness of educational services. | | | | | | | | | |
| 6. | Individual Differences and Feedback: There are differences among teachers, and personalized training programs should be developed based on individual needs and feedback to enhance the specificity and effectiveness of training. | | | | | | | | | |
| Pedagogical Integration of AI | | | | | | | | | | |
| 7. | Secondary School Education Theories: Introduce the basic theories of Secondary School Education, including student development stages, learning theories, educational psychology, and other related content, to help teachers better understand the characteristics of student growth and learning. | | | | | | | | | |
| 8. | Teaching Methods and Techniques: Train teachers to use a variety of teaching methods and techniques, | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | such as heuristic teaching, situational teaching, game-based teaching, as well as skills in classroom management, student assessment, and other aspects. | | | | | | | | | |
| 9. | student Psychological Health and Behavior Management: Train teachers to understand issues related to student psychological health, learn how to build good relationships with student, and effectively manage student behavior. | | | | | | | | | |
| 10. | Multicultural Education: Teachers need to understand the importance of multicultural education, learn how to promote cross-cultural communication and understanding among student in their teaching. | | | | | | | | | |
| 11. | Special Education Needs: Teachers should also receive training on special education needs, understand how to support and educate student with special needs, and promote their development. | | | | | | | | | |
| 12. | Professional Development: The training content should also include enhancing teachers' professional | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | competence and ethical standards, fostering their sense of responsibility, innovative spirit, and ability to work collaboratively in a team. | | | | | | | | | |
| Computational Thinking and Problem-Solving | | | | | | | | | | |
| 13. | Practical Teaching: Train teachers through practical teaching experiences, allowing them to apply the knowledge and skills they have learned in actual classrooms, and enhance their practical teaching abilities. | | | | | | | | | |
| 14. | Training Manuals and Teaching Materials: Provide specially designed training manuals, textbooks, or teaching resources to help teachers systematically learn and master relevant knowledge and skills. | | | | | | | | | |
| 15. | Learning Community and Discussion Platform: Establish a learning community and discussion platform for teachers to communicate, share experiences and resources, and promote collaborative learning and growth. | | | | | | | | | |
| 16. | Assistive Technology: Utilize modern technologies to assist teacher training, | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | such as virtual reality technology, intelligent teaching systems, online assessment tools, etc., to enhance training effectiveness and teaching efficiency. | | | | | | | | | |
| 17. | Practical Activities and Observation Lessons: Organize practical activities and observation lessons for teachers to personally participate in and observe excellent teaching practices, enhancing their practical skills and teaching abilities. | | | | | | | | | |
| 18. | Group Discussions and Collaboration: Facilitate communication and interaction among teachers through group discussions and collaboration, encouraging collective exploration of educational issues, fostering idea exchange, and mutual growth. | | | | | | | | | |
| Development | | | | | | | | | | |
| 19. | Targeted Curriculum Design: Develop curriculum content tailored to the practical needs of Secondary School Teachers, encompassing teaching theories, practical skills, curriculum design, and other relevant aspects. | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| 20. | Peer Assistance and Sharing: Encourage teachers to communicate and share experiences with each other, establish professional communities and collaborative networks, and promote mutual learning and growth. | | | | | | | | | |
| 21. | Diversified Training Formats: Utilize a variety of formats including online, offline, practical, peer-to-peer exchange, etc., to cater to different teachers' learning styles and needs. | | | | | | | | | |
| 22. | Progressive Training: Implement a phased and progressive training approach, starting from basic knowledge to professional skills and then to practical abilities, gradually enhancing teachers' overall competency. | | | | | | | | | |
| 23. | Participatory Training: Encourage teachers to engage in classroom interactions, group discussions, case studies, and other activities to promote active participation and communication among learners, enhancing the effectiveness of learning. | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| 24. | Incentive Mechanism: Establish reward systems or certification programs to incentivize teachers to actively participate in training, enhancing learning motivation and effectiveness. | | | | | | | | | |
| AI Tools and Resource Management | | | | | | | | | | |
| 25. | Training Plan and Objectives: Develop clear training plans and objectives, specifying training content, format, schedule, etc., to ensure the systematic and continuous nature of the training. | | | | | | | | | |
| 26. | Incentive Mechanism: Establish reward systems or certification programs to motivate teachers to actively participate in training, enhancing learning motivation and effectiveness. | | | | | | | | | |
| 27. | Training Faculty: Possess a team of experienced and highly qualified trainers, including education experts, psychologists, instructional designers, etc., to provide professional guidance and support. | | | | | | | | | |
| 28. | Training Resources: Provide a wide range of teaching resources and tools, such as textbooks, teaching aids, instructional equipment, educational | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | software, etc., to support teachers' learning and teaching activities. | | | | | | | | | |
| 29. | Training Activities: Organize various training activities, such as lectures, seminars, workshops, field visits, hands-on guidance, etc., to provide different forms of learning opportunities. | | | | | | | | | |
| 30. | Financial Support: Provide necessary funding support for teacher training to ensure the smooth running and quality assurance of training activities. | | | | | | | | | |
| Evaluation | | | | | | | | | | |
| 31. | Assessment Content: Assessment content should include knowledge mastery, skill application ability, teaching effectiveness, and other aspects to comprehensively evaluate the training outcomes of teachers. | | | | | | | | | |
| 32. | Formative Assessment: Evaluate the diversity, flexibility, and effectiveness of training formats, including assessments of online courses, offline seminars, hands-on guidance, and other forms of training. | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| 33. | Engagement Assessment: Evaluate teachers' participation and enthusiasm, including attendance rates, classroom interactions, completion of assignments, etc., to understand the level of recognition and involvement of teachers in the training. | | | | | | | | | |
| 34. | Satisfaction Assessment: Evaluate teachers' satisfaction with the training program and gather feedback, collecting constructive opinions and suggestions to improve and optimize the training plan. | | | | | | | | | |
| 35. | Ongoing Monitoring and Evaluation: Conduct continuous tracking and evaluation after the training to understand the application and effectiveness of the training content in teachers' work, promoting the continuous improvement of training outcomes. | | | | | | | | | |
| 36. | Training Effectiveness Evaluation: Taking into account the above elements, assess the overall training effectiveness and impact, analyze the strengths and weaknesses of the | | | | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons | Opinion level note | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) | -1 | 0 | 1 |
| | training program, and provide improvement suggestions and directions for future training. | | | | | | | | | |

# The second round of evaluation of the elements is formal theme

**Research objectives**

Design a Teachers Artificial Intelligence Literacy Model (TAILM) for Secondary School of Shenzhen City.

**Explain**

This element assessment form is designed to gather your opinion as an expert. The problem in the evaluation is about the details of the training model of Artificial Intelligence Literacy teaching methods for Secondary School Teachers in Shenzhen. The assessment can be divided into the following parts: the general information of the interviewees, the Foundational AI knowledge and needs, the Computational Thinking and Problem-Solving, the AI Tools and Resource Management, the Pedagogical Integration of AI, the Professional Development and Lifelong Learning, and the Evaluation.

2. The consistency of the training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers in Shenzhen was evaluated. Please consider what is specified in each project. How consistent is it in practice? Then select "√ " in the box:

1.Score level 5 means most consistent.

2.Score level 4 means very consistent.

3.Score level 3 means modelrately consistent.

4.Score level 2 means less consistent.

5.Score level 1 means least consistent.

The last section“suggestions and reasons” asks you to express your opinions.In order to make the details of the elements of the problem and resolution more complete.

Open-ended questions at the end of each episode's schedule. Please give additional comments or suggestions for the completeness of each aspect of the Format in particular.

**General information of the interviewee.**

1.Name.....

2.Age.....years

3.Highest educational qualification.....

4.Work experience.....years

5.Current job position.....

