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Analysis of Improving the Effectiveness of Mathematics Teaching in Higher Vocational Colleges Based on Intelligent Information Technology

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Abstract: With the rapid growth of intelligent information technology, its application in the field of education is gradually deepening, injecting new vitality into the traditional teaching model. As a key link in the training system of technical and skilled talents, mathematics teaching in higher vocational colleges (HVC) faces the urgent task of improving teaching effectiveness. At present, there are common problems in mathematics teaching in HVC, such as low student participation and poor teaching effect, which urgently need to be innovated with the help of intelligent information technology. Therefore, in order to improve the effectiveness of mathematics teaching in HVC, this paper deeply analyzes the application of intelligent information technology. In terms of method application, we use big data analysis to understand students' learning status and achieve personalized teaching; we use intelligent teaching platforms to provide rich resources and carry out online and offline blended teaching. By selecting two parallel classes in a higher vocational college to carry out experiments, based on the experimental results, this paper analyzes the significant improvement effect of intelligent information technology on the effectiveness of higher vocational mathematics teaching. The overall utilization rate of information resources in the experimental group is above 35; the teaching data search time range is roughly between 14s and 20s. This shows that intelligent information technology can effectively improve the effectiveness of mathematics teaching in HVC and provide strong support for teaching reform.

1. Introduction

In recent years, the widespread application of intelligent information technology in the field of education has brought profound changes to traditional teaching models. As an important part of cultivating high-quality technical and skilled talents with innovative spirit and practical ability, the effectiveness of vocational mathematics teaching directly affects students' knowledge mastery and skill improvement. However, traditional vocational mathematics teaching has problems such as single teaching methods, low student participation, and unclear teaching effects, which are difficult to meet the current demand for high skilled talents in society. Therefore, exploring how to use

intelligent information technology to enhance the effectiveness of vocational mathematics teaching has important practical significance.

This article explores the application effect and improvement strategies of intelligent information technology in vocational mathematics teaching through empirical research. This article introduces intelligent information technology, integrates teaching methods, and evaluates and improves teaching effectiveness. By designing and implementing an intelligent teaching system, teaching reform experiments were conducted on vocational mathematics courses, and experimental data was collected and analyzed to verify the effectiveness of intelligent information technology in improving mathematics teaching. This provides practical references for the deep integration of intelligent information technology and education teaching.

2. Related Work

In the field of education, scholars have carried out extensive and in - depth exploration and research on the application of intelligent information technology. They've incorporated the latest technological achievements into educational practice not only to enhance teaching quality and learning effectiveness but also to accelerate the process of educational modernization, thus making contributions to cultivating outstanding talents who meet the demands of future society. For instance, Mao and Zhang utilized an improved decision tree algorithm and fuzzy mathematics to analyze college students' entrepreneurship education, with the goal of optimizing educational strategies to boost the success rate of entrepreneurship [1]. Kossybayeva et al. delved into the application of innovative technologies in natural science and mathematics teaching, striving to enhance teaching effectiveness and engage students more [2]. You et al. appraised the effectiveness of professional growth projects by examining how educational robots integrated into science and mathematics courses [3]. Dahlan et al. carried out a systematic literature review regarding gamified learning in vocational education and training so as to understand its influence on learning outcomes [4]. Alrakhawi et al. conducted a systematic review on the utilization, tools, effectiveness, and evaluation of intelligent tutoring systems in education, uncovering their potential in personalized learning [5]. Memon et al. studied the impact of information and communication technology intervention on diabetes management, resolved the evaluation issue of the related intervention effect, and provided a comprehensive review along with an evidence map [6]. Haidabrus' two publications centered on the application of information technology in higher education and scientific management, stressing the significance of technological integration in elevating the quality of education [7]. Kamilovna et al. talked about using digital and information communication technologies to build globally competitive teacher professional competence, highlighting the importance of technological literacy [8]. Mailizar et al. probed into the impact of Technology, Pedagogy, and Content Knowledge (TPACK) on mathematics teachers' acceptance of online professional growth, aiming to promote teachers' ability to integrate technology into teaching [9]. Sun et al. designed an online intelligent English teaching platform based on artificial intelligence technology, with the intention of improving the interactivity and personalization of English teaching [10]. Given the analysis of intelligent information technology in enhancing the effectiveness of vocational mathematics teaching, future research work should further concentrate on and engage in in - depth exploration and solution - seeking for these core key issues.

