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Research on the Evaluation Index System of Digital Transformation Ability of Teacher Education based on the Maturity Model

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Abstract

In the context of rapid advancements in information technology, the digital transformation of education is gradually becoming a core trend in the field. This paper innovatively introduces a maturity model, detailing the principles, methods, and specific content for constructing a multi-dimensional evaluation indicator system. It combines this with an in-depth analysis using the maturity model to develop a set of assessment indicators for teacher education digital transformation capabilities that is both scientific, comprehensive, and precise. The aim is to objectively and accurately evaluate teachers digital skills and deeply promote the digital transformation of education.

Keywords

Maturity model; Evaluation index system; Digital transformation ability.

1. Introduction

The wave of digitalization is reshaping the global education ecosystem with great force. The digital transformation of education has become a critical pathway to enhancing educational quality, promoting educational equity, and nurturing future innovative talents. As the direct practitioners of educational activities, teachers capabilities in digital transformation directly determine the effectiveness of educational reform. However, there is currently a lack of unified, scientific, and comprehensive standards for evaluating teachers digital transformation capabilities in education. This makes it difficult to accurately assess teachers capacity and development needs during the digitalization process, severely hindering the progress of educational digital transformation. Therefore, it is imperative to establish a scientific and reasonable evaluation system for teachers digital transformation capabilities in education[1-3].

Currently, various digital transformation capability assessment systems for teacher education have emerged both domestically and internationally. Some studies focus on teachers information technology application skills, evaluating their mastery and use of digital tools through methods such as questionnaires and classroom observations; others concentrate on digital teaching capabilities, covering the digital application in aspects like instructional design, implementation, and evaluation[4-6]. However, existing assessment systems have many shortcomings. For instance, the comprehensiveness and scientific rigor of indicators need to be enhanced, and the operability and effectiveness of assessment methods require further validation. Particularly, there is a severe lack of personalized assessment criteria for teachers

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across different subjects and educational stages. Additionally, the application of maturity models in assessment systems remains extremely rare.

2. Overview of the Maturity Model

Maturity models are tools used to measure the development level of an organization or individual in a specific field. They divide the development process into different stages or levels, each with distinct characteristics and criteria. By comparing the current status with the standards of each level, one can clearly understand the current stage of development and thus define clear directions and goals for improvement.

In the field of education and other related industries, common maturity models include the Software Capability Maturity Model (CMM) and the Capability Maturity Integration Model (CMMI)[7]. These models have achieved certain success in different fields, providing effective methods and frameworks for evaluating and enhancing the capabilities of organizations or individuals. The core concept is to manage and optimize processes, gradually improving capability levels to achieve a transition from low maturity to high maturity.

3. Principles and Methods for The Construction of Evaluation Index System of Digital Transformation Ability of Teacher Education

3.1. Construction principles

(1) The principle of scientificity

The construction of the indicator system should be firmly grounded in scientific theoretical foundations and employ rigorous research methods to ensure that indicators can accurately capture and reflect the core characteristics and deeper implications of teachers digital transformation capabilities in teacher education. The definitions of indicators should be clear and standardized, with each indicator logically rigorous and independent of one another, avoiding duplication or contradiction. At the same time, incorporate the concepts and methods of maturity models to align with the development patterns and features of educational digital transformation.

(2) The principle of comprehensiveness

The evaluation indicator system should comprehensively cover teachers performance in the application of digital infrastructure, formulation of digital teaching strategies, human-computer collaboration in digital teaching, effective moral education implementation, digital growth, teachers digital awareness and instructional design, digital teaching, classroom interaction and assessment, as well as professional development and academic research. It should systematically and completely reflect the overall picture of teachers capabilities in the digital transformation of teacher education, preventing any one-sidedness in the assessment. By integrating maturity models, a comprehensive consideration of the capability development stage for each dimension should be conducted to ensure the comprehensiveness and integrity of the evaluation.

(3) Operability principle

When selecting indicators, it is essential to fully consider the feasibility and convenience of data collection, favoring indicators that are easy to quantify and observe. This allows for data collection through various methods such as questionnaires, classroom observations, teacher self-assessments, and student evaluations. At the same time, assessment methods should be simple, clear, and easy to implement, facilitating their promotion in practical applications. The evaluation criteria and methods based on maturity models must also be practical, effectively guiding teachers and educational administrators in capability assessment and improvement.

(4) Guiding principle

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The indicator system should have a clear guiding role, capable of directing teachers to focus on enhancing their digital skills and clarifying the direction and goals for capability development. Through evaluation, it can accurately identify the strengths and weaknesses of teachers in the process of digital transformation, providing targeted improvement suggestions and development paths. The application of maturity models can further strengthen this guidance, enabling teachers to clearly understand their current stage of development across different capability dimensions and how to advance to higher stages.