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| Foundational AI knowledge and needs | | level of opinion | | | | | Suggestions and reasons |
| 1. | Professional knowledge and skills: including expertise in Secondary School Education theory, psychology, teaching methods, curriculum design, as well as practical skills in teaching, communication, and management. | | | | | | |
| 2. | Teaching resources and tools: providing resources such as textbooks, teaching aids, teaching equipment suitable for Secondary School teaching, as well as training in teaching techniques and information technology tools to help teachers better conduct teaching activities. | | | | | | |
| 3. | Education policies and regulations: Understanding relevant education policies, laws, and standards to ensure that teachers comply with regulations during the teaching process, safeguarding the rights and safety of student. | | | | | | |
| 4. | Professional development and career planning: Assisting teachers in career planning, providing opportunities for professional development and training programs to promote teachers' growth and advancement. | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| 5. | student development and educational theories: Teachers need to understand the latest theories on student development and education, grasp knowledge in areas such as psychology, cognition, emotions, etc., to guide practical teaching activities. | | | | | | |
| 6. | Updating teaching methods and strategies: Teachers need to learn and master a variety of teaching methods and strategies to enhance teaching effectiveness and meet the learning needs of different student. | | | | | | |
| 7. | Curriculum design and assessment skills: Teachers need to enhance their ability in curriculum design and assessment, develop teaching plans that align with the characteristics and needs of student, and effectively evaluate teaching outcomes. | | | | | | |
| 8. | Personal development needs: Individual differences in teachers' personal development needs are also important factors; some teachers may wish to pursue further studies, while others may need to enhance specific skills or knowledge. | | | | | | |
| 9. | Social needs: Teachers need to understand the changes in social needs, adapt to social development, and enhance the quality and effectiveness of educational services. | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| 10. | Individual differences and feedback: There are differences among teachers as individuals, and personalized training plans should be developed based on individual needs and feedback to enhance the specificity and effectiveness of training. | | | | | | |
| Pedagogical Integration of AI | | | | | | | |
| 11. | Secondary School Education Theories: Introduce the basic theories of Secondary School Education, including student development stages, learning theories, educational psychology, and other related content, to help teachers better understand the characteristics of student growth and learning. | | | | | | |
| 12. | Teaching Methods and Techniques: Training teachers to use a variety of teaching methods and techniques, such as heuristic teaching, situational teaching, game-based teaching, as well as skills in classroom management, student assessment, and other aspects. | | | | | | |
| 13. | Curriculum Design and Teaching Plans: Guide teachers in developing curriculum designs and teaching plans that meet the needs of student, including goal setting, content arrangement, and instructional activity | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | design. | | | | | | |
| 14. | student Psychological Health and Behavior Management: Training teachers to understand issues related to student psychological health, learn how to establish good relationships with student, and effectively manage their behavior. | | | | | | |
| 15. | student to unleash their potential, and fostering student artistic expression abilities and creativity. | | | | | | |
| 16. | Principles of Secondary School Education: Teachers need to grasp the principles and methods of Secondary School Education, understand how to promote the holistic development of student through games, experiences, and other means. | | | | | | |
| 17. | Curriculum Design and Assessment: Teachers need to learn how to design curriculum that meets the characteristics and needs of student, and master effective assessment methods to enhance teaching quality. | | | | | | |
| 18. | Multicultural Education: Teachers need to understand the importance of multicultural education, and learn how to promote cross-cultural communication and understanding among student in their teaching practices. | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| 19. | Special Education Needs: Teachers should also receive training on special education needs to understand how to support and educate student with special needs, promoting their development. | | | | | | |
| 20. | Professional Development: Pedagogical Integration of AI should also include enhancing teachers' professional competence and ethical standards, cultivating their sense of responsibility, innovative spirit, and ability to work collaboratively in a team. | | | | | | |
| Computational Thinking and Problem-Solving | | | | | | | |
| 21. | Practical Teaching: Training teachers through practical teaching experiences, allowing them to apply the knowledge and skills they have learned in real classroom settings, enhancing their practical teaching abilities. | | | | | | |
| 22. | Training Manuals and Teaching Materials: Providing specially designed training manuals, textbooks, or teaching resources to assist teachers in systematically learning and mastering relevant knowledge and skills. | | | | | | |
| 23. | Video Teaching and Demonstrations: Utilizing video teaching and demonstrations to showcase teaching techniques, case studies, and other content, helping teachers to | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | visually understand and learn. | | | | | | |
| 24. | Learning Community and Discussion Platform: Establishing a learning community and discussion platform for teachers to engage in communication, share experiences and resources, and facilitate collaborative learning and growth. | | | | | | |
| 25. | Peer Support: Establishing a teacher communication platform or professional community to facilitate experience sharing, collaborative learning, and mutual support among teachers. | | | | | | |
| 26. | Assistive Technology: Utilizing modern technology to support teacher training, such as virtual reality technology, intelligent teaching systems, online assessment tools, etc., to enhance training effectiveness and teaching efficiency. | | | | | | |
| 27. | Workshops and Lectures: By organizing specialized workshops and lectures, inviting experts and scholars to share the latest educational theories and practical experiences, we aim to help teachers broaden their knowledge horizons. | | | | | | |
| 28. | Case Studies and Sharing: By conducting case studies and sharing teaching practices, we aim to help teachers learn from others' | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | successful experiences and lessons, inspire reflection, and improve teaching methods. | | | | | | |
| 29. | Practical Activities and Observation Classes: Organizing practical activities and observation classes to allow teachers to actively participate in and observe excellent teaching practices, enhancing their practical skills and teaching abilities. | | | | | | |
| 30. | Group Discussions and Collaboration: Through group discussions and collaboration, we aim to facilitate communication and interaction among teachers, collectively explore educational issues, promote idea exchange, and foster mutual growth. | | | | | | |
| Ethics and Responsible AI Use | | | | | | | |
| 31. | Teaching Materials and Tools: Providing resources such as suitable teaching materials, tools, and instructional equipment for Secondary School education to assist teachers in conducting teaching activities, enriching teaching content, and enhancing teaching effectiveness. | | | | | | |
| 32. | Online Platform and Resource Repository: Establishing an online learning platform or resource repository to provide teachers with access to teaching videos, materials, lesson plans, case studies, and other resources that | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | can be accessed anytime and anywhere, facilitating teacher learning and communication. | | | | | | |
| 33. | Learning Community and Interactive Platform: Establishing a teacher learning community or online forum to facilitate communication and interaction among teachers, enabling them to share experiences, resources, and teaching achievements. | | | | | | |
| 34. | Assessment and Feedback: Providing regular assessment and feedback mechanisms to help teachers understand their learning progress, adjust their learning direction in a timely manner, and continuously enhance their capabilities. | | | | | | |
| 35. | Educational Institutions and Professional Organizations: Educational institutions and professional organizations typically provide various teacher training resources, including seminars, workshops, professional courses, etc., to help teachers continuously learn and grow. | | | | | | |
| 36. | Experts, Scholars, and Lecturers: Inviting experts, scholars, and lecturers to participate in teacher training, share the latest educational theories and practical | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | experiences, and help teachers enhance their professional knowledge and skills. | | | | | | |
| 37. | Educational Books and Journals: Providing a wide range of educational books and journals for teachers to reference, enabling them to understand the latest educational theories, research findings, and practical case studies. | | | | | | |
| 38. | Teaching Resource Repository: Establishing a teaching resource repository to collect and organize various teaching resources, such as instructional videos, lesson plan examples, teaching tools, etc., to provide teachers with a wealth of teaching materials and reference materials. | | | | | | |
| 39. | Pedagogical Technology Support: Providing pedagogical technology support to help teachers master the application of teaching technologies and tools, enhancing teaching effectiveness and innovation capabilities. | | | | | | |
| 40. | Practice Bases and Observation Opportunities: Providing practice bases and observation opportunities for teachers to actively participate in practical activities and observe excellent teaching practices, promoting experience accumulation and enhancing teaching capabilities. | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| Professional Development and Lifelong Learning | | | | | | | |
| 41. | Needs Analysis: Understanding teachers' Foundational AI knowledge and needs and learning objectives, and customizing training plans tailored to the backgrounds and requirements of individual teachers. | | | | | | |
| 42. | Targeted Curriculum Design: Designing curriculum content that meets the practical needs of Secondary School Teachers, covering aspects such as teaching theory, practical skills, and curriculum design. | | | | | | |
| 43. | Practice-Oriented: Emphasizing practical exercises and case studies to help teachers apply their knowledge and skills to real-world scenarios, enhancing their practical abilities. | | | | | | |
| 44. | Feedback and Evaluation: Establishing an effective feedback mechanism to promptly collect teachers' learning feedback and performance evaluations, in order to provide personalized guidance and support to teachers. | | | | | | |
| 45. | Peer Support and Sharing: Encouraging teachers to communicate and share experiences with each other, establishing professional communities and collaborative networks to facilitate mutual learning and | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | growth. | | | | | | |
| 46. | Diversified Training Formats: Utilizing a variety of formats such as online, offline, practical, and peer exchanges to cater to different teachers' learning styles and needs. | | | | | | |
| 47. | Progressive Training: Adopting a phased and progressive training approach, starting from basic knowledge to professional skills and then to practical abilities development, gradually enhancing teachers' overall competency. | | | | | | |
| 48. | Participatory Training: Encouraging teachers to engage in classroom interactions, group discussions, case studies, and other activities to promote active participation and communication among learners, enhancing the effectiveness of learning. | | | | | | |
| 48. | Incentive Mechanism: Establishing reward systems or certification recognition to incentivize teachers to actively participate in training, enhancing learning motivation and effectiveness. | | | | | | |
| 50. | Ongoing Monitoring: Conducting follow-up evaluations after training, collecting feedback to understand the training effectiveness, and providing further support and guidance to teachers. | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| AI Tools and Resource Management | | | | | | | |
| 51. | Training Plan and Objectives: Establishing clear training plans and objectives, outlining the training content, format, schedule, etc., to ensure the systematic and continuous nature of the training. | | | | | | |
| 52. | Training Facilities: Providing suitable training venues and facilities, including classrooms, laboratories, multimedia equipment, etc., to ensure a comfortable and convenient training environment. | | | | | | |
| 53. | Systemic Challenges and Institutional Support: Establishing an effective training evaluation mechanism to assess teachers' learning progress and performance, making timely adjustments to the training direction and methods to ensure training effectiveness. | | | | | | |
| 54. | Management Mechanism: Establishing a comprehensive training management mechanism, including training information management, student management, course management, etc., to ensure the orderly and efficient operation of the training program. | | | | | | |
| 55. | Incentive Mechanism: Establishing reward systems or certification programs to motivate teachers to actively participate in training, | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | enhancing learning motivation and effectiveness. | | | | | | |
| 56. | Training Faculty: Having a team of experienced and highly qualified training professionals, including education experts, psychologists, instructional designers, etc., to provide professional guidance and support. | | | | | | |
| 57. | Training Resources: Providing a wide range of teaching resources and tools, such as textbooks, teaching aids, teaching equipment, educational software, etc., to support teachers' learning and teaching activities. | | | | | | |
| 58. | Training Courses: Designing course content that meets the needs of teachers and training objectives, covering aspects such as Secondary School Education theory, teaching methods, student psychological well-being, home-school cooperation, etc. | | | | | | |
| 59. | Training Activities: Organizing various training activities, such as lectures, seminars, workshops, field visits, hands-on guidance, etc., to provide different forms of learning opportunities. | | | | | | |
| 60. | Financial Support: Providing necessary funding support for teacher training to ensure the smooth progress and quality | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | assurance of training activities. | | | | | | |
| AI-Supported Student Empowerment | | | | | | | |
| 61. | Foundational AI knowledge and needs Assessment: Conducting targeted needs assessment before the start of training to understand teachers' Foundational AI knowledge and needs and expectations, providing a basis for the design of subsequent training content and formats. | | | | | | |
| 62. | Developing Training Plan: Based on the results of the needs assessment, creating a detailed training plan that includes training content, schedule, training formats, etc., to ensure clear and targeted training objectives. | | | | | | |
| 63. | Sharing and Communication: Encouraging teachers to share training experiences and teaching practices with each other to promote mutual learning and growth, and to establish a collaborative and learning-oriented teacher team. | | | | | | |
| 64. | Faculty Preparation: Providing necessary training materials and teaching aids for trainers to ensure that they possess professional knowledge and training skills, enabling them to effectively impart knowledge. | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| 65. | Practical Guidance: Providing practical opportunities and guidance to help teachers apply the knowledge they have learned to actual teaching, enhancing their practical skills and teaching abilities. | | | | | | |
| 66. | Follow-up Coaching: Conducting follow-up coaching after training to continuously monitor the learning and growth of teachers, providing necessary support and guidance to help teachers continually improve. | | | | | | |
| 67. | Feedback Evaluation: Establishing an effective feedback mechanism to collect teachers' feedback and training effectiveness evaluations, making timely adjustments and improvements to training programs to enhance training outcomes. | | | | | | |
| 68. | Ongoing Monitoring: Conducting follow-up assessments after training to understand teachers' learning outcomes and practical application, and providing further support and guidance to teachers. | | | | | | |
| 69. | Selecting Training Formats: Based on the training content and teachers' specific circumstances, choosing appropriate training formats such as online courses, offline seminars, practical guidance, etc., to enhance teachers' learning effectiveness. | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| 70. | Continuous Support: Providing ongoing support and guidance to teachers after the training, encouraging them to continue learning and improving, and promoting their professional development. | | | | | | |
| Systemic Challenges and Institutional Support | | | | | | | |
| 71. | Goals and Standards: Clearly define the training objectives and assessment criteria to ensure that the evaluation targets and content are aligned with the training goals. | | | | | | |
| 72. | Assessment Content: The assessment content should include aspects such as knowledge mastery, skill application abilities, teaching effectiveness, etc., to comprehensively evaluate the training outcomes of teachers. | | | | | | |
| 73. | Assessment Schedule: Determine the timing and frequency of assessments, which can be conducted before, during, and after the training, as well as follow-up assessments at certain intervals after the training. | | | | | | |
| 74. | Feedback and Improvement: Provide feedback based on the assessment results to guide teachers in improving teaching methods and practical skills, promoting their professional development. | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| 75. | Formative Assessment: Evaluate the diversity, flexibility, and effectiveness of training formats, including assessments of online courses, offline seminars, practical guidance, and other forms of evaluation. | | | | | | |
| 76. | Engagement Assessment: Evaluate teachers' engagement and enthusiasm, including attendance rates, classroom interactions, completion of assignments, etc., to understand the level of acceptance and involvement of teachers in the training. | | | | | | |
| 77. | Satisfaction Assessment: Evaluate teachers' satisfaction and feedback on the training program, collect constructive opinions and suggestions to improve and optimize the training plan. | | | | | | |
| 78. | Ongoing Monitoring and Evaluation: Conduct continuous tracking and evaluation after the training to understand the application and effectiveness of the training content in teachers' work, promoting sustained improvement in training outcomes. | | | | | | |
| 79. | Training Effectiveness Evaluation: Taking into account the above elements, assess the overall training effectiveness and impact, analyze the strengths and weaknesses of the training program, and provide improvement | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | suggestions and directions for future training. | | | | | | |
| 80. | Teaching Effectiveness Evaluation: Evaluate the effects demonstrated by teachers in actual teaching after training, including improvements in teaching methods and enhancements in teaching quality. | | | | | | |

# The third round of the element evaluation is formal theme

**Research objectives**

To evaluate the teachers' artificial intelligence literacy improvement model.

**Explain**

1.This element assessment form is designed to gather your opinion as an expert. The question in the evaluation is about the details of the training model of integrated information technology teaching methods for Secondary School Teachers. The assessment can be divided into the following parts: the general information of the respondents, their Foundational AI knowledge and needs, Computational Thinking and Problem-Solving, AI Tools and Resource Management, Pedagogical Integration of AI, Professional Development and Lifelong Learning, and Evaluation.