3. Method

3.1 Intelligent Information Technology

Advanced technologies like artificial intelligence, big data analysis, and cloud computing have

been integrated into intelligent information technology, bringing revolutionary changes to mathematics teaching in HVC. Big data analysis technology is especially crucial in the area of personalized learning recommendations. Through the analysis of students' learning behaviors and performance data, it can accurately anticipate students' learning requirements and offer customized learning resources and paths [11-12]. The following formula can be used in this paper:

$$\mathrm{Re}commended\mathrm{Re}sources = f\left(Learningbrhavior Data, Achievenment Data\right) \tag{1}$$

Here, the algorithm function is denoted by f. It computes the most appropriate learning resources for the student according to the student's learning behavior data (like study duration, learning frequency, interactions, and so on) and performance data (such as examination results, assignment completion, etc.). This procedure is highly individualized. Since the data of each student is distinct, the recommended learning resources are also custom - made. Among them, learning behavior data and performance data serve as input variables, jointly determining the output variable, namely the recommended learning resources. Through intelligent analysis of these data, this paper is able to offer each student the most fitting learning path and resources, thus enhancing learning efficiency and attaining the objective of personalized teaching. Moreover, artificial intelligence technology also has a crucial part to play in intelligent tutoring. It can communicate with students in real - time, respond to inquiries, and offer personalized tutoring and guidance by means of technologies such as natural language processing and machine learning [13-14]. Cloud computing technology offers robust computing and storage assistance for these applications, rendering large - scale data analysis and processing feasible. Secondly, when it comes to the assessment of the effect of intelligent tutoring, the following formula is adopted in this paper:

$$Tutoring\ Effectiveness = \frac{\Delta Knowledge}{Tutoring Time} \times Satisfaction \tag{2}$$

This formula quantifies the effectiveness of the intelligent tutoring system. Among them, ΔKnowledge represents the amount of knowledge gained by students during the tutoring process, Tutoring Time represents the time spent on tutoring, and Satisfaction reflects the satisfaction of students or teachers with tutoring. Through this formula, this paper can evaluate the effect of intelligent tutoring and optimize the tutoring strategy. Finally, in terms of learning effect prediction, this paper uses the following model formula:

$$\mathrm{Pr}edicted\ Score = Learning\ Model\left(Historical Data, Current\ Perfomance\right) \tag{3}$$

This formula is a learning effect prediction model that analyzes students' historical learning data and current learning performance through a learning model to predict students' future test scores. This prediction helps teachers identify students' learning difficulties in advance and take appropriate intervention measures to improve the overall learning effect. Intelligent information technology can provide students with more accurate and personalized learning support by applying these formulas and models in higher vocational mathematics teaching.

3.2 Mathematics Teaching in HVC

In mathematics teaching in HVC, this paper pays special attention to practical application and skill training, and designs teaching content and methods that are both targeted and practical, combining students' professional background and career growth needs. The introduction of intelligent information technology, such as virtual laboratories and online courses, has undoubtedly added new means and rich resources to teaching, greatly enriched the teaching form, and effectively stimulated students' interest in learning [15-16]. In this process, this paper uses some mathematical

models and formulas to quantify the teaching effect and the impact of intelligent information technology. When evaluating students' learning outcomes, this paper uses the following formula:

$$Learing\ Qutcome = f\left(Teaching\ Method, Student\ Background, IT\ \text{Re}\ sources\right) \quad (4)$$

Among them, Learning Outcome represents the students' learning outcomes, and f is a function that represents the comprehensive impact of various factors on students' learning outcomes. Teaching Method refers to teaching methods, which covers new teaching methods that are the integration of traditional teaching methods and intelligent information technology; Student Background refers to students' professional background and basic knowledge; IT Resources represents the resources provided by intelligent information technology, such as virtual laboratories, online courses, etc. This formula explains how intelligent information technology combines with teaching methods and student background to jointly influence students' learning outcomes. By adjusting teaching methods and making full use of intelligent information technology resources, this paper better meets students' personalized learning needs and improves their practical application ability and professional skills.

3.3 Vocational Mathematics Teaching Model Based on Intelligent Information Technology

This paper focuses on the core goal of how to effectively improve the quality of vocational mathematics teaching and cultivate students' mathematical literacy and comprehensive ability, and constructs a vocational mathematics teaching model based on intelligent information technology. Its specific structure is shown in Figure 1.