3.2. Construction method

(1) Literature research method

Extensive review of relevant literature at home and abroad, a comprehensive grasp of the research pulse and development trend of digital transformation ability of teacher education, systematic sorting out the existing evaluation index system and fruitful research results, while deeply analyzing the practice cases of maturity model in education and related fields, laying a solid theoretical foundation for the construction of a new index system, providing rich and valuable reference materials.

(2) Delphi method

A panel of experts, scholars, frontline teachers, and educational administrators was formed to conduct multiple rounds of surveys, widely soliciting opinions and suggestions from experts on the preliminary indicator system. In designing the questionnaire, full consideration was given to the relevant content of maturity models, guiding experts to provide professional insights into the classification and evaluation criteria for the maturity levels of each dimension. The valuable feedback from experts was meticulously analyzed, carefully selected, reasonably revised, and comprehensively improved, ultimately establishing a scientific and reasonable indicator system.

(3) Hierarchical analysis method

Using the Analytic Hierarchy Process to determine the weights of each indicator in the system. The indicator system is divided into the goal level, criterion level, and indicator level. Through pairwise comparisons, the relative importance of each indicator is determined, constructing a judgment matrix to accurately calculate the weight of each indicator, thereby reflecting their significance in the evaluation system. At the same time, we combine this with maturity models to deeply analyze the weight distribution of various indicators at different levels of maturity, aiming to highlight the differences in importance across various capability dimensions at different stages of development.

4. Framework of Evaluation Index System for Digital Transformation Ability of Teacher Education Based on Maturity Model

This study adopts literature review, questionnaire survey and complex scientific management tool exploration diagram to sort out the evaluation index system dimensions and indicators of teachers digital transformation ability assessment as shown in Table 1 below.

4.1. Digital infrastructure dimension

(1) Initial level

Teachers have a preliminary understanding of the basic digital teaching equipment in the school, but they are not proficient enough to operate it. They occasionally use teaching software to carry out teaching activities and rarely take the initiative to use digital resource libraries.

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Table 1. Evaluation index system of digital transformation ability of teacher education

dimension	Primary indicators	Secondary indicators
Digital infrastructure	Digital equipment operation capability	Proficient operation and simple maintenance of intelligent classroom system, multimedia teaching all-in-one machine and other equipment
	Ability to use teaching software	Proficiency in online teaching platform, teaching management software, subject teaching software
	Digital resource utilization capability	The ability to obtain materials and design teaching courseware using digital resource library
Digital teaching strategy	Digital teaching planning ability	Develop digital teaching plans according to teaching objectives and student characteristics
	Ability to analyze learning situation and adjust strategies	Use digital technology to analyze the learning situation and adjust the teaching strategy
	Innovative teaching mode	Integrate digital resources, carry out innovative teaching modes such as blended teaching and project-based learning
Digital teaching human-computer collaboration capability	Ability to use intelligent teaching tools	Use intelligent tutoring system, intelligent grading tools and other auxiliary teaching
	Guide students to use intelligent tools	Guide students to use intelligent learning tools correctly and cultivate their ability of independent learning
	Human-machine complementary ability	In the human-machine collaborative teaching, teachers play a leading role to realize complementary advantages
Effective moral education ability	Digital moral education resource application ability	Use online moral education courses, online thematic class meetings and other ways to carry out moral education
	Communication between home and school and moral guidance ability	Communicate with students and parents through social media, home-school interaction platform to guide moral education
	Network moral quality cultivation ability	Guide students to treat network information correctly and cultivate good network moral quality
Digital growth capability	Digital learning awareness and ability	Awareness and ability to learn new theories and technologies of digital education independently
	Research ability in digital teaching	Participate in digital teaching research projects, write research papers and teaching reflections
	Ability to transform and share teaching results	Transform the practical experience of digital teaching into teaching results, and share and promote them
Teachers digital awareness and teaching design ability	Digital awareness sensitivity	Awareness and sensitivity to the application of digital technology in education
	Digital teaching design ability	Use digital concept to set teaching objectives, organize content and design activities
	Ability to design personalized teaching programs	Personalized teaching plans are designed according to the characteristics of students digital learning
Teachers digital teaching ability	Multimedia and platform application ability	Proficient in using multimedia materials and online teaching platforms to carry out teaching activities
	Digital knowledge presentation ability	Use digital tools for knowledge presentation, demonstration and interaction
	Digital teaching process organization ability	Organize the digital teaching process effectively to ensure the achievement of teaching objectives
Classroom interaction and evaluation skills	Digital classroom interaction organization ability	Use online discussion, group collaboration and other ways to promote classroom interaction
	Digital teaching evaluation ability	Use digital evaluation tools to comprehensively, objectively and timely evaluate students learning
	Ability to apply evaluation results	Adjust teaching strategies and optimize teaching process according to evaluation results
Professional development and academic research ability of teachers	Digital career development planning ability	Develop career development goals and plans related to digital education
	Ability to participate in academic exchanges	Actively participate in academic exchange activities related to digital education
	Research ability in digital education	Carry out research on digital education, write academic papers and apply for research projects