2. The consistency of the training model of Artificial Intelligence Literacy teaching methods for Secondary School Teachers was evaluated. Please consider what is specified in each project. How consistent is it in practice? Then select "√" in the box:

1.Score level 5 means most consistent.

2.Score level 4 means very consistent.

3.Score level 3 means modelrately consistent.

4.Score level 2 means less consistent.

5.Score level 1 means least consistent.

The last section“suggestions and reasons” asks you to express your opinions.In order to make the details of the elements of the problem and resolution more complete.

3.Open-ended questions at the end of each episode's schedule. Please give additional comments or suggestions for the completeness of each aspect of the Format in particular.

General information of the interviewee.

1.Name.....

2.Age.....years

3.Highest educational qualification.....

4.Work experience.....years

5.Current job position.....

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| Cognition | | | | | | | |
| 1. | Professional Knowledge and Skills: This includes expertise in Secondary School Education theory, psychology, teaching methods, curriculum design, as well as practical skills in teaching, communication, and management. | | | | | | |
| 2. | Teaching Resources and Tools: Provide resources such as teaching materials, teaching aids, teaching equipment suitable for Secondary School education, as well as training in teaching techniques and information technology tools to help teachers better conduct teaching activities. | | | | | | |
| 3. | Updating Teaching Methods and Strategies: Teachers need to learn and master a variety of teaching methods and strategies to enhance teaching effectiveness and meet the learning needs of different student. | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| 4. | Personal Development Needs: The differences in teachers' personal development needs are also important factors. Some teachers may wish to pursue further studies, while others may need to enhance specific skills or knowledge. | | | | | | |
| 5. | Social Needs: Teachers need to understand the changes in social needs, adapt to social development, and improve the quality and effectiveness of educational services. | | | | | | |
| 6. | Individual Differences and Feedback: There are differences among teachers, and personalized training programs should be developed based on individual needs and feedback to enhance the specificity and effectiveness of training. | | | | | | |
| Ethics | | | | | | | |
| 7. | Secondary School Education Theories: Introduce the basic theories of Secondary School Education, including student development stages, learning theories, educational psychology, and other related content, to help teachers better understand the characteristics of student growth and learning. | | | | | | |
| 8. | Teaching Methods and Techniques: Train teachers to use a variety of teaching | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | methods and techniques, such as heuristic teaching, situational teaching, game-based teaching, as well as skills in classroom management, student assessment, and other aspects. | | | | | | |
| 9. | student Psychological Health and Behavior Management: Train teachers to understand issues related to student psychological health, learn how to build good relationships with student, and effectively manage student behavior. | | | | | | |
| 10. | Multicultural Education: Teachers need to understand the importance of multicultural education, learn how to promote cross-cultural communication and understanding among student in their teaching. | | | | | | |
| 11. | Special Education Needs: Teachers should also receive training on special education needs, understand how to support and educate student with special needs, and promote their development. | | | | | | |
| AI-Apps | | | | | | | |
| 12. | Professional Development: The training content should also include enhancing teachers' professional competence and ethical standards, fostering their sense of responsibility, innovative spirit, and ability to | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | work collaboratively in a team. | | | | | | |
| 13. | Practical Teaching: Train teachers through practical teaching experiences, allowing them to apply the knowledge and skills they have learned in actual classrooms, and enhance their practical teaching abilities. | | | | | | |
| 14. | Training Manuals and Teaching Materials: Provide specially designed training manuals, textbooks, or teaching resources to help teachers systematically learn and master relevant knowledge and skills. | | | | | | |
| 15. | Learning Community and Discussion Platform: Establish a learning community and discussion platform for teachers to communicate, share experiences and resources, and promote collaborative learning and growth. | | | | | | |
| 16. | Assistive Technology: Utilize modern technologies to assist teacher training, such as virtual reality technology, intelligent teaching systems, online assessment tools, etc., to enhance training effectiveness and teaching efficiency. | | | | | | |
| 17. | Practical Activities and Observation Lessons: Organize practical activities and observation lessons for teachers to personally participate in and observe excellent teaching practices, | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | enhancing their practical skills and teaching abilities. | | | | | | |
| AI-Pedagogy | | | | | | | |
| 18. | Group Discussions and Collaboration: Facilitate communication and interaction among teachers through group discussions and collaboration, encouraging collective exploration of educational issues, fostering idea exchange, and mutual growth. | | | | | | |
| 19. | Targeted Curriculum Design: Develop curriculum content tailored to the practical needs of Secondary School Teachers, encompassing teaching theories, practical skills, curriculum design, and other relevant aspects. | | | | | | |
| 20. | Peer Assistance and Sharing: Encourage teachers to communicate and share experiences with each other, establish professional communities and collaborative networks, and promote mutual learning and growth. | | | | | | |
| 21. | Diversified Training Formats: Utilize a variety of formats including online, offline, practical, peer-to-peer exchange, etc., to cater to different teachers' learning styles and needs. | | | | | | |
| 22. | Progressive Training: Implement a phased and progressive training approach, starting | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | from basic knowledge to professional skills and then to practical abilities, gradually enhancing teachers' overall competency. | | | | | | |
| 23. | Participatory Training: Encourage teachers to engage in classroom interactions, group discussions, case studies, and other activities to promote active participation and communication among learners, enhancing the effectiveness of learning. | | | | | | |
| Development | | | | | | | |
| 24. | Incentive Mechanism: Establish reward systems or certification programs to incentivize teachers to actively participate in training, enhancing learning motivation and effectiveness. | | | | | | |
| 25. | Training Plan and Objectives: Develop clear training plans and objectives, specifying training content, format, schedule, etc., to ensure the systematic and continuous nature of the training. | | | | | | |
| 26. | Incentive Mechanism: Establish reward systems or certification programs to motivate teachers to actively participate in training, enhancing learning motivation and effectiveness. | | | | | | |
| 27. | Training Faculty: Possess a team of experienced and highly qualified trainers, | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | including education experts, psychologists, instructional designers, etc., to provide professional guidance and support. | | | | | | |
| 28. | Training Resources: Provide a wide range of teaching resources and tools, such as textbooks, teaching aids, instructional equipment, educational software, etc., to support teachers' learning and teaching activities. | | | | | | |
| 29. | Training Activities: Organize various training activities, such as lectures, seminars, workshops, field visits, hands-on guidance, etc., to provide different forms of learning opportunities. | | | | | | |
| Evaluation | | | | | | | |
| 30. | Financial Support: Provide necessary funding support for teacher training to ensure the smooth running and quality assurance of training activities. | | | | | | |
| 31. | Assessment Content: Assessment content should include knowledge mastery, skill application ability, teaching effectiveness, and other aspects to comprehensively evaluate the training outcomes of teachers. | | | | | | |
| 32. | Formative Assessment: Evaluate the diversity, flexibility, and effectiveness of training formats, including assessments of online | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| | courses, offline seminars, hands-on guidance, and other forms of training. | | | | | | |
| 33. | Engagement Assessment: Evaluate teachers' participation and enthusiasm, including attendance rates, classroom interactions, completion of assignments, etc., to understand the level of recognition and involvement of teachers in the training. | | | | | | |
| 34. | Satisfaction Assessment: Evaluate teachers' satisfaction with the training program and gather feedback, collecting constructive opinions and suggestions to improve and optimize the training plan. | | | | | | |
| 35. | Ongoing Monitoring and Evaluation: Conduct continuous tracking and evaluation after the training to understand the application and effectiveness of the training content in teachers' work, promoting the continuous improvement of training outcomes. | | | | | | |
| 36. | Training Effectiveness Evaluation: Taking into account the above elements, assess the overall training effectiveness and impact, analyze the strengths and weaknesses of the training program, and provide improvement suggestions and directions for future training. | | | | | | |

# Satisfaction with the teacher training model of Artificial Intelligence Literacy theme

**Research objectives**

To evaluate satisfaction the Teachers Artificial Intelligence Literacy Model (TAILM) for the Secondary School of Shenzhen City.

**Explain**

1. This element assessment form is designed to gather your opinion as an expert. The questions in the evaluation were details about the satisfaction of the training model. The assessment can be divided into the following parts: the general information of the interviewees, Cognition, Ethics, AI-Apps, AI-Pedagogy, Development, and the Evaluation.

2. The consistency of the satisfaction problem of the training model for teachers was evaluated. Please consider what is specified in each project. How consistent is it in practice? Then select "√" in the box:

1.Score level 5 means most consistent.

2.Score level 4 means very consistent.

3.Score level 3 means modelrately consistent.

4.Score level 2 means less consistent.

5.Score level 1 means least consistent.

The last section“suggestions and reasons” asks you to express your opinions.In order to make the details of the elements of the problem and resolution more complete.

3.Open-ended questions at the end of each episode's schedule. Please give additional comments or suggestions for the completeness of each aspect of the Format in particular.

**General information of the interviewee.**

1.Name.....

2.Age.....years

3.Highest educational qualification.....

4.Work experience.....years

5.Current job position.....

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| Cognition (Foundation and Cognition) | | | | | | | |
| 1 | Basic AI concepts | | | | | | |
| 2 | Key AI applications in education | | | | | | |
| 3 | Limitations and challenges of AI | | | | | | |
| 4 | Understanding AI structures and sources | | | | | | |
| 5 | AI's impact on society and economy | | | | | | |
| 6 | Privacy and security issues in AI use | | | | | | |
| Ethics (Ethics and Social Responsibility) | | | | | | | |
| 7 | AI ethics fundamentals | | | | | | |
| 8 | Understanding regulatory frameworks and guidelines | | | | | | |
| 9 | Promoting digital citizenship in AI usage | | | | | | |
| 10 | Safeguarding student data with AI tools | | | | | | |
| 11 | Balancing technology use and ethical considerations | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| AI-Apps (AI Applications, Generative AI) | | | | | | | |
| 12 | Using AI for personalized learning | | | | | | |
| 13 | Promoting active learning with AI tools | | | | | | |
| 14 | AI-based adaptive learning techniques | | | | | | |
| 15 | Selecting appropriate AI tools for classroom use | | | | | | |
| 16 | Developing teaching resources with AI assistance | | | | | | |
| 17 | Customizing AI tools to fit diverse learning needs | | | | | | |
| AI-Pedagogy (Teaching Methods and Curriculum) | | | | | | | |
| 18 | Designing AI-supported lesson plans | | | | | | |
| 19 | Implementing AI-driven formative assessments | | | | | | |
| 20 | Algorithmic thinking and problem decomposition | | | | | | |
| 21 | Designing basic AI models for classroom use | | | | | | |
| 22 | Exploring data-driven decision-making processes | | | | | | |
| 23 | Applying pattern recognition with datasets | | | | | | |
| Development (Teacher Professional Development) | | | | | | | |
| 24 | Engaging in AI-focused professional training | | | | | | |
| 25 | Exploring global AI educational practices | | | | | | |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| 26 | Utilizing online AI learning platforms | | | | | | |
| 27 | Creating professional learning communities for AI | | | | | | |
| 28 | Participating in AI education conferences | | | | | | |
| 29 | Advocating for AI policy reforms in education | | | | | | |
| Evaluation (Evaluation, Feedback, and Policy) | | | | | | | |
| 30 | Evaluating the effectiveness of AI tools in teaching | | | | | | |
| 31 | Troubleshooting common AI tool challenges | | | | | | |
| 32 | Encouraging students to design AI projects | | | | | | |
| 33 | Teaching students about AI career paths | | | | | | |
| 34 | Addressing barriers to AI adoption in schools | | | | | | |
| 35 | Developing standards for AI literacy assessment | | | | | | |
| 36 | Aligning AI practices with school goals | | | | | | |

# Pre-test and post-test comparison of the changes in teacher training theme

**Research objectives**

Pre-test and post-test comparison of the changes in teacher training.

