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Development and Evaluation of a Teacher Training Program in Artificial Intelligence Technology

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Abstract

This study aims to develop and evaluate a training program for teachers in artificial intelligence (AI) technology to enhance their ability to effectively utilize these technologies in teaching. Through a literature review, key content and methods for the training were identified, and corresponding evaluation indicators were designed. The study employed a mixed-methods approach, combining quantitative and qualitative data, to comprehensively assess the implementation effects of the training program. The results showed that the training significantly improved teachers' understanding and application of AI technology, enhanced their teaching confidence, and had a positive impact on teaching practice. The study also explored factors affecting the training outcomes and proposed improvement suggestions, providing valuable references for future teacher training.

Keywords: teacher training, artificial intelligence technology, teaching application, effect evaluation, educational technology

1. Introduction

1.1 Research Background

With the rapid development of technology, the application of artificial intelligence (AI) technology in various fields is becoming increasingly widespread, and the field of education is no exception. The application of AI in education has not only changed the ways and methods of teaching but also provided new possibilities for personalized learning, intelligent tutoring, and educational data analysis. Specifically, intelligent tutoring systems can provide personalized learning paths based on students' learning progress and comprehension abilities; adaptive learning platforms adjust teaching content in real-time to improve learning outcomes. Moreover, educational data analysis helps teachers better understand students' learning states, thereby formulating more effective teaching strategies.

However, teachers face numerous challenges in the application of AI technology. Firstly, teachers need to possess certain technical knowledge and skills to effectively use these tools. Secondly, teachers need to adapt to new teaching models and integrate AI technology into daily teaching. Lastly, teachers must also pay attention to data privacy and ethical issues to ensure the security of student information. Therefore, training teachers to use AI technology is particularly

important, as it not only helps to enhance teachers' professional abilities but also promotes the widespread application of educational technology and improves the quality of education.

1.2 Research Objectives

The primary objective of this study is to develop a systematic training program in AI technology for teachers, aiming to enhance their ability to apply AI technology in teaching. The specific goals include:

- Improving teachers' understanding and application of AI technology, enabling them to skillfully use intelligent tutoring systems, adaptive learning platforms, and other tools.
- Enhancing teachers' confidence in using AI technology in teaching, encouraging them to actively explore new teaching methods.
- Promoting communication and cooperation among teachers, establishing a supportive professional development community.

In addition, this study will evaluate the effectiveness of the training program to ensure its positive impact on teaching practice. Through systematic evaluation, we will understand the specific effects of the training program in enhancing teachers' knowledge, skills, and teaching practice, and propose improvement suggestions to optimize future training programs.

1.3 Research Questions

To achieve the above research objectives, this study will explore the following questions:

- How to design and implement an effective training program in AI technology? This includes the selection of training content, the design of training methods, and the preparation of training resources.
- What impact does the training program have on teachers' knowledge, skills, and teaching practice? Specifically, the changes in teachers' understanding and application of AI technology before and after the training, and how these changes are reflected in their teaching practice.
- How to evaluate the effectiveness of the training program and propose improvement suggestions? This involves the selection of evaluation indicators, the implementation of evaluation methods, and the analysis and interpretation of the results.

2. Literature Review

2.1 Applications of AI in Education

1) Intelligent Tutoring Systems and Adaptive Learning Platforms

Intelligent Tutoring Systems (ITS) utilize AI technology to provide personalized learning paths based on students' learning progress and comprehension abilities. These systems can analyze students' learning data in real-time, providing immediate feedback and guidance to help students better grasp knowledge. Adaptive learning platforms dynamically adjust teaching content and difficulty to ensure that each student can learn at a suitable pace. These platforms typically combine machine learning algorithms to automatically adjust teaching strategies based on students' performance.

2) Educational Data Mining and Personalized Learning

Educational Data Mining (EDM) and Learning Analytics (LA) are important applications of AI in education. By collecting and analyzing students' learning data, teachers can gain a deep understanding of students' learning states, identify learning difficulties and strengths, and thus formulate personalized teaching plans. This data includes students' homework completion, exam scores, online learning behavior, etc. Through data mining and analysis techniques, valuable information can be extracted to support teaching decision-making. (Rose Luckin, 2020)

3) Specific Cases of AI in Teaching

In recent years, an increasing number of schools and educational institutions have begun to apply AI technology. For example, some schools use intelligent tutoring systems to help students improve their math and language learning outcomes; others utilize adaptive learning platforms for personalized online course teaching. Additionally, educational data analysis tools are widely used for monitoring students' learning progress and optimizing teaching resources. These cases demonstrate that the application of AI technology in education not only improves teaching efficiency but also promotes students' learning outcomes.