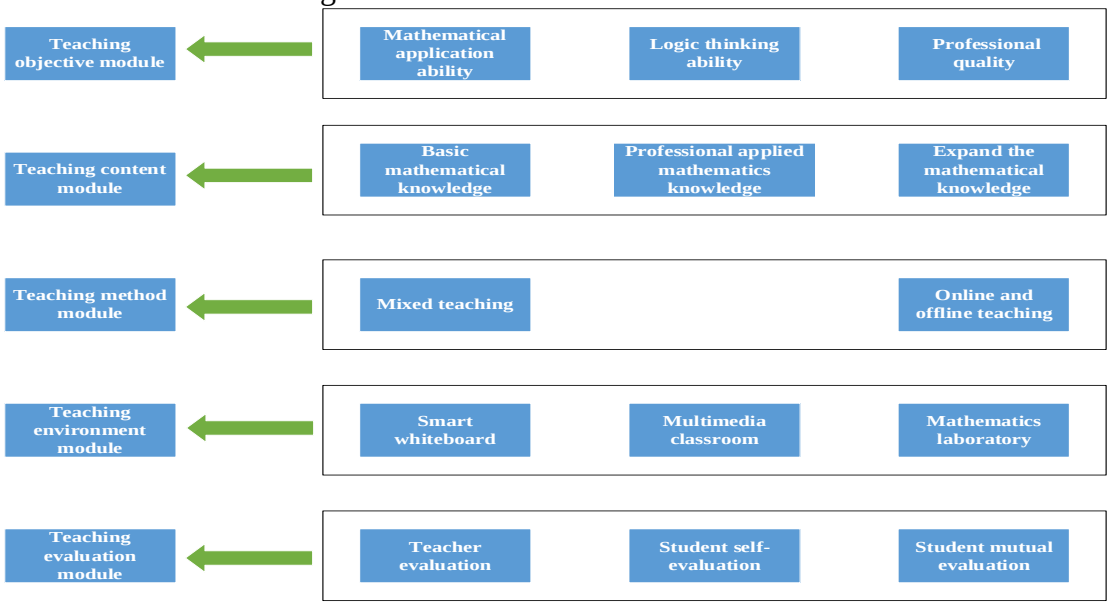

Figure 1. Higher vocational mathematics teaching model

(1) Teaching objectives module

The teaching objectives are clearly centered on cultivating students' mathematical application ability, logical thinking ability, and professional accomplishment. Based on the mathematical knowledge requirements of different majors, the teaching objectives are broken down into sub-objectives that are appropriate for the major. For computer majors, the emphasis is on cultivating students' mathematical thinking in algorithm design and mathematical application capabilities related to data processing; for architecture majors, the emphasis is on cultivating students' ability to use mathematical knowledge to solve practical problems in engineering

surveying and drawing. At the same time, digital literacy goals are set in combination with intelligent information technology, such as allowing students to learn to use mathematical software to perform complex calculations and use online platforms to expand their mathematical knowledge [17-18].

(2) Teaching content module

The content module of this article consists of basic mathematical knowledge, professional applied mathematical knowledge, and expanded mathematical knowledge. Basic mathematical knowledge covers the fundamental content commonly used in vocational mathematics, such as functions, limits, derivatives, etc; Professional applied mathematical knowledge is customized according to the characteristics of different majors, such as integrating financial mathematics and probability statistics into economic analysis for finance and economics majors; Expanded mathematical knowledge is introduced through intelligent information technology, such as mathematical modeling cases and mathematical cultural popularization, to broaden students' mathematical horizons. In addition, utilizing the resource integration function of the intelligent teaching platform, various mathematics textbooks, teaching videos, online exercises, etc. are classified and integrated to facilitate teachers and students to access them as needed.

(3) Teaching Method Module

This article adopts a blended learning method that integrates online and offline teaching. Online teaching utilizes intelligent learning platforms for self-directed learning. The platform provides rich teaching videos, electronic textbooks, and intelligent tutoring systems, allowing students to learn independently based on their own progress and receive immediate feedback. Offline classrooms mainly focus on interactive teaching such as project-based learning and group discussions. When explaining mathematical modeling, teachers propose practical project problems, students discuss in groups, analyze and solve using learned mathematical knowledge and intelligent tools, teachers provide on-site guidance, and promote student cooperation, communication, and knowledge application.