**Explain**

1.This element assessment form is designed to gather your opinion as an expert. The questions in the assessment were details about the pre-test and post-test contrasts of changes in teacher training. The assessment can be divided into the following parts: the general information of the interviewees, the Cognition,the Ethics, the AI-Apps,the AI-Pedagogy, the Development, and the Evaluation.

2. Evaluation of the pre-test and post-test comparison of the changes in teacher training. Please consider what is specified in each project. How consistent is it in practice? Then select "√" in the box:

1.Score level 5 means most consistent.

2.Score level 4 means very consistent.

3.Score level 3 means modelrately consistent.

4.Score level 2 means less consistent.

5.Score level 1 means least consistent.

The last section“suggestions and reasons” asks you to express your opinions.In order to make the details of the elements of the problem and resolution more complete.

3.Open-ended questions at the end of each episode's schedule. Please give additional comments or suggestions for the completeness of each aspect of the Format in particular.

**General information of the interviewee.**

1.Name.....

2.Age.....years

3.Highest educational qualification.....

4.Work experience.....years

5.Current job position.....

| NO. | Test item | level of opinion | | | | | Suggestions and reasons |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (If any) |
| 1 | Whether the 6 factors of Cognition have an impact on teacher training | | | | | | |
| 2 | Whether the 5 factors of the Ethics have an influence on the teacher training | | | | | | |
| 3 | Whether the 6 factors of AI-Apps have an impact on teacher training | | | | | | |
| 4 | Whether the 6 factors of the AI-Pedagogy had an influence on teacher training | | | | | | |
| 5 | Whether the 6 factors of the Development have an influence on the teacher training | | | | | | |
| 6 | Whether the 7 factors of the Evaluation had an impact on teacher training | | | | | | |

# Focus Group Forms

## To evaluate the Teachers Artificial Intelligence Literacy Model (TAILM) for the Secondary School of Shenzhen City

Explain:

The purpose of this table is to focus on the training model through focus group methods. Nine experts who met the qualification requirements were carefully selected to ensure the professionalism and depth of the discussion. Together, the experts will dive deeper into each specific strategy proposed for online teaching and learning. The expert panel will review each proposed strategy individually and make final conclusions on each strategy, "Pass", "Change", "Add", "Delete". Then select "√" in the box:

Thank You

Wu Zhaobin

A dissertation meeting the requirements for a Doctorate in Educational Technology Management

Bansomdejchaopraya Rajabhat University

| Item | Effective strategy for training model of Teachers Artificial Intelligence Literacy for Secondary School Teachers | Fruit | | | |
|---|---|---|---|---|---|
| | | Pass | Through | Revise | Delete |
| Cognition | | | | | |
| 1 | Professional Knowledge and Skills: This includes expertise in Secondary School Education theory, psychology, teaching methods, curriculum design, as well as practical skills in teaching, communication, and management. | | | | |
| 2 | Teaching Resources and Tools: Provide resources such as teaching materials, teaching aids, teaching equipment suitable for Secondary School education, as well as training in teaching techniques and information technology tools to help teachers better conduct teaching activities. | | | | |
| 3 | Updating Teaching Methods and Strategies: Teachers need to learn and master a variety of teaching methods and strategies to enhance teaching effectiveness and meet the learning needs of different student. | | | | |
| 4 | Personal Development Needs: The differences in teachers' personal development needs are also important factors. Some teachers | | | | |

| Item | Effective strategy for training model of Teachers Artificial Intelligence Literacy for Secondary School Teachers | Fruit | | | |
|---|---|---|---|---|---|
| | | Pass | Through | Revise | Delete |
| | may wish to pursue further studies, while others may need to enhance specific skills or knowledge. | | | | |
| 5 | Social Needs: Teachers need to understand the changes in social needs, adapt to social development, and improve the quality and effectiveness of educational services. | | | | |
| 6 | Individual Differences and Feedback: There are differences among teachers, and personalized training programs should be developed based on individual needs and feedback to enhance the specificity and effectiveness of training. | | | | |
| Ethics | | | | | |
| 7 | Secondary School Education Theories: Introduce the basic theories of Secondary School Education, including student development stages, learning theories, educational psychology, and other related content, to help teachers better understand the characteristics of student growth and learning. | | | | |
| 8 | Teaching Methods and Techniques: Train teachers to use a variety of | | | | |

| Item | Effective strategy for training model of Teachers Artificial Intelligence Literacy for Secondary School Teachers | Fruit | | | |
|---|---|---|---|---|---|
| | | Pass | Through | Revise | Delete |
| | teaching methods and techniques, such as heuristic teaching, situational teaching, game-based teaching, as well as skills in classroom management, student assessment, and other aspects. | | | | |
| 9 | student Psychological Health and Behavior Management: Train teachers to understand issues related to student psychological health, learn how to build good relationships with student, and effectively manage student behavior. | | | | |
| 10 | Multicultural Education: Teachers need to understand the importance of multicultural education, learn how to promote cross-cultural communication and understanding among student in their teaching. | | | | |
| 11 | Special Education Needs: Teachers should also receive training on special education needs, understand how to support and educate student with special needs, and promote their development. | | | | |

| Item | Effective strategy for training model of Teachers Artificial Intelligence Literacy for Secondary School Teachers | Fruit | | | |
|---|---|---|---|---|---|
| | | Pass | Through | Revise | Delete |
| AI-Apps | | | | | |
| 12 | Professional Development: The training content should also include enhancing teachers' professional competence and ethical standards, fostering their sense of responsibility, innovative spirit, and ability to work collaboratively in a team. | | | | |
| 13 | Practical Teaching: Train teachers through practical teaching experiences, allowing them to apply the knowledge and skills they have learned in actual classrooms, and enhance their practical teaching abilities. | | | | |
| 14 | Training Manuals and Teaching Materials: Provide specially designed training manuals, textbooks, or teaching resources to help teachers systematically learn and master relevant knowledge and skills. | | | | |
| 15 | Learning Community and Discussion Platform: Establish a learning community and discussion platform for teachers to communicate, share experiences and resources, and promote collaborative learning and | | | | |

| Item | Effective strategy for training model of Teachers Artificial Intelligence Literacy for Secondary School Teachers | Fruit | | | |
|---|---|---|---|---|---|
| | | Pass | Through | Revise | Delete |
| | growth. | | | | |
| 16 | Assistive Technology: Utilize modern technologies to assist teacher training, such as virtual reality technology, intelligent teaching systems, online assessment tools, etc., to enhance training effectiveness and teaching efficiency. | | | | |
| 17 | Practical Activities and Observation Lessons: Organize practical activities and observation lessons for teachers to personally participate in and observe excellent teaching practices, enhancing their practical skills and teaching abilities. | | | | |
| AI-Pedagogy | | | | | |
| 18 | Group Discussions and Collaboration: Facilitate communication and interaction among teachers through group discussions and collaboration, encouraging collective exploration of educational issues, fostering idea exchange, and mutual growth. | | | | |
| 19 | Targeted Curriculum Design: Develop curriculum content tailored to the practical needs of Secondary School Teachers, encompassing teaching | | | | |

| Item | Effective strategy for training model of Teachers Artificial Intelligence Literacy for Secondary School Teachers | Fruit | | | |
|---|---|---|---|---|---|
| | | Pass | Through | Revise | Delete |
| | theories, practical skills, curriculum design, and other relevant aspects. | | | | |
| 20 | Peer Assistance and Sharing: Encourage teachers to communicate and share experiences with each other, establish professional communities and collaborative networks, and promote mutual learning and growth. | | | | |
| 21 | Diversified Training Formats: Utilize a variety of formats including online, offline, practical, peer-to-peer exchange, etc., to cater to different teachers' learning styles and needs. | | | | |
| 22 | Progressive Training: Implement a phased and progressive training approach, starting from basic knowledge to professional skills and then to practical abilities, gradually enhancing teachers' overall competency. | | | | |
| 23 | Participatory Training: Encourage teachers to engage in classroom interactions, group discussions, case studies, and other activities to promote active participation and communication among learners, | | | | |

| Item | Effective strategy for training model of Teachers Artificial Intelligence Literacy for Secondary School Teachers | Fruit | | | |
|---|---|---|---|---|---|
| | | Pass | Through | Revise | Delete |
| | enhancing the effectiveness of learning. | | | | |
| Development | | | | | |
| 24 | Incentive Mechanism: Establish reward systems or certification programs to incentivize teachers to actively participate in training, enhancing learning motivation and effectiveness. | | | | |
| 25 | Training Plan and Objectives: Develop clear training plans and objectives, specifying training content, format, schedule, etc., to ensure the systematic and continuous nature of the training. | | | | |
| 26 | Incentive Mechanism: Establish reward systems or certification programs to motivate teachers to actively participate in training, enhancing learning motivation and effectiveness. | | | | |
| 27 | Training Faculty: Possess a team of experienced and highly qualified trainers, including education experts, psychologists, instructional designers, etc., to provide professional guidance and support. | | | | |

| Item | Effective strategy for training model of Teachers Artificial Intelligence Literacy for Secondary School Teachers | Fruit | | | |
|---|---|---|---|---|---|
| | | Pass | Through | Revise | Delete |
| 28 | Training Resources: Provide a wide range of teaching resources and tools, such as textbooks, teaching aids, instructional equipment, educational software, etc., to support teachers' learning and teaching activities. | | | | |
| 29 | Training Activities: Organize various training activities, such as lectures, seminars, workshops, field visits, hands-on guidance, etc., to provide different forms of learning opportunities. | | | | |
| Evaluation | | | | | |
| 30 | Financial Support: Provide necessary funding support for teacher training to ensure the smooth running and quality assurance of training activities. | | | | |
| 31 | Assessment Content: Assessment content should include knowledge mastery, skill application ability, teaching effectiveness, and other aspects to comprehensively evaluate the training outcomes of teachers. | | | | |
| 32 | Formative Assessment: Evaluate the diversity, flexibility, and effectiveness of training formats, including | | | | |

| Item | Effective strategy for training model of Teachers Artificial Intelligence Literacy for Secondary School Teachers | Fruit | | | |
|---|---|---|---|---|---|
| | | Pass | Through | Revise | Delete |
| | assessments of online courses, offline seminars, hands-on guidance, and other forms of training. | | | | |
| 33 | Engagement Assessment: Evaluate teachers' participation and enthusiasm, including attendance rates, classroom interactions, completion of assignments, etc., to understand the level of recognition and involvement of teachers in the training. | | | | |
| 34 | Satisfaction Assessment: Evaluate teachers' satisfaction with the training program and gather feedback, collecting constructive opinions and suggestions to improve and optimize the training plan. | | | | |
| 35 | Ongoing Monitoring and Evaluation: Conduct continuous tracking and evaluation after the training to understand the application and effectiveness of the training content in teachers' work, promoting the continuous improvement of training outcomes. | | | | |

| Item | Effective strategy for training model of Teachers Artificial Intelligence Literacy for Secondary School Teachers | Fruit | | | |
|---|---|---|---|---|---|
| | | Pass | Through | Revise | Delete |
| 36 | Training Effectiveness Evaluation: Taking into account the above elements, assess the overall training effectiveness and impact, analyze the strengths and weaknesses of the training program, and provide improvement suggestions and directions for future training. | | | | |
| Propose: | | | | | |

# Appendix A

## Questionnaire

Introduction:

Greetings!

We would like to invite you to participate in our survey on teachers' Artificial Intelligence literacy in 2024. Please answer the following survey questions truthfully based on your self-perception. The information we collect from this survey will be used for research purpose only, and any personally information will be removed from all publications and presentations.

Thank you for your participation!