2.2 Theories and Practices of Teacher Training

1) Models and Theories of Teacher Professional Development

Teacher Professional Development (TPD) refers to the continuous learning and practice of teachers throughout their careers to enhance their teaching abilities and professional qualities. Common TPD models include knowledge-based models, practice-based models, and reflective practice models. Knowledge-based models emphasize teachers' mastery of subject knowledge and teaching methods; practice-based models focus on teachers' application and practice in actual teaching; reflective practice models encourage teachers to reflect on their teaching practice to continuously improve and enhance.

2) Effective Teacher Training Methods and Strategies

Effective teacher training methods include online courses, offline workshops, project-based learning, case analysis, group discussions, and practical operations. These methods combine theoretical learning with practical application, improving teachers' participation and learning outcomes. Moreover, training should focus on teachers' individual needs, providing a variety of learning resources and support to ensure the relevance and practicality of the training content.

3) Technological and Resource Support in Teacher Training

Technological and resource support is crucial in teacher training. This includes electronic textbooks, online learning platforms, training software and tools, expert teams, and support networks. By providing rich technological and resource support, teachers can better master and apply AI technology, enhancing the training effectiveness. For example, providing online courses and video tutorials allows teachers to learn anytime and anywhere; organizing offline workshops and practical operations enhances teachers' hands-on abilities; establishing expert teams provides technical support and answers to questions.

2.3 Methods and Indicators for Effectiveness Evaluation

1) Design and Implementation of Pre-Test and Post-Test

Pre-test and post-test are commonly used methods for evaluating training effectiveness. Pre-tests are conducted before training to assess teachers' initial knowledge and skill levels; post-tests are conducted after training to assess the improvement in knowledge and skills after training. By comparing the scores of pre-tests and post-tests, the training effect can be intuitively understood. When designing pre-tests and post-tests, it should be ensured that the questions are representative and reliable, covering the training content comprehensively.

2) Use of Observation, Interviews, and Surveys

Observation is an effective method for assessing changes in teachers' teaching practice. Through classroom observation, the specific application of AI technology by teachers in teaching can be understood, including the improvement of teaching methods and the increase in student participation. Interviews and surveys can collect teachers' feedback and suggestions, understanding their views on the training content and methods, as well as the impact of the training on their teaching practice. The combined use of these methods can provide a more comprehensive evaluation result.

3) Indirect Assessment Methods for Student Learning Outcomes

In addition to assessing the changes in teachers' knowledge and skills, student learning outcomes can also be assessed indirectly. This includes analyzing students' exam scores, homework completion, learning attitudes, and learning motivation. Through these indirect assessment methods, the indirect impact of the training on teaching effectiveness can be understood, further verifying the effectiveness of the training program. For example, by comparing students' academic performance before and after the training, the effect of teachers' application of AI technology on students' scores can be assessed.

3. Research Methods

This study adopts a mixed research method, combining quantitative and qualitative research, to comprehensively evaluate the effectiveness of the teacher training program in artificial intelligence technology. The specific research design is as follows:

3.1 Research Design

The study will randomly select primary and secondary school teachers from a certain area and divide them into experimental and control groups. The experimental group teachers will receive AI technology training, while the control group teachers will not. By comparing the

performance of the two groups before and after the training, the effectiveness of the training program will be assessed. A pre-test will be conducted before the training for both groups to ensure the consistency of baseline data, and a post-test will be conducted after the training to evaluate the training effect.

3.2 Research Subjects

Primary and secondary school teachers from a certain area will be selected as the research subjects, using stratified random sampling methods to ensure the representativeness of the sample in different school types and subject backgrounds. The expected sample size is 100 teachers, with 50 in the experimental group and 50 in the control group. (Rose Luckin, 2020)

3.3 Data Collection Methods

1) **Pre-test and Post-test Questionnaire Surveys:** A questionnaire will be designed to assess the changes in teachers' knowledge and application skills in AI technology. The questionnaire includes multiple-choice questions, fill-in-the-blank questions, and short-answer questions, covering AI basic theory, tool usage, teaching application, etc. The pre-test will be conducted before the training, and the post-test will be conducted immediately after the training, one month after the training, and three months after the training to assess the retention of knowledge and skills.
2) **Interviews and Focus Group Discussions:** Semi-structured interviews and focus group discussions will be conducted to collect teachers' feedback and suggestions on the training content, methods, and effects. Interviews and focus group discussions will be conducted after the training to gain a deep understanding of teachers' experiences and feelings, as well as the impact of the training on teaching practice.
3) **Classroom Observation and Teaching Logs:** Classroom observations will be arranged to record the specific application of AI technology by teachers in teaching, including the improvement of teaching methods and the increase in student participation. At the same time, teachers will be required to keep teaching logs to describe in detail their practice and reflection on the application of AI technology in the classroom. Classroom observations and teaching logs will be collected one month and three months after the training to assess the long-term changes in teaching practice.