(4) Teaching Environment Module

This article constructs an intelligent teaching environment, equipped with intelligent whiteboards, multimedia classrooms, mathematics laboratories, etc. in terms of hardware. The mathematics laboratory is equipped with professional mathematics software and high-performance computers to meet students' practical operation needs. In terms of software, we will build an intelligent teaching platform with functions such as course management, learning data analysis, and interactive communication. Through learning data analysis, teachers can gain real-time insights into students' learning progress, such as the level of mastery of knowledge points and the distribution of learning time, in order to adjust teaching strategies. Meanwhile, the platform supports online communication between students and between teachers and students, facilitating timely resolution of learning issues.

(5) Teaching evaluation module

This article establishes a diversified and dynamic evaluation system. The evaluation subjects include teacher evaluation, student self-evaluation, and peer evaluation. The evaluation content covers both the learning process and learning outcomes, with a focus on the duration of students' online learning, the number of discussions they participate in, and the quality of homework completion; In addition to exam scores, the evaluation of learning outcomes also includes project completion and performance in mathematical modeling competitions. Using the big data analysis function of the intelligent teaching platform, automatically generate student learning reports, comprehensively present student learning trajectories and growth trends, and provide accurate basis for teaching improvement and student learning adjustment.

4. Results and Discussion

4.1 Testing the Effectiveness of Mathematics Teaching in HVC

In order to comprehensively evaluate the effectiveness of mathematics teaching reform in HVC based on intelligent information technology, this paper constructs a testing index system. The system starts from two key aspects: information resource utilization rate and teaching data search time. The information resource utilization rate can directly reflect the degree of integration and application of various digital resources by intelligent information technology in teaching. The higher the utilization rate, the more efficient the reform has made teaching in resource acquisition and utilization. The teaching data search time reflects whether intelligent information technology can help teachers quickly locate the required teaching materials. The shorter the time, the more convenient the intelligent technology brings to teaching work. These two indicators are interrelated and have their own emphasis, providing a key quantitative basis for measuring the effectiveness of teaching reform. This paper takes two parallel classes in a higher vocational college as an example, one class is the experimental group, which adopts a teaching method based on intelligent information technology; the other class is the control group, which adopts traditional teaching methods. During the one-semester teaching process, data collection was carried out according to the above testing process. At the beginning of the experiment, the initial factors of the students in the two groups were basically the same. The following Table 1 is an example of some basic data:

Table 1. Part of the basic data

Group	Teaching methods	Number of students	Average score of admission score	Average math score at the beginning of the semester	Self-study ability
Experimental group	Intelligent Information Technology Teaching	10	Same	66.59	Same
Control group	Traditional teaching mode	10	Same	66.60	Same

4.2 Analysis of Experimental Results

By embedding a monitoring program in the teaching process, the data of students' use of various information resources is recorded in real time. This paper uses statistical software to process the collected data and generate a visualization chart to present the differences in the utilization rate of information resources between the experimental group and the control group.

From Figure 2, it can be clearly seen that the experimental group used information resources more frequently than the control group within a week, indicating that students in the experimental group were more actively utilizing information resources to assist learning in the teaching environment based on intelligent information technology, and the utilization rate of information resources was significantly improved. The overall utilization rate of information resources in the experimental group was above 35, while the control group was above 25. This not only reflects that intelligent information technology provides students with rich and diverse learning resources, stimulates their desire to actively acquire knowledge, but also reflects the transformation of teaching modes, which has led to a change in students' learning methods, from traditional passive acceptance of knowledge to active exploration of knowledge with the help of information tools,

enhancing their autonomy and enthusiasm for learning.