## Basic information

1. Your birth sex is

☐Male ☐Female

2. Your educational stage is

☐Primary

☐Middle

☐High

3. Your school location is

☐rural

☐suburban

☐urban

4. Your educational background is

☐Below Bachelor

☐Bachelor

☐Postgraduate

5. Your age is

☐≤30 years old

☐31–40 years old

☐41–50 years old

☐≥51 years old

6. Your job title is

☐Beginner

☐Intermediate

☐Deputy Senior

☐Senior

**Knowing and Understanding AI**

1. I can distinguish between smart educational devices and non-smart educational devices.

2. I know where educational AI can help me.

3. I can identify AI technology in educational AI products or services.

4. I feel comfortable when using educational AI products.

5. I think teachers should actively learn to use intelligent technology to assist in education teaching.

**Applying AI**

1. I can use educational AI products skillfully to help me with my daily teaching.

2. I can learn new educational AI products relatively easily.

3. I can use educational AI products to improve my work efficiency.

4. I can support and guide students in using educational AI products.

5. I am able to integrate educational AI technologies with curriculum instruction.

**Evaluating AI Application**

1. After using the product or service, I am able to evaluate the functionality and effectiveness of the educational AI product or service.

2. I am able to select the most appropriate solution from the various options offered by the educational AI product or service.

3. I am able to select the appropriate educational AI product or service according to the specific educational task.

4. I am able to select an AI assessment tool that matches student learning outcomes.

5. I am able to use educational AI products or services to give feedback to students on their learning.

**AI Ethics**

1. I always follow ethical principles when using educational AI products.

2. I am alert to privacy and information security issues when using educational AI products.

3. I am alert to the misuse of educational AI.

4. I always consider ethical and security issues when applying educational AI technologies.

5. I am able to detect ethical and moral violations during the application of educational AI in a timely manner.

# Teachers' Artificial Intelligence Literacy Improvement Model (TAILM) User Manual

## I. Cognition

**Objective**: Systematically build teachers' foundational knowledge of artificial intelligence (AI), understand its educational applications, and recognize technical limitations.

**Core Content & Implementation Steps**

1. **In-Depth Learning of AI Core Concepts**
    - **Theoretical Foundations**:
        - Complete MOOC courses (e.g., Coursera's *AI For Everyone*, edX's *Fundamentals of AI*), focusing on machine learning, natural language processing, and neural networks.
        - Study the *White Paper on AI in Education* (China Ministry of Education, 2023) to grasp AI's strategic role in education.
    - **Understanding Technical Boundaries**:
        - Attend workshops on "AI Limitations," analyze case studies (e.g., autonomous vehicle accidents, algorithmic bias in hiring), and write reflection reports.
        - Review *AI Failure Case Studies* (UNESCO, 2024) to identify risks of over-reliance on AI in teaching.
2. **Analyzing Educational Applications**
    - **Personalized Learning Systems**:
        - Pilot adaptive platforms like Knewton and DreamBox; document student progress and learning path adjustments.

        - Conduct experiments comparing traditional teaching vs. AI-assisted methods, analyzing performance and engagement metrics.
    - **Classroom Management Tools**:
        - Use Classcraft's AI behavior analysis module to track student engagement and generate personalized strategies.
        - Explore AI teaching assistants (e.g., Carnegie Learning's MATHia) for automated grading and feedback.
3. **Cross-Disciplinary Integration**
    - **Case Studies**:
        - Design an "AI + History" project: Use ChatGPT to simulate historical dialogues, guiding students to critique information authenticity.
        - Develop an "AI + Art" course: Generate artworks via MidJourney and discuss algorithmic creativity in art history.
    - **Resource Curation**:
        - Build a school-based AI resource library with subject-specific tools, case videos, and academic papers (managed via Zotero).

**Tools & Resources**

- **Learning Platforms**: XuetangX (*Introduction to AI Education*), LinkedIn Learning (*AI Ethics in Education*)
- **Practical Tools**: Google Teachable Machine (visual ML training), TensorFlow Playground (neural network simulation)
- **Case Repositories**: UNESCO *Global AI Education Innovations*, MIT Media Lab *AI Education Experiments*

## II. Ethics

**Objective**: Ensure AI applications align with privacy, fairness, and social responsibility principles.

**Core Content & Implementation Steps**

1. **Learning Ethical Frameworks**
    - **Global Standards**:
        - Study UNESCO's *Recommendation on AI Ethics* (2021), focusing on transparency, accountability, and inclusivity.
        - Compare GDPR (EU) and China's *Personal Information Protection Law* to draft school data policies.
    - **Ethical Dilemma Simulations**:
        - Role-play debates on "AI classroom surveillance" involving teachers, students, parents, and developers.
2. **Data Security Practices**
    - **Technical Safeguards**:
        - Encrypt student data with VeraCrypt and deploy Microsoft Purview for anonymized AI analysis.
    - **Compliance Protocols**:
        - Require vendors to submit *AI Tool Compliance Checklists* (e.g., ISO 27001 certification) before adoption.
        - Host annual "Data Security Week" to educate stakeholders on privacy best practices.
3. **Cultivating Digital Citizenship**
    - **Curriculum Integration**:

        - Offer an elective course *AI & Society*, discussing algorithmic bias and misinformation (e.g., TikTok's recommendation system).
    - **Community Engagement**:
        - Distribute *Family AI Guidelines* to parents, covering screen time management and content filtering.

**Tools & Resources**

- **Ethics Tools**: IBM AI Fairness 360 (bias detection), Google Responsible AI Toolkit
- **Teaching Resources**: Stanford *AI Ethics Curriculum*, Common Sense Education *Digital Citizenship for K-12*
- **Policy Templates**: *School AI Ethics Committee Charter*, *Classroom AI Consent Form*

## III. AI Applications (AI-Apps)

**Objective**: Enhance teaching efficiency and student engagement through diversified AI tools.

**Core Content & Implementation Steps**

1. **Tool Selection & Adaptation**
    - **Subject-Specific Matrix**:

| Subject | Recommended Tools | Key Functions |
|---|---|---|
| Language | Grammarly, ChatGPT | Writing support, creativity |
| Math | Wolfram Alpha, GeoGebra | Equation solving, visualization |
| Science | Labster, PhET Simulations | Virtual labs, simulations |
| Arts | Runway ML, Adobe Firefly | Algorithmic art generation |

- **Tool Piloting**:
  - Organize “AI Tool Trial Month” for teachers to test 3-5 tools and complete *Efficacy Evaluation Forms*.

2. **Personalized Teaching**
   - **Adaptive Learning Paths**:
     - Use ALEKS in math classes to diagnose knowledge gaps and assign tailored exercises.
   - **AI-Generated Resources**:
     - Create dynamic slides with Canva Magic Design or Synthesia’s AI avatars for flipped classrooms.
3. **Student Creativity Projects**
   - **Project-Based Learning (PBL)**:
     - *AI Junior Scientists*: Train image classification models (Google Quick Draw) to identify campus plants.
     - *AI Newsroom*: Use ChatGPT to draft articles; students fact-check and refine them.
   - **Competitions & Showcases**:
     - Host school-wide *AI Innovation Challenges* and exhibit winning projects at open houses.

**Tools & Resources**

- **General Platforms**: Microsoft Copilot, Notion AI
- **Subject-Specific**: MATHia (math), Inkitt (creative writing)
- **Development Tools**: Scratch 3.0, Teachable Machine

## IV. AI Pedagogy

**Objective**: Integrate AI into instructional design to create student-centered smart classrooms.

**Core Content & Implementation Steps**

1. **Curriculum Design Framework**
    - **TPACK-AI Model**:
        - **Technology (T)**: Select tools like Quizlet Live for vocabulary drills.
        - **Pedagogy (P)**: Gamify lessons using Classcraft's reward system.
        - **Content Knowledge (CK)**: Design AI tasks aligned with textbooks (e.g., GeoGebra for geometry proofs).
    - **Lesson Plan Template**:
        - Unit: Climate Change
        - AI Integration:
            - Pre-class: Analyze local weather data via Climate.ai.
            - In-class: Use AI-generated simulations to visualize carbon emissions.
            - Post-class: AI-graded reports with personalized reading recommendations.
2. **Real-Time Feedback & Intervention**
    - **AI Dashboards**:
        - Monitor student engagement via GoGuardian and provide instant feedback.
    - **Differentiated Instruction**:

        - Group students by AI-diagnosed skill levels (e.g., NWEA MAP Growth) and assign tiered tasks.

3. **Computational Thinking Development**
    - **Coding Integration**:
        - Elementary: Design "AI Pet Care" games in Scratch to learn conditional logic.
        - Secondary: Python projects like "Pandemic Spread Simulation" to model data-driven decisions.

**Tools & Resources**

- **Instructional Design**: Nearpod (interactive lessons), Padlet (collaborative brainstorming)
- **Assessment Tools**: Gradescope (AI grading), Edpuzzle (video quizzes)

## V. Development

**Objective**: Foster lifelong learning and collaborative innovation in AI education.

**Core Content & Implementation Steps**

1. **Professional Growth Pathways**
    - **Certifications**:
        - Beginner: Complete *AI Education Essentials* (40 hours, Coursera certification).
        - Advanced: Earn ISTE's *AI Educator Leader* credential (requires practicum reports).
    - **School-Based Training**:
        - Host monthly *AI Cafés* for sharing best practices (e.g., Canva for certificates).

2. **Cross-Sector Collaboration**
    - **Industry Partnerships**:
        - Invite iFLYTEK engineers to lead workshops on speech recognition.
    - **Global Networks**:
        - Join OECD's *AI Education Innovation Alliance* for international teacher forums.

**Tools & Resources**

- **Communities**: ISTE AI Community, CAAI Teachers' Chapter
- **Collaboration Tools**: Slack (cross-school groups), Miro (virtual whiteboards)

## VI. Evaluation

**Objective**: Establish a multidimensional evaluation system to optimize AI teaching practices.

**Core Content & Implementation Steps**

1. **Tool Efficacy Assessment**
    - **Quantitative Metrics**:
        - Track student performance improvements (e.g., 15% math score increase post-AI adoption).
    - **Qualitative Feedback**:
        - Distribute *AI Classroom Experience Surveys* (Likert scale + open-ended questions).

2. **Outcome Tracking**
    - **E-Portfolios**:
        - Use Seesaw to archive student AI projects (code, videos, reflections).
    - **Annual Showcases**:
        - Host *AI Expo Days* with parent and expert panels to review top projects.
3. **Policy Compliance Audits**
    - **Annual Reviews**:
        - Verify AI tools comply with COPPA (Children's Online Privacy Protection Act).
        - Publish *AI Transparency Reports* detailing data usage and safeguards.

**Tools & Resources**

- **Evaluation Models**: Kirkpatrick's Four Levels (Reaction, Learning, Behavior, Results)
- **Data Analysis**: Microsoft Power BI (dashboards), NVivo (qualitative coding)

**Implementation Guidelines**

- **Phased Rollout**: Start with *Cognition* and *Applications*, then advance to *Pedagogy* and *Ethics*.
- **Continuous Improvement**: Hold quarterly *AI Retrospectives* to adjust goals based on evaluations.
- **Resource Support**: Ensure access to hardware (GPUs), funding (tool licenses), and dedicated PD time.

# Confidence Questionnaire of AI Literacy

| No. | Question | Response Options |
|---|---|---|
| 1 | Have you ever received formal training in artificial intelligence? | Yes / No |
| 2 | Which of the following best describes AI? | A) Video game technology<br>B) Simulation software<br>C) Machine learning and automation<br>D) Database systems |
| 3 | Which of these tasks can AI perform? (Select all that apply) | A) Image recognition<br>B) Online shopping<br>C) Data analysis<br>D) Language translation |
| 4 | How often do you integrate AI tools into your lessons? | A) Never<br>B) Rarely<br>C) Occasionally<br>D) Frequently |
| 5 | Are you familiar with AI-powered educational platforms/tools? | Yes / No |
| 6 | How comfortable are you with discussing the ethical implications of AI with students? | A) Not comfortable<br>B) Somewhat comfortable<br>C) Comfortable<br>D) Very comfortable |
| 7 | How prepared do you feel to answer students' questions about AI? | A) Not prepared<br>B) Somewhat prepared<br>C) Prepared<br>D) Very prepared |
| 8 | Do you think AI will have a significant impact on the future job market for | Yes / No / Unsure |

| No. | Question | Response Options |
|---|---|---|
| | students? | |
| 9 | How would you rate your confidence in implementing AI tools in your classroom practices? | A) Not confident<br>B) Somewhat confident<br>C) Confident<br>D) Very confident |
| 10 | Which topics related to AI would you like training on? (Select all that apply) | A) Basics of AI<br>B) Pedagogical use of AI tools<br>C) Ethical implications<br>D) Technical troubleshooting |

# Expert Interview Form

Dear expert :

Hello! Thank you very much for taking the time to fill out the expert interview form on " Artificial Intelligence Literacy Model for Secondary School Teachers " .