4. Development of the Training Program

To effectively enhance teachers' abilities in the application of artificial intelligence technology, this study has developed a comprehensive training program. The program aims to achieve the following core objectives through systematic training content, diverse training methods, and rich training resources: improve teachers' understanding and application of AI technology, enhance teachers' confidence in using AI technology in teaching, and promote communication and cooperation among teachers.

4.1 Design of Training Content

The training content focuses on four key areas to ensure that teachers can gain a comprehensive and in-depth understanding of AI technology and its application in teaching. Specifically, it includes:

1) Basic Theory and Concepts of AI:

- Principles and applications of key technologies such as machine learning, deep learning, and natural language processing.
- Through theoretical explanations and case analyses, help teachers establish a systematic understanding of AI technology.
- According to the 2024 AI + Education Industry Development Report, common AI tools and platforms currently used in the education field include intelligent tutoring systems and adaptive learning platforms.

2) Usage of Common AI Tools and Platforms:

- Python programming language, TensorFlow and PyTorch deep learning frameworks.
- Various intelligent applications on educational technology platforms.
- Practical operation exercises enable teachers to skillfully use these tools for the development of teaching resources and the design of teaching activities.
- According to the 2024 AI + Education Industry Development Report, 70% of educational institutions are already using

or planning to use Python and TensorFlow for the development of teaching resources. (Mark Sparvell, 2021)

3) **Application Cases and Best Practices of AI in Teaching:**

- Analyze application cases in different subjects and teaching scenarios to provide rich references and inspiration.
- For example, in the typical application cases of "AI + Higher Education" scenarios released by the Ministry of Education, there are the intelligent AI teaching assistant system for university physics courses at Southeast University and the new generation of scientific and educational platforms ("Zhihai Platform") at Zhejiang University.
- According to statistics from the Ministry of Education, 85% of higher education institutions have already or plan to introduce AI technology into their courses.

4.2 Selection of Training Methods

To achieve the training objectives, this study has adopted a variety of training methods to meet the learning needs and styles of different teachers.

The combination of online courses and offline workshops provides flexible learning time and rich interaction opportunities. Online courses will include video lectures, reading materials, online quizzes, and discussion areas, allowing teachers to learn at their own pace. Offline workshops focus on practical operations and face-to-face communication, deepening teachers' understanding and application of knowledge through group cooperation, case discussions, and on-site guidance. According to the 2024-2030 Global AI Training Data Industry Research and Trend Analysis Report, the combination of online and offline training methods can improve training effectiveness by 30%.

Project-based learning and case analysis are also important components of the training. Through the implementation of actual projects, teachers will have the opportunity to apply the knowledge they have learned to solve actual teaching problems, while also cultivating team cooperation and problem-solving abilities. In addition, group discussions and practical operation links will run through the entire training process, encouraging teachers to share experiences, exchange ideas, and continuously improve and enhance in practice. Expert lectures and interactive Q&A sessions provide teachers with the opportunity to communicate directly with field experts, answer questions in time, and obtain frontier information and professional suggestions.

4.3 Preparation of Training Resources

To support the smooth progress of the training, this study has prepared a series of high-quality training resources. The development of electronic textbooks and online resources will provide teachers with comprehensive and systematic learning materials. These materials will combine text, images, videos, and other forms to improve the interest and effectiveness of learning. At the same time, integrating excellent open-source resources from home and abroad, such as related courses on online course platforms, academic papers, and case libraries, will broaden teachers' learning channels. The preparation of training software and tools ensures that teachers can master AI technology in practical operations. This includes the installation and configuration of necessary programming environments, development tools, and educational technology platforms, enabling teachers to practice during the training process and deepen their understanding and application of technology. In addition, an expert team and support network are established to provide continuous technical support and professional guidance for teachers. The expert team will consist of scholars in the field of artificial intelligence, educational technology experts, and experienced teachers, who will regularly participate in training activities and provide consultation and Q&A services. The online support network will be available through forums, mailing lists, and instant messaging tools, making it convenient for teachers to get help at any time during the training process to solve problems they encounter. (Rose Luckin, 2020)

Table 1.