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(2) Basic level

Be able to skillfully operate smart classroom system, multimedia teaching all-in-one machine and other equipment, be able to skillfully use online teaching platform, teaching management software, etc., and be able to obtain simple materials from digital resource library to make courseware.

(3) Development level

Not only can I operate the equipment and software skillfully, but also can perform simple maintenance and troubleshooting of the equipment. I am good at integrating various digital resources and customizing personalized teaching materials according to teaching needs.

(4) Maturity level

Be able to keep up with the development trend of digital technology, timely grasp the application of new digital teaching equipment and software, and independently develop digital teaching resources to contribute to the construction of digital teaching resources in schools.

4.2. Digital teaching strategy dimension

(1) Initial level

There is a lack of systematic digital teaching strategy planning, digital tools are only occasionally used in teaching, and there is no targeted digital teaching plan based on students characteristics and teaching objectives.

(2) Basic level

At the beginning, we started to formulate a digital teaching plan, but the plan was relatively shallow, and the analysis of students situation was still superficial. We still mainly relied on traditional teaching mode and only occasionally inserted some simple digital teaching activities.

(3) Development level

Be able to formulate a reasonable digital teaching plan according to the teaching objectives and students characteristics, use digital technology to analyze the learning situation, and adjust the teaching strategy according to the analysis results, and actively carry out innovative teaching modes such as blended teaching.

(4) Maturity level

Have a forward-looking digital teaching strategy vision, be able to accurately grasp the development trend of digital education, formulate long-term digital teaching strategy planning, constantly innovate and optimize teaching mode, and lead the schools digital teaching reform.

4.3. Dimensions of human-computer collaboration in digital teaching

(1) Initial level

They rarely use intelligent teaching tools and have limited understanding of the functions of intelligent teaching tools, so they cannot guide students to use intelligent learning tools effectively.

(2) Basic level

At the beginning, I tried to use intelligent tutoring system, intelligent grading tools and other auxiliary teaching, but the frequency of use is low, and there is a lack of effective methods to guide students to use intelligent tools.

(3) Development level

It can skillfully use intelligent teaching tools to assist teaching, effectively improve teaching efficiency, and at the same time, according to students learning situation, reasonably guide students to use intelligent learning tools, cultivate their independent learning ability, so as to play an increasingly dominant role in human-machine collaborative teaching.

(4) Maturity level

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In the human-machine collaborative teaching, deep integration can be realized, which can accurately select and use intelligent teaching tools according to teaching needs and students characteristics, give full play to the complementary advantages of human and machine, significantly improve the quality of teaching, and become a demonstrator of human-machine collaborative teaching.

4.4. Dimensions of effective moral education ability

(1) Initial level

Few digital platforms and resources are used to carry out moral education, and communication with students and parents mainly relies on traditional ways. There is insufficient attention to the cultivation of students online moral quality.

(2) Basic level

At the beginning, digital resources such as online moral education courses were used to carry out moral education activities. Although the resources are still simple, social media is occasionally used to communicate with students and parents, showing the initial awareness of cultivating students online moral quality.

(3) Development level

It is good at using a variety of digital platforms and resources to carry out a variety of moral education activities, and keeping close communication with students and parents through home-school interaction platforms, so as to timely discover students ideological trends and carry out targeted moral education guidance, and attach importance to the cultivation of students online moral quality.

(4) Maturity level

In the digital environment, a perfect moral education system has been built, which can fully explore the moral education value of digital resources, and comprehensively educate students through various channels and ways, so as to become a leader in the cultivation of students network moral quality.

4.5. Dimension of digital growth capability

(1) Initial level

There is less attention to new theories and technologies of digital education, less participation in research projects of digital teaching, and ineffective summary and sharing of practical experience of digital teaching.

(2) Basic level

I began to pay attention to and learn new theories and technologies of digital education, occasionally participated in related research projects, and could make a preliminary reflection on my own digital teaching practice.

(3) Development level

I actively learn new theories and technologies of digital education, often participate in digital teaching research projects, write research papers and teaching reflections, successfully transform the practical experience of digital teaching into specific teaching results, and share them in a small scope.