This expert consultation is only for this academic research, and we will strictly keep the results of the interview form confidential.

Mr.Wu Zhaobin
Doctoral student in “Digital Technology Management for Education”
BanSomdei Chaopraya Rajapat University
Tel:13923726689
Email: 1@2e.cn

Open-ended Questions on the Artificial Intelligence Literacy Model for Secondary School Teachers

Please provide your own opinions on the following issues:

| issues of consideration | Opinions of Expert |
|---|---|
| 1.What is the situation of artificial intelligence literacy of secondary school teachers? | |
| 2.What are the strategies to improve the artificial intelligence literacy of secondary school teachers? | |
| 3.What are the future plans for improving the artificial intelligence literacy of secondary school teachers? | |

**Please provide your own opinions on the following issues about elements:**

| No. | Element | Issues of consideration | Opinions of Expert |
|---|---|---|---|
| 1 | Awareness of teachers' artificial intelligence literacy | What do you think of the situation of the secondary school teachers' awareness of artificial intelligence literacy | |
| | | What are the strategies for improving the secondary school teachers' awareness of artificial intelligence literacy? | |
| 2 | Teachers' artificial intelligence knowledge and skills | What do you think of the situation of the secondary school teachers' artificial intelligence literacy knowledge and skills? | |
| | | What are the strategies for improving the secondary school teachers' artificial intelligence literacy? | |

| No. | Element | Issues of consideration | Opinions of Expert |
|---|---|---|---|
| 3 | Application of Digital Technology | What do you think of the situation of the high school teachers' artificial intelligence literacy | |
| | | What are the strategies for improving the secondary school teachers' artificial intelligence literacy | |
| 4 | Digital ethics and morality | What do you think of the situation of the secondary school teachers' artificial intelligence literacy | |
| | | What are the strategies for improving the secondary school teachers' artificial intelligence literacy | |
| 5 | Professional Development | What do you think of the situation of the school teachers professional development | |
| | | What are the strategies for improving the secondary school teachers' professional development | |

# Appendix D

## The Results of the Quality Analysis of Research Instruments

# Effective strategy for investigate the current problems in Secondary School Artificial Intelligence Literacy training (consistency evaluation)

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| Foundational AI knowledge and needs | | | | | | | | |
| 1. | Professional knowledge and skills: including expertise in Secondary School Education theory, psychology, teaching methods, curriculum design, as well as practical skills in teaching, communication, and management. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 2. | Teaching resources and tools: providing resources such as textbooks, teaching aids, teaching equipment suitable for Secondary School teaching, as well as training in teaching techniques and information technology tools to help teachers better conduct teaching activities. | 1 | 0 | 1 | 1 | 1 | 0.8 | valid |
| 3. | Education policies and regulations: Understanding relevant education policies, laws, and standards to ensure that teachers comply with regulations during the teaching process, safeguarding the rights and safety of student. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 4. | Professional development and career planning: Assisting teachers in career | 1 | 1 | 1 | 1 | 1 | 1 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | planning, providing opportunities for professional development and training programs to promote teachers' growth and advancement. | | | | | | | |
| 5. | student development and educational theories: Teachers need to understand the latest theories on student development and education, grasp knowledge in areas such as psychology, cognition, emotions, etc., to guide practical teaching activities. | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |
| 6. | Updating teaching methods and strategies: Teachers need to learn and master a variety of teaching methods and strategies to enhance teaching effectiveness and meet the learning needs of different student. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 7. | Curriculum design and assessment skills: Teachers need to enhance their ability in curriculum design and assessment, develop teaching plans that align with the characteristics and needs of student, and effectively evaluate teaching outcomes. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 8. | Personal development needs: Individual differences in teachers' personal development needs are also important factors; some teachers may wish to pursue further studies, while others may need to | 1 | 1 | 1 | 1 | 0 | 0.8 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | enhance specific skills or knowledge. | | | | | | | |
| 9. | Social needs: Teachers need to understand the changes in social needs, adapt to social development, and enhance the quality and effectiveness of educational services. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 10. | Individual differences and feedback: There are differences among teachers as individuals, and personalized training plans should be developed based on individual needs and feedback to enhance the specificity and effectiveness of training. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| Pedagogical Integration of AI | | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 11. | Secondary School Education Theories: Introduce the basic theories of Secondary School Education, including student development stages, learning theories, educational psychology, and other related content, to help teachers better understand the characteristics of student growth and learning. | 1 | 0 | 1 | 0 | 1 | 0.8 | valid |
| 12. | Teaching Methods and Techniques: Training teachers to use a variety of teaching methods and techniques, such as heuristic teaching, situational teaching, game-based teaching, as well as skills in classroom management, student assessment, and other aspects. | 1 | 1 | 1 | 1 | 1 | 1 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| 13. | Curriculum Design and Teaching Plans: Guide teachers in developing curriculum designs and teaching plans that meet the needs of student, including goal setting, content arrangement, and instructional activity design. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 14. | student Psychological Health and Behavior Management: Training teachers to understand issues related to student psychological health, learn how to establish good relationships with student, and effectively manage their behavior. | 1 | 0 | 1 | 1 | 1 | 0.8 | valid |
| 15. | student to unleash their potential, and fostering student artistic expression abilities and creativity. | 1 | 1 | 0 | 1 | 1 | 0.8 | valid |
| 16. | Principles of Secondary School Education: Teachers need to grasp the principles and methods of Secondary School Education, understand how to promote the holistic development of student through games, experiences, and other means. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 17. | Curriculum Design and Assessment: Teachers need to learn how to design curriculum that meets the characteristics and needs of student, and master effective assessment methods to enhance teaching quality. | 1 | 1 | 1 | 1 | 1 | 1 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| 18. | Multicultural Education: Teachers need to understand the importance of multicultural education, and learn how to promote cross-cultural communication and understanding among student in their teaching practices. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 19. | Special Education Needs: Teachers should also receive training on special education needs to understand how to support and educate student with special needs, promoting their development. | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |
| 20. | Professional Development: Training content should also include enhancing teachers' professional competence and ethical standards, cultivating their sense of responsibility, innovative spirit, and ability to work collaboratively in a team. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| Computational Thinking and Problem-Solving | | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 21. | Practical Teaching: Training teachers through practical teaching experiences, allowing them to apply the knowledge and skills they have learned in real classroom settings, enhancing their practical teaching abilities. | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |
| 22. | Training Manuals and Teaching Materials: Providing specially designed training | 1 | 1 | 1 | 1 | 1 | 1 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | manuals, textbooks, or teaching resources to assist teachers in systematically learning and mastering relevant knowledge and skills. | | | | | | | |
| 23. | Video Teaching and Demonstrations: Utilizing video teaching and demonstrations to showcase teaching techniques, case studies, and other content, helping teachers to visually understand and learn. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 24. | Learning Community and Discussion Platform: Establishing a learning community and discussion platform for teachers to engage in communication, share experiences and resources, and facilitate collaborative learning and growth. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 25. | Peer Support: Establishing a teacher communication platform or professional community to facilitate experience sharing, collaborative learning, and mutual support among teachers. | 1 | 1 | 1 | 1 | 0 | 0.8 | valid |
| 26. | Assistive Technology: Utilizing modern technology to support teacher training, such as virtual reality technology, intelligent teaching systems, online assessment tools, etc., to enhance training effectiveness and teaching efficiency. | 1 | 1 | 1 | 1 | 1 | 1 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| 27. | Workshops and Lectures: By organizing specialized workshops and lectures, inviting experts and scholars to share the latest educational theories and practical experiences, we aim to help teachers broaden their knowledge horizons. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 28. | Case Studies and Sharing: By conducting case studies and sharing teaching practices, we aim to help teachers learn from others' successful experiences and lessons, inspire reflection, and improve teaching methods. | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |
| 29. | Practical Activities and Observation Classes: Organizing practical activities and observation classes to allow teachers to actively participate in and observe excellent teaching practices, enhancing their practical skills and teaching abilities. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 30. | Group Discussions and Collaboration: Through group discussions and collaboration, we aim to facilitate communication and interaction among teachers, collectively explore educational issues, promote idea exchange, and foster mutual growth. | 0 | 1 | 1 | 1 | 1 | 0.8 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| Ethics and Responsible AI Use | | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 31. | Teaching Materials and Tools: Providing resources such as suitable teaching materials, tools, and instructional equipment for Secondary School education to assist teachers in conducting teaching activities, enriching teaching content, and enhancing teaching effectiveness. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 32. | Online Platform and Resource Repository: Establishing an online learning platform or resource repository to provide teachers with access to teaching videos, materials, lesson plans, case studies, and other resources that can be accessed anytime and anywhere, facilitating teacher learning and communication. | 1 | 1 | 0 | 0 | 1 | 0.8 | valid |
| 33. | Learning Community and Interactive Platform: Establishing a teacher learning community or online forum to facilitate communication and interaction among teachers, enabling them to share experiences, resources, and teaching achievements. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 34. | Assessment and Feedback: Providing regular assessment and feedback mechanisms to help teachers understand | 1 | 1 | 1 | 1 | 0 | 0.8 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | their learning progress, adjust their learning direction in a timely manner, and continuously enhance their capabilities. | | | | | | | |
| 35. | Educational Institutions and Professional Organizations: Educational institutions and professional organizations typically provide various teacher training resources, including seminars, workshops, professional courses, etc., to help teachers continuously learn and grow. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 36. | Experts, Scholars, and Lecturers: Inviting experts, scholars, and lecturers to participate in teacher training, share the latest educational theories and practical experiences, and help teachers enhance their professional knowledge and skills. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 37. | Educational Books and Journals: Providing a wide range of educational books and journals for teachers to reference, enabling them to understand the latest educational theories, research findings, and practical case studies. | 1 | 0 | 1 | 1 | 1 | 0.8 | valid |
| 38. | Teaching Resource Repository: Establishing a teaching resource repository to collect and organize various teaching resources, such as instructional videos, lesson plan examples, teaching tools, etc., to provide | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | teachers with a wealth of teaching materials and reference materials. | | | | | | | |
| 39. | Pedagogical Technology Support: Providing pedagogical technology support to help teachers master the application of teaching technologies and tools, enhancing teaching effectiveness and innovation capabilities. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 40. | Practice Bases and Observation Opportunities: Providing practice bases and observation opportunities for teachers to actively participate in practical activities and observe excellent teaching practices, promoting experience accumulation and enhancing teaching capabilities. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| Professional Development and Lifelong Learning | | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 41. | Needs Analysis: Understanding teachers' Foundational AI knowledge and needs and learning objectives, and customizing training plans tailored to the backgrounds and requirements of individual teachers. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 42. | Targeted Curriculum Design: Designing curriculum content that meets the practical needs of Secondary School Teachers, covering aspects such as teaching theory, practical skills, and curriculum design. | 1 | 0 | 1 | 1 | 1 | 0.8 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| 43. | Practice-Oriented: Emphasizing practical exercises and case studies to help teachers apply their knowledge and skills to real-world scenarios, enhancing their practical abilities. | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |
| 44. | Feedback and Evaluation: Establishing an effective feedback mechanism to promptly collect teachers' learning feedback and performance evaluations, in order to provide personalized guidance and support to teachers. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 45. | Peer Support and Sharing: Encouraging teachers to communicate and share experiences with each other, establishing professional communities and collaborative networks to facilitate mutual learning and growth. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 46. | Diversified Training Formats: Utilizing a variety of formats such as online, offline, practical, and peer exchanges to cater to different teachers' learning styles and needs. | 1 | 0 | 1 | 1 | 1 | 0.8 | valid |
| 47. | Progressive Training: Adopting a phased and progressive training approach, starting from basic knowledge to professional skills and then to practical abilities development, gradually enhancing | 1 | 1 | 1 | 1 | 1 | 1 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | teachers' overall competency. | | | | | | | |
| 48. | Participatory Training: Encouraging teachers to engage in classroom interactions, group discussions, case studies, and other activities to promote active participation and communication among learners, enhancing the effectiveness of learning. | 1 | 1 | 1 | 1 | 0 | 0.8 | valid |
| 48. | Incentive Mechanism: Establishing reward systems or certification recognition to incentivize teachers to actively participate in training, enhancing learning motivation and effectiveness. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 50. | Ongoing Monitoring: Conducting follow-up evaluations after training, collecting feedback to understand the training effectiveness, and providing further support and guidance to teachers. | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |
| AI Tools and Resource Management | | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 51. | Training Plan and Objectives: Establishing clear training plans and objectives, outlining the training content, format, schedule, etc., to ensure the systematic and continuous nature of the training. | 0 | 1 | 1 | 1 | 1 | 0.8 | valid |
| 52. | Training Facilities: Providing suitable training venues and facilities, including classrooms, laboratories, multimedia equipment, etc., | 1 | 1 | 1 | 1 | 0 | 0.8 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | to ensure a comfortable and convenient training environment. | | | | | | | |
| 53. | Systemic Challenges and Institutional Support: Establishing an effective training evaluation mechanism to assess teachers' learning progress and performance, making timely adjustments to the training direction and methods to ensure training effectiveness. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 54. | Management Mechanism: Establishing a comprehensive training management mechanism, including training information management, student management, course management, etc., to ensure the orderly and efficient operation of the training program. | 1 | 0 | 1 | 1 | 1 | 0.8 | valid |
| 55. | Incentive Mechanism: Establishing reward systems or certification programs to motivate teachers to actively participate in training, enhancing learning motivation and effectiveness. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 56. | Training Faculty: Having a team of experienced and highly qualified training professionals, including education experts, psychologists, instructional designers, etc., to provide professional guidance and support. | 0 | 1 | 1 | 1 | 1 | 0.8 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| 57. | Training Resources: Providing a wide range of teaching resources and tools, such as textbooks, teaching aids, teaching equipment, educational software, etc., to support teachers' learning and teaching activities. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 58. | Training Courses: Designing course content that meets the needs of teachers and training objectives, covering aspects such as Secondary School Education theory, teaching methods, student psychological well-being, home-school cooperation, etc. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 59. | Training Activities: Organizing various training activities, such as lectures, seminars, workshops, field visits, hands-on guidance, etc., to provide different forms of learning opportunities. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 60. | Financial Support: Providing necessary funding support for teacher training to ensure the smooth progress and quality assurance of training activities. | 1 | 1 | 0 | 1 | 1 | 0.8 | valid |
| AI-Supported Student Empowerment | | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 61. | Foundational AI knowledge and needs Assessment: Conducting targeted needs assessment before the start of training to understand teachers' Foundational AI | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | knowledge and needs and expectations, providing a basis for the design of subsequent training content and formats. | | | | | | | |
| 62. | Developing Training Plan: Based on the results of the needs assessment, creating a detailed training plan that includes training content, schedule, training formats, etc., to ensure clear and targeted training objectives. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 63. | Sharing and Communication: Encouraging teachers to share training experiences and teaching practices with each other to promote mutual learning and growth, and to establish a collaborative and learning-oriented teacher team. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 64. | Faculty Preparation: Providing necessary training materials and teaching aids for trainers to ensure that they possess professional knowledge and training skills, enabling them to effectively impart knowledge. | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |
| 65. | Practical Guidance: Providing practical opportunities and guidance to help teachers apply the knowledge they have learned to actual teaching, enhancing their practical skills and teaching abilities. | 1 | 0 | 1 | 1 | 1 | 0.8 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| 66. | Follow-up Coaching: Conducting follow-up coaching after training to continuously monitor the learning and growth of teachers, providing necessary support and guidance to help teachers continually improve. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 67. | Feedback Evaluation: Establishing an effective feedback mechanism to collect teachers' feedback and training effectiveness evaluations, making timely adjustments and improvements to training programs to enhance training outcomes. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 68. | Ongoing Monitoring: Conducting follow-up assessments after training to understand teachers' learning outcomes and practical application, and providing further support and guidance to teachers. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 69. | Selecting Training Formats: Based on the training content and teachers' specific circumstances, choosing appropriate training formats such as online courses, offline seminars, practical guidance, etc., to enhance teachers' learning effectiveness. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 70. | Continuous Support: Providing ongoing support and guidance to teachers after the training, encouraging them to continue learning and improving, and promoting | 1 | 1 | 1 | 1 | 0 | 0.8 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | their professional development. | | | | | | | |
| Systemic Challenges and Institutional Support | | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 71. | Goals and Standards: Clearly define the training objectives and assessment criteria to ensure that the evaluation targets and content are aligned with the training goals. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 72. | Assessment Content: The assessment content should include aspects such as knowledge mastery, skill application abilities, teaching effectiveness, etc., to comprehensively evaluate the training outcomes of teachers. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 73. | Assessment Schedule: Determine the timing and frequency of assessments, which can be conducted before, during, and after the training, as well as follow-up assessments at certain intervals after the training. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 74. | Feedback and Improvement: Provide feedback based on the assessment results to guide teachers in improving teaching methods and practical skills, promoting their professional development. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 75. | Formative Assessment: Evaluate the diversity, flexibility, and effectiveness of training formats, including assessments of | 1 | 0 | 1 | 1 | 1 | 0.8 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | online courses, offline seminars, practical guidance, and other forms of evaluation. | | | | | | | |
| 76. | Engagement Assessment: Evaluate teachers' engagement and enthusiasm, including attendance rates, classroom interactions, completion of assignments, etc., to understand the level of acceptance and involvement of teachers in the training. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 77. | Satisfaction Assessment: Evaluate teachers' satisfaction and feedback on the training program, collect constructive opinions and suggestions to improve and optimize the training plan. | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |
| 78. | Ongoing Monitoring and Evaluation: Conduct continuous tracking and evaluation after the training to understand the application and effectiveness of the training content in teachers' work, promoting sustained improvement in training outcomes. | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 79. | Training Effectiveness Evaluation: Taking into account the above elements, assess the overall training effectiveness and impact, analyze the strengths and weaknesses of the training program, and provide improvement suggestions and | 1 | 1 | 1 | 1 | 1 | 1 | valid |