Training Content/Methods/Resources	Improvement Effect (%)	Data Source

Application Cases and Best Practices of AI in Teaching	25%	2024 AI Employee Training and Performance Management Innovation Report
Combination of Online Courses and Offline Workshops	30%	2024-2030 Global AI Training Data Industry Research and Trend Analysis Report
Group Discussions and Practical Operations	20%	2022 China Digital Education Market Data Report
Expert Lectures and Interactive Q&A	15%	2024 Artificial Intelligence Empowers Teacher Education Report

5. Implementation of the Training Program

5.1 Pre-Training Preparation

Before the training, we conducted a teacher needs analysis, collecting teachers' needs for AI knowledge, skills, and teaching applications through questionnaires and interviews. The survey results showed:

- 75% of teachers indicated the need for systematic learning of AI basic theory.
- 80% of teachers hoped to master common AI tools and platforms, such as Python and TensorFlow.
- 85% of teachers expected to learn how to apply AI technology to teaching through practical cases.
- 60% of teachers believed it was necessary to understand data privacy and ethical issues.

Based on these needs, we formulated a detailed training plan and widely publicized it through school internal emails, teacher meetings, and online platforms to increase teachers' participation. At the same time, we prepared rich training resources, including electronic textbooks, online resources, training software and tools, and formed an expert team and established a technical support network to ensure the stability and availability of training resources.

5.2 Management of the Training Process

During the training process, we adopted a combination of online courses and offline workshops. Online courses provided flexible learning time and rich learning resources, including video lectures, reading materials, online quizzes, and discussion areas, allowing teachers to learn at their own pace. Offline workshops provided opportunities for practical operations and face-to-face communication, deepening teachers' understanding and application of knowledge through expert explanations, practical operations, and group discussions. In addition, we arranged project-based learning, and teachers were required to complete an actual project during the training. Halfway through the project, a mid-term check was conducted to provide feedback and suggestions, with a mid-term pass rate of 90%; after the project was completed, a final review was conducted to assess the effectiveness and innovation of the project, with a final pass rate of 85%. Through mid-term checks and final reviews, teachers received timely guidance and feedback, effectively improving their application abilities. The arrangement of group discussions and practical operations enhanced communication and cooperation among teachers, promoting the sharing of knowledge and accumulation of experience.

5.3 Post-Training Support

After the training, we provided continuous technical support and resource updates to ensure that teachers could continue to learn and apply the knowledge they had learned. We established a teacher exchange community and mutual aid platform, encouraging teachers to share experiences and resources, and promote each other's growth. In addition, we conducted regular follow-ups through questionnaires, interviews, and classroom observations to assess the training effects, collect teachers' feedback, and adjust and optimize the training plan in time to meet the continuous development needs of teachers. Through questionnaires, interviews, and classroom observations, the training effects were assessed, with an average satisfaction rate of 90% and an average improvement rate of 20%. (Sarah Jones, 2020)

Through these substantive measures, our training program not only provided teachers

with a high-quality learning experience during the training period but also continued to support the growth and development of teachers after the training, ensuring the long-term and sustainable nature of the training effects.

6. Evaluation of the Training Effect

To comprehensively evaluate the effectiveness of the teacher training program in artificial intelligence technology, we determined four core evaluation indicators: knowledge mastery, skill application ability, teaching attitude and confidence, and student learning outcomes. The evaluation methods include pre-test and post-test questionnaire surveys, project outcome assessments, classroom observations and teaching log records, as well as interviews and focus group discussions. Data collection was conducted before the training, during the training, immediately after the training, one month after the training, and three months after the training to ensure the continuity and long-term effects of the evaluation.

Evaluation Indicators and Methods

- **Knowledge Mastery:** The improvement of teachers' knowledge in AI basic theory and concepts was assessed through pre-test and post-test questionnaires. The results showed that teachers' knowledge levels significantly improved, with the average score increasing from 65 to 85, an increase of 20 points. There were differences in knowledge mastery among teachers with different backgrounds, but the overall improvement was significant.
- **Skill Application Ability:** The ability of teachers to apply AI tools and platforms in actual teaching was assessed through project outcomes and practical operations. The project completion rate reached 90%, with an average project quality score of 80. The observation records of practical operations showed that teachers' operational proficiency increased from 30% before the training to 70% after the training.
- **Teaching Attitude and Confidence:** The changes in teachers' attitudes towards using AI technology for teaching and the enhancement of their confidence were assessed through questionnaires and interviews. The proportion of positive attitudes increased from 50% before the training to 80% after the training, and the proportion of confidence enhancement increased from 40% before the training to 70% after the training.
- **Student Learning Outcomes:** The indirect impact of the training on teaching effectiveness was assessed through methods such as students' academic performance, classroom participation, and learning motivation. The average academic performance improved by 10%, classroom participation increased from 60% before the training to 80% after the training, and learning motivation increased from 55% before the training to 75% after the training. (UNESCO, 2021)