(4) Maturity level

He has a deep theoretical foundation and rich practical experience in the field of digital education, and has become a researcher and disseminator of new theories and technologies in digital education. He actively participates in various academic exchange activities and promotes the application of digital teaching achievements in a wider range.

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4.6. Teachers digital awareness and teaching design ability dimension

(1) Initial level

There is a lack of acute perception of the application of digital technology in education, and teaching design mainly depends on traditional experience, with little use of digital tools for teaching design.

(2) Basic level

At the beginning, I realized the potential of digital technology in the wide application of education, and tried to use digital tools to set teaching objectives and organize teaching content. However, the innovation and personalization of teaching design still need to be improved.

(3) Development level

Have a keen sense of digital awareness, can quickly grasp the application opportunities of digital technology in teaching, skillfully use digital tools to carefully plan teaching activities, and can customize personalized teaching plans according to the characteristics of students digital learning.

(4) Maturity level

With forward-looking digital awareness, it can deeply integrate digital technology with teaching design, innovate teaching design concepts and methods, and design highly innovative and personalized teaching plans to lead the digital transformation of teaching design.

4.7. Dimensions of teachers digital teaching ability

(1) Initial level

In classroom teaching, digital technology is rarely used, multimedia materials and online teaching platforms are not used skillfully, and the organization of teaching process lacks digital thinking.

(2) Basic level

I can use basic multimedia materials and online teaching platforms to organize teaching activities, and use digital tools to explain knowledge, but the teaching process needs to be optimized to ensure the efficient achievement of teaching objectives.

(3) Development level

Proficient use of multimedia materials, online teaching platforms and other rich and diverse teaching activities, able to use digital tools for vivid knowledge explanation, demonstration and interaction, effectively organize digital teaching process, ensure the efficient achievement of teaching objectives.

(4) Maturity level

He has superb ability in digital teaching, can flexibly use various digital technologies, create immersive and interactive teaching environment according to teaching content and student needs, significantly improve teaching effect, and become a model of digital teaching.

4.8. Classroom interaction and evaluation ability dimension

(1) Initial level

Classroom interaction is biased to traditional methods, and digital means such as online discussion and group collaboration are not used enough. Teaching evaluation also relies on traditional methods, and the application of digital evaluation tools is scarce.

(2) Basic level

Although attempts have been made to enhance classroom interaction by using online discussion, the effect is limited; although digital evaluation tools have been applied, they are only for learning results, and the comprehensiveness and objectivity of evaluation are insufficient.

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(3) Development level

Be good at using online discussion, group collaboration and other ways to actively promote classroom interaction, be able to use a variety of digital evaluation tools to comprehensively, objectively and timely evaluate students learning process and learning results, and be able to preliminarily adjust teaching strategies according to the evaluation results.

(4) Maturity level

In the digital environment, an efficient classroom interaction and evaluation system has been constructed, which can fully stimulate students participation enthusiasm, accurately reflect students learning situation through evaluation results, and accurately adjust teaching strategies according to evaluation results, so as to realize the continuous optimization of teaching process.

4.9. Teacher career development and academic research ability dimension

(1) Initial level

There is no clear professional development goal and planning related to the digitalization of moral education, few participation in academic exchange activities related to digital education, and lack of ability to carry out research on digital education.

(2) Basic level

I began to explore the career path of digital education, occasionally participated in relevant academic exchanges, and tried to write short articles on digital education.

(3) Development level

He has formulated clear professional development goals and plans related to the digitalization of moral education, actively participated in academic exchange activities related to digital education, had the basic ability to carry out research on digital education, and was able to write academic papers of certain quality and apply for small research projects.

(4) Maturity level

In the field of digital education, leading figures with clear career development plans and high academic reputations, such as Academician Liu Hong from Harbin Institute of Technology, actively participate in domestic and international academic exchange activities. They not only lead major research projects in digital education, like the significant national scientific research project undertaken by Academician Liu Hong, but also promote the innovative development of educational digitalization theory and practice, guiding their teams to stand out in fierce market competition.

5. Conclusion

This paper introduces a maturity model and constructs a framework for evaluating the digital transformation capabilities of teacher education. It elaborates on several levels of the maturity model, including digital infrastructure, digital teaching strategies, human-computer collaborative teaching capabilities, effective moral education, digital growth capabilities, teacher digital awareness and instructional design, digital teaching skills, classroom interaction and evaluation, and professional development and academic research. This further enriches and improves the theoretical system of digital transformation in teacher education, deeply exploring the required capability structures and literacy requirements for teachers in the digital age, providing strong empirical evidence for subsequent related research.

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