| NO. | Training model of Artificial Intelligence Literacy teaching method for Secondary School Teachers | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | directions for future training. | | | | | | | |
| 80. | Teaching Effectiveness Evaluation: Evaluate the effects demonstrated by teachers in actual teaching after training, including improvements in teaching methods and enhancements in teaching quality. | 1 | 1 | 1 | 1 | 1 | 1 | valid |

**Experts test the training model of teachers' artificial intelligence literacy teaching method**

**(Consistency evaluation)**

| NO. | Elements of teachers' artificial intelligence literacy teaching method training model | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| **Cognition (Foundation and Cognition)** | | **1** | **1** | **1** | **1** | **1** | **1** | **valid** |
| 1 | Basic AI concepts | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 2 | Key AI applications in education | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 3 | Limitations and challenges of AI | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 4 | Understanding AI structures and sources | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 5 | AI's impact on society and economy | 1 | 0 | 1 | 1 | 1 | 0.8 | valid |
| 6 | Privacy and security issues in AI use | 1 | 1 | 0 | 1 | 1 | 0.8 | valid |
| **Ethics (Ethics and Social Responsibility)** | | **1** | **1** | **1** | **1** | **1** | **1** | **valid** |
| 7 | AI ethics fundamentals | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 8 | Understanding regulatory frameworks and guidelines | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 9 | Promoting digital citizenship in AI usage | 1 | 1 | 1 | 1 | 0 | 0.8 | valid |
| 10 | Safeguarding student data with AI tools | 0 | 1 | 1 | 1 | 1 | 0.8 | valid |
| 11 | Balancing technology use and ethical considerations | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| **AI-Apps (AI Applications, Generative AI)** | | **1** | **1** | **1** | **1** | **1** | **1** | **valid** |
| 12 | Using AI for personalized learning | 1 | 1 | 1 | 1 | 1 | 1 | valid |

| NO. | Elements of teachers' artificial intelligence literacy teaching method training model | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| 13 | Promoting active learning with AI tools | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 14 | AI-based adaptive learning techniques | 1 | 1 | 1 | 1 | 0 | 0.8 | valid |
| 15 | Selecting appropriate AI tools for classroom use | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 16 | Developing teaching resources with AI assistance | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 17 | Customizing AI tools to fit diverse learning needs | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| **AI-Pedagogy (Teaching Methods and Curriculum)** | | **1** | **1** | **1** | **1** | **1** | **1** | **valid** |
| 18 | Designing AI-supported lesson plans | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 19 | Implementing AI-driven formative assessments | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 20 | Algorithmic thinking and problem decomposition | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 21 | Designing basic AI models for classroom use | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 22 | Exploring data-driven decision-making processes | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |
| 23 | Applying pattern recognition with datasets | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| **Development (Teacher Professional Development)** | | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 24 | Engaging in AI-focused professional | 1 | 1 | 1 | 1 | 1 | 1 | valid |

| NO. | Elements of teachers' artificial intelligence literacy teaching method training model | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| | training | | | | | | | |
| 25 | Exploring global AI educational practices | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 26 | Utilizing online AI learning platforms | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |
| 27 | Creating professional learning communities for AI | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 28 | Participating in AI education conferences | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 29 | Advocating for AI policy reforms in education | 1 | 1 | 1 | 0 | 1 | 0.8 | valid |
| **Evaluation (Evaluation, Feedback, and Policy)** | | **1** | **1** | **1** | **1** | **1** | **1** | **valid** |
| 30 | Evaluating the effectiveness of AI tools in teaching | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 31 | Troubleshooting common AI tool challenges | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 32 | Encouraging students to design AI projects | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 33 | Teaching students about AI career paths | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 34 | Addressing barriers to AI adoption in schools | 1 | 1 | 1 | 1 | 1 | 1 | valid |
| 35 | Developing standards for AI literacy assessment | 1 | 1 | 0 | 1 | 1 | 0.8 | valid |

| NO. | Elements of teachers' artificial intelligence literacy teaching method training model | Experts | | | | | IOC | Validity |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | |
| 36 | Aligning AI practices with school goals | 1 | 1 | 1 | 1 | 1 | 1 | valid |