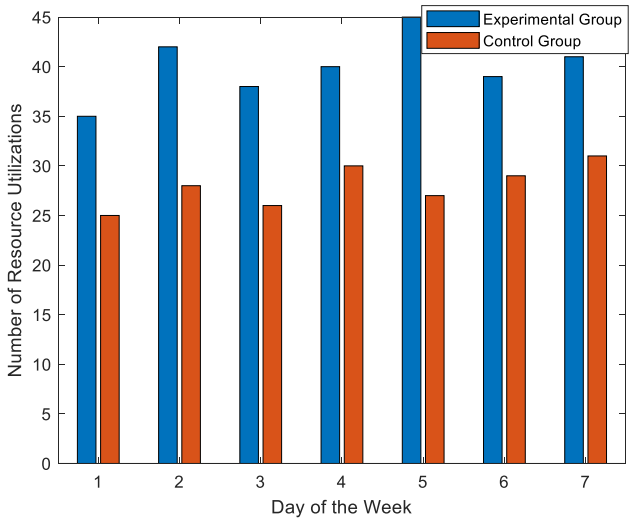

Figure 2. Utilization rate of information resources

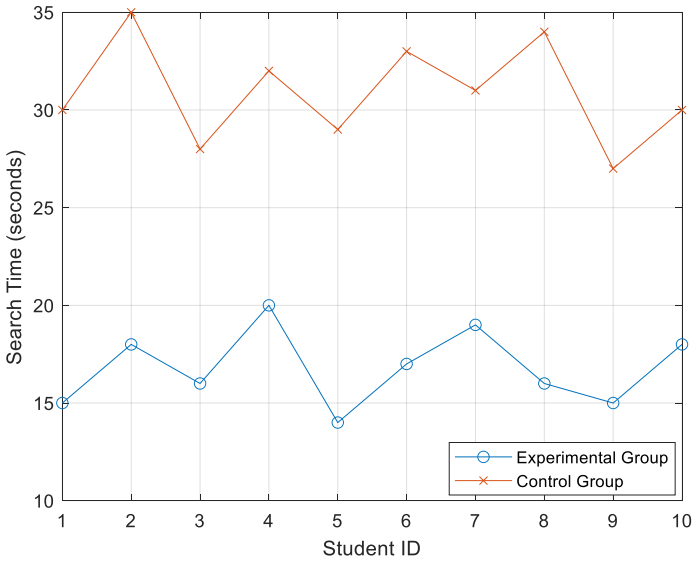

Figure 3. Teaching data search time

In the process of learning mathematics, students need to find various teaching data. By setting up a data search function in the teaching platform and recording the time of each student's search operation, the time interval from the student's initiation of a search request to the acquisition of valid data is counted. The results in Figure 3 show that the teaching data search time of the experimental group students is significantly shorter than that of the control group. The teaching data search time of the experimental group is roughly between 14s-20s, while the data of the control group is roughly between 27s-35s. This is due to the powerful data analysis and retrieval functions of intelligent information technology, which can quickly and accurately locate the teaching data needed by students, greatly saving students' time in finding information and improving learning efficiency. With the support of intelligent information technology, the teaching platform can use intelligent algorithms to filter out the most relevant content from the massive teaching resource library based on students' search keywords, reducing the time wasted by students blindly searching

in the ocean of information, enabling students to acquire knowledge more efficiently, and providing a strong guarantee for in-depth learning and problem solving.

4.3 Discussion of Experimental Results

Through comparative analysis of the information resource utilization rate and teaching data search time of the experimental group and the control group, intelligent information technology has shown significant advantages in improving the effectiveness of higher vocational mathematics teaching. In terms of the use of information resources, the experimental group used information resources significantly more times within a week than the control group. This data shows that the teaching environment constructed by intelligent information technology has greatly stimulated students' enthusiasm for learning. In traditional vocational mathematics teaching, students have relatively few channels for acquiring knowledge, mainly relying on textbooks and teachers' lectures. However, the rich and diverse learning resources brought by intelligent information technology, such as online courses, mathematical simulation software, and intelligent tutoring platforms, have opened a wider door to knowledge for students, met the learning needs and styles of different students, and prompted students to change from passively accepting knowledge to actively exploring knowledge, thereby improving the effectiveness of teaching. The comparison results of teaching data search time are also significantly different. The powerful data analysis and retrieval functions of intelligent information technology allow students to quickly and accurately obtain the required teaching data. In higher vocational mathematics learning, students often need to find a large amount of mathematical formulas, case analysis, problem-solving ideas and other materials. The teaching platform supported by intelligent information technology uses intelligent algorithms to filter relevant content from massive resource libraries based on students' search keywords, avoiding students' blind searches, saving a lot of time, and enabling students to devote more energy to understanding and applying knowledge, effectively improving learning efficiency and teaching effectiveness. Intelligent information technology has a positive impact on improving the effectiveness of mathematics teaching in HVC from the two aspects of expanding learning resources and optimizing learning processes, and has provided strong support for the reform of mathematics teaching in HVC.