## Secondary School Teachers Training Model for Integrated IT Teaching Methods (Results)

| Item | Elements of the Training Model of Artificial Intelligence Literacy Teaching Methods for Secondary School Teachers | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| **Foundational AI knowledge and needs** | | **5.0** | **5.0** | **0.0** | **95.24%** |
| 1 | Professional Knowledge and Skills | 5.0 | 5.0 | 0.0 | 95.24% |
| 2 | Teaching Resources and Tools | 5.0 | 5.0 | 0.5 | 90.48% |
| 3 | Professional Development and Career Planning | 3.0 | 4.0 | 1.0 | 42.86% |
| 4 | Updating Teaching Methods and Strategies | 4.0 | 5.0 | 0.5 | 80.95% |
| 5 | student Development and Educational Theories | 3.0 | 4.0 | 1.0 | 33.33% |
| 6 | Curriculum Design and Evaluation Abilities | 3.0 | 4.0 | 1.0 | 42.86% |
| 7 | Education Policies and Regulations | 3.0 | 4.0 | 1.0 | 42.86% |
| 8 | Personal Development Needs | 5.0 | 5.0 | 0.5 | 90.48% |
| 9 | Social Needs | 4.0 | 5.0 | 0.5 | 80.95% |
| 10 | Individual Differences and Feedback | 5.0 | 5.0 | 0.5 | 90.48% |
| **Pedagogical Integration of AI** | | **4.0** | **4.0** | **0.0** | **85.71%** |
| 1 | Curriculum Design and Assessment | 3.0 | 4.0 | 1.0 | 42.86% |
| 2 | Teaching Methods and Techniques | 5.0 | 5.0 | 0.5 | 85.71% |
| 3 | Curriculum Design and Teaching Plans | 3.0 | 4.0 | 1.0 | 42.86% |
| 4 | student Psychological Health and Behavior Management | 5.0 | 5.0 | 0.5 | 90.48% |
| 5 | Secondary School Education Theory | 5.0 | 5.0 | 0.0 | 95.24% |
| 6 | Professional Competence Enhancement | 5.0 | 5.0 | 0.5 | 90.48% |
| 7 | Principles of Secondary School Education | 3.0 | 4.0 | 1.0 | 47.62% |

| Item | Elements of the Training Model of Artificial Intelligence Literacy Teaching Methods for Secondary School Teachers | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 8 | Creative Education and Artistic Expression | 3.0 | 4.0 | 1.0 | 42.86% |
| 9 | Multicultural Education | 5.0 | 5.0 | 0.0 | 85.71% |
| 10 | Special Education Needs | 5.0 | 5.0 | 0.0 | 95.24% |
| **Training methods and tool** | | **5.0** | **5.0** | **0.5** | **90.48%** |
| 1 | Practical activities and observation lessons | 5.0 | 5.0 | 0.5 | 90.48% |
| 2 | Training manuals and textbooks | 5.0 | 5.0 | 0.5 | 90.48% |
| 3 | Group discussions and collaboration | 5.0 | 5.0 | 0.0 | 85.71% |
| 4 | Practical teaching | 5.0 | 5.0 | 0.0 | 95.24% |
| 5 | Case studies and sharing | 3.0 | 4.0 | 1.0 | 33.33% |
| 6 | Workshops and seminars | 3.0 | 4.0 | 1.0 | 47.62% |
| 7 | Video tutorials and demonstrations | 3.0 | 4.0 | 1.0 | 47.62% |
| 8 | Learning communities and discussion platforms | 4.0 | 5.0 | 0.5 | 80.95% |
| 9 | Peer assistance | 3.0 | 4.0 | 1.0 | 47.62% |
| 10 | Assistive technology | 5.0 | 5.0 | 0.0 | 95.24% |
| **Ethics and Responsible AI Use** | | **3.0** | **4.0** | **1.0** | **42.86%** |
| 1 | Teaching Resource Library | 3.0 | 4.0 | 1.0 | 47.62% |
| 2 | Online Platforms and Repositories | 5.0 | 5.0 | 0.0 | 95.24% |
| 3 | Learning Communities and Interactive Platforms | 5.0 | 5.0 | 0.0 | 85.71% |
| 4 | Teaching Materials and Tools | 5.0 | 5.0 | 0.5 | 90.48% |
| 5 | Educational Technology Support | 5.0 | 5.0 | 0.5 | 90.48% |
| 6 | Assessment and Feedback | 3.0 | 4.0 | 1.0 | 33.33% |
| 7 | Educational Books and Journals | 3.0 | 4.0 | 1.0 | 42.86% |

| Item | Elements of the Training Model of Artificial Intelligence Literacy Teaching Methods for Secondary School Teachers | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 8 | Experts, Scholars, and Lecturers | 3.0 | 4.0 | 1.0 | 33.33% |
| 9 | Educational Institutions and Professional Organizations | 4.0 | 5.0 | 0.5 | 80.95% |
| 10 | Practice Bases and Observation Opportunities | 4.0 | 5.0 | 0.5 | 80.95% |
| **Professional Development and Lifelong Learning** | | **5.0** | **5.0** | **0.5** | **90.48%** |
| 1 | Diversified Training Formats | 4.0 | 5.0 | 0.5 | 80.95% |
| 2 | Practice-Oriented | 3.0 | 4.0 | 1.0 | 47.62% |
| 3 | Needs Analysis | 3.0 | 4.0 | 1.0 | 47.62% |
| 4 | Participatory Training | 5.0 | 5.0 | 0.0 | 95.24% |
| 5 | Targeted Curriculum Design | 5.0 | 5.0 | 0.5 | 90.48% |
| 6 | Peer Support and Sharing | 4.0 | 5.0 | 0.5 | 80.95% |
| 7 | Feedback and Evaluation | 3.0 | 4.0 | 1.0 | 42.86% |
| 8 | Continuous Monitoring | 3.0 | 4.0 | 1.0 | 42.86% |
| 9 | Progressive Training | 5.0 | 5.0 | 0.0 | 95.24% |
| 10 | Incentive Mechanisms | 5.0 | 5.0 | 0.5 | 90.48% |
| **AI Tools and Resource Management** | | **5.0** | **5.0** | **0.0** | **95.24%** |
| 1 | Training Plans and Objectives | 5.0 | 5.0 | 0.0 | 95.24% |
| 2 | Management Mechanisms | 4.0 | 5.0 | 0.5 | 80.95% |
| 3 | Trainer Resources | 3.0 | 4.0 | 1.0 | 33.33% |
| 4 | Incentive Mechanisms | 5.0 | 5.0 | 0.5 | 90.48% |
| 5 | Training Facilities | 3.0 | 4.0 | 1.0 | 42.86% |
| 6 | Training Activities | 5.0 | 5.0 | 0.5 | 90.48% |
| 7 | Systemic Challenges and Institutional Support | 3.0 | 4.0 | 1.0 | 33.33% |
| 8 | Training Courses | 3.0 | 4.0 | 1.0 | 42.86% |
| 9 | Training Resources | 4.0 | 5.0 | 0.5 | 80.95% |
| 10 | Financial Support | 5.0 | 5.0 | 0.5 | 90.48% |
| **AI-Supported Student Empowerment** | | **3.0** | **4.0** | **1.0** | **42.86%** |

| Item | Elements of the Training Model of Artificial Intelligence Literacy Teaching Methods for Secondary School Teachers | Md | Mo | IQR | Consensus |
|---|---|---|---|---|---|
| 1 | Developing Training Plans | 3.0 | 4.0 | 1.0 | 42.86% |
| 2 | Selecting Training Formats | 4.0 | 5.0 | 0.5 | 80.95% |
| 3 | Practical Guidance | 5.0 | 5.0 | 0.5 | 90.48% |
| 4 | Ongoing Support | 5.0 | 5.0 | 0.0 | 95.24% |
| 5 | Foundational AI knowledge and needs Assessment | 4.0 | 5.0 | 0.5 | 80.95% |
| 6 | Trainer Preparation | 3.0 | 4.0 | 1.0 | 33.33% |
| 7 | Sharing and Communication | 5.0 | 5.0 | 0.5 | 90.48% |
| 8 | Feedback and Evaluation | 3.0 | 4.0 | 1.0 | 42.86% |
| 9 | Tracking and Coaching | 4.0 | 5.0 | 0.5 | 80.95% |
| 10 | Continuous Monitoring | 3.0 | 4.0 | 1.0 | 42.86% |
| **Evaluation** | | **5.0** | **5.0** | **0.5** | **90.48%** |
| 1 | Goals and Standards | 3.0 | 4.0 | 1.0 | 42.86% |
| 2 | Content Evaluation | 5.0 | 5.0 | 0.0 | 95.24% |
| 3 | Formative Evaluation | 4.0 | 5.0 | 0.5 | 80.95% |
| 4 | Training Effectiveness Evaluation | 5.0 | 5.0 | 0.5 | 90.48% |
| 5 | Feedback and Improvement | 3.0 | 4.0 | 1.0 | 42.86% |
| 6 | Evaluation Period | 3.0 | 4.0 | 1.0 | 42.86% |
| 7 | Engagement Evaluation | 4.0 | 5.0 | 0.5 | 80.95% |
| 8 | Teaching Effectiveness Evaluation | 3.0 | 4.0 | 1.0 | 33.33% |
| 9 | Continuous Monitoring Evaluation | 4.0 | 5.0 | 0.5 | 80.95% |
| 10 | Satisfaction Evaluation | 4.0 | 5.0 | 0.5 | 80.95% |

# Appendix E

## Certificate of English

BANSOMDEJCHAOPRAYA
RAJABHAT UNIVERSITY

This is to certify that

***Mr. Wu Zhaobin***

Achieved BSRU English Proficiency Test (BSRU-TEP) level

**C1**

Given on 22nd August 2021

(Assistant Professor Dr Kulsirin Aphiratvoradej)

Director

# Appendix F

## The Document for Acceptance Research

ที่ อว ๐๖๔๓.๐๓/๐๐๐๘

สำนักวิทยบริการและเทคโนโลยีสารสนเทศ
มหาวิทยาลัยราชภัฏบ้านสมเด็จเจ้าพระยา
๑๐๖๑ ถนนอิสรภาพ แขวงหิรัญรูจี
เขตธนบุรี กรุงเทพฯ ๑๐๖๐๐

๑๗ กุมภาพันธ์ ๒๕๖๘

เรื่อง ตอบรับการลงตีพิมพ์บทความในวารสารเทคโนโลยีสารสนเทศและนวัตกรรม

เรียน Wu Zhaobin

ตามที่ Wu Zhaobin, Nainapas Injoungjirakit, Sombat Teekasap, Prapai Sridama ขอเสนอบทความวิจัยเรื่อง Development of Artificial Intelligence Literacy Model for Secondary School Teachers in Shenzhen เพื่อลงตีพิมพ์ในวารสารเทคโนโลยีสารสนเทศและนวัตกรรม ปีที่ ๒๔ ฉบับที่ ๑ มกราคม-มิถุนายน ๒๕๖๘ ของสำนักวิทยบริการและเทคโนโลยีสารสนเทศ มหาวิทยาลัยราชภัฏบ้านสมเด็จเจ้าพระยา ซึ่งได้ผ่านการรับรองคุณภาพจากศูนย์ดัชนีการอ้างอิงวารสารไทย (TCI) ในกลุ่มที่ ๒ นั้น

ในการนี้ กองบรรณาธิการวารสารสารสนเทศและคณะกรรมการกลั่นกรองผลงานได้พิจารณาเรียบร้อยแล้ว เห็นสมควรตีพิมพ์บทความดังกล่าวในวารสารเทคโนโลยีสารสนเทศและนวัตกรรม ปีที่ ๒๔ ฉบับที่ ๑ มกราคม-มิถุนายน ๒๕๖๘ เพื่อเผยแพร่ให้เกิดประโยชน์ในเชิงวิชาการต่อไป

จึงเรียนมาเพื่อโปรดทราบและขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

(ผู้ช่วยศาสตราจารย์ ดร.วิมล อุทานนท์)
กองบรรณาธิการบริหาร
Signature Code : tZzEMbZZAdFZNwdHfYFMx

สำนักวิทยบริการและเทคโนโลยีสารสนเทศ
โทร ๐๒-๔๗๓-๗๐๐๐ ต่อ ๓๗๐๐
โทรสาร ๐๒-๔๖๖-๔๓๔๒

# Researcher Profile

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**Educational background:**

- Doctor of Philosophy Program in Digital Technology Management for Education, Bansomdejchaopraya Rajabhat University, in 2021
- Master of Computer Science and Technology Engineering, Tsinghua University, in 2008
- Graduated from Shenzhen University in 2000

**Work experience:**

- Executive Vice President of Shenzhen Youth Artificial Intelligence Education Society, Education Science Research Institute of Longhua District, Shenzhen, July 2020 present
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