5. Conclusion

Intelligent information technology can significantly enhance the effectiveness of mathematics teaching in higher vocational education, manifested in improving students' utilization of information resources and teaching data search time. However, there are also some technical implementation and resource integration challenges in the implementation process. In response to these shortcomings, improvements can be made in the following aspects in the future: firstly, strengthening the technological research and upgrading of intelligent teaching systems to improve their stability and usability; Secondly, optimize the integration and allocation strategies of teaching resources to ensure that students can access high-quality learning resources; The third is to strengthen the cultivation and guidance of students' self-learning ability, improve their self-learning ability and learning effectiveness. Through these improvement measures, the role of intelligent information technology in enhancing the effectiveness of vocational mathematics teaching can be further utilized.

References

[1] Mao L, Zhang W. Analysis of entrepreneurship education in colleges and based on improved decision tree

algorithm and fuzzy mathematics [J]. Journal of Intelligent & Fuzzy Systems, 2021, 40(2): 2095-2107.
[2] Kossybayeva U, Shaldykova B, Akhmanova D, et al. Improving teaching in different disciplines of natural science and mathematics with innovative technologies[J]. Education and Information Technologies, 2022, 27(6): 7869-7891.
[3] You H S, Chacko S M, Kapila V. Examining the effectiveness of a professional development program: integration of educational robotics into science and mathematics curricula[J]. Journal of science education and technology, 2021, 30(4): 567-581.
[4] Dahalan F, Alias N, Shaharom M S N. Gamification and game based learning for vocational education and training: A systematic literature review[J]. Education and Information Technologies, 2024, 29(2): 1279-1317.
[5] Alrakhawi H A, Jamiat N, Abu-Naser S S. Intelligent tutoring systems in education: a systematic review of usage, tools, effects and evaluation[J]. Journal of Theoretical and Applied Information Technology, 2023, 101(4): 1205-1226.
[6] Memon Christoph. Sound Field Optimization of Construction Machinery Cab Structure based on Ergonomics and Mathematical Modelling [J]. Kinetic Mechanical Engineering, 2021, 2(3): 20-29.
[7] Haidabrus B. Information technology and management in higher education and science [J]. Futurity Education, 2022, 2(4): 26-35.
[8] Kamilovna Z G, Fayzulloyevna N F, Subxonqulov To'xtamurod o'g U. Building the professional competence of globally competitive teachers in digital and information and communication technologies[J]. Journal of Survey in Fisheries Sciences, 2023, 10(3S): 2254-2264.
[9] Mailizar M, Hidayat M, Al-Manthari A. Examining the impact of mathematics teachers' TPACK on their acceptance of online professional development[J]. Journal of Digital Learning in Teacher Education, 2021, 37(3): 196-212.
[10] Sun Z, Anbarasan M, Praveen Kumar D. Design of online intelligent English teaching platform based on artificial intelligence techniques[J]. Computational Intelligence, 2021, 37(3): 1166-1180.
[11] Ran H, Kasli M, Secada W G. A meta-analysis on computer technology intervention effects on mathematics achievement for low-performing students in K-12 classrooms[J]. Journal of Educational Computing Research, 2021, 59(1): 119-153.
[12] Wu T T, Lee H Y, Li P H, et al. Promoting self-regulation progress and knowledge construction in blended learning via ChatGPT-based learning aid[J]. Journal of Educational Computing Research, 2024, 61(8): 3-31.
[13] Sun J, Ma H, Zeng Y, et al. Promoting the AI teaching competency of K-12 computer science teachers: A TPACK-based professional development approach[J]. Education and Information Technologies, 2023, 28(2): 1509-1533.
[14] García-Martínez I, Fernández-Batanero J M, Fernández-Cerero J, et al. Analysing the impact of artificial intelligence and computational sciences on student performance: Systematic review and meta-analysis[J]. Journal of New Approaches in Educational Research, 2023, 12(1): 171-197.
[15] Liu H, Chen R, Cao S, et al. Evaluation of college English teaching quality based on grey clustering analysis[J]. International Journal of Emerging Technologies in Learning (iJET), 2021, 16(2): 173-187.
[16] Dede E, Ozdemir E. Mapping and Performance Evaluation of Mathematics Education Research in Turkey: A Bibliometric Analysis from 2005 to 2021[J]. Journal of Pedagogical Research, 2022, 6(4): 1-19.
[17] Karim S, Zoker E M. Technology in Mathematics Teaching and Learning: An Impact Evaluation in Selected Senior Schools in Masingbi Town[J]. Assyfa Learning Journal, 2023, 1(2): 60-72.
[18] Dinçer S. Bridging the gap in technology integration in education: An examination of science teachers' competencies and needs[J]. Journal of Turkish Science Education, 2024, 21(4): 620-634.