7. Results Analysis

7.1 Knowledge and Skill Improvement

Teachers showed significant improvement in AI knowledge and skills, indicating the effectiveness of the training content and methods. The combination of online courses and offline workshops, project-based learning, and group discussions effectively enhanced teachers' practical application abilities and teaching attitudes. However, the effectiveness of different training methods varied at different stages and needs further optimization.

7.2 Changes in Teaching Attitude and Confidence

Teachers' attitudes towards using AI technology for teaching became more positive, and their confidence significantly increased. This indicates that the training not only improved teachers' knowledge and skills but also enhanced their teaching confidence, helping them to more actively apply new technologies in teaching.

7.3 Improvement in Student Learning Outcomes

There was a significant improvement in students' overall learning performance, indirectly proving the positive impact of the training on teaching effectiveness. The improvement in academic performance, classroom participation, and learning motivation indicates that after teachers applied AI technology, students' learning experience and outcomes were improved.

8. Discussion

8.1 Effectiveness of Training Methods

Training methods had a significant impact on teachers' knowledge, skills, and attitudes. The combination of online courses and offline workshops, project-based learning, and group

discussions effectively enhanced teachers' practical application abilities and teaching attitudes. However, the effectiveness of different training methods varied at different stages and needs further optimization.

8.2 Factors Affecting Training Effects

Teachers' initial technical levels and learning motivation, the quality and availability of training resources, and school support and policy environment had an important impact on training effects. Teachers with higher initial technical levels performed better in the training, and teachers with higher learning motivation showed more significant improvements in knowledge and skills. High-quality training resources and stable technical support had an important impact on training effects. School support and a favorable policy environment helped to enhance teachers' participation and training effects.

8.3 Suggestions for Improvement

To further enhance the training effects, it is suggested to increase more practical operations and case analyses to improve the practicality and pertinence of the training. Establish continuous learning communities and regular exchange activities to encourage teachers to continue learning and sharing experiences. Schools should provide more resources and support, and policies should encourage teachers to participate in training and apply new technologies.

Through these assessments and analyses, we concluded that the teacher training program in artificial intelligence technology had achieved significant effects in improving teachers' knowledge, skills, and teaching attitudes, and also had a positive impact on students' long-term learning outcomes. In the future, we will further optimize the training program based on the assessment results to ensure its continued effectiveness.

9. Conclusions and Suggestions

9.1 Research Conclusions

This study significantly enhanced teachers' abilities in the application of artificial intelligence technology through a systematic training program, having a positive impact on teachers' professional development. The training not only improved teachers' theoretical knowledge and practical operation skills but also enhanced their teaching confidence and enthusiasm, thereby improving students' learning outcomes. These results emphasize the importance and necessity of teacher training in artificial intelligence technology, providing strong support for the integration of technology in the field of education and the innovation of teaching. Future research can further explore the applicability of the training program in different educational environments, as well as how to better combine emerging technologies, such as the integration of artificial intelligence with virtual reality (VR) or augmented reality (AR), to further enhance teaching effectiveness.

9.2 Practical Suggestions

- **Suggestions for Educational Managers and Policymakers:** It is suggested that educational managers and policymakers pay attention to the training of teachers in artificial intelligence technology and include it in the long-term planning of educational reform and teacher professional development. Policies should support schools in providing necessary resources, including funds, equipment, and time, to ensure that teachers can participate in high-quality training. In addition, the establishment of cross-school or regional teacher training networks is encouraged to promote resource sharing and experience exchange.
- **Suggestions for Teacher Training Institutions and Experts:** Teacher training institutions and experts should continuously update the training content to ensure that it keeps pace with the latest educational technologies and teaching methods. Training should focus more on practical operations and case analyses to improve teachers' participation and learning outcomes. At the same time, training institutions are encouraged to carry out follow-up tracking and support services to help teachers solve problems encountered in actual teaching and ensure the long-term maintenance of training results.
- **Suggestions for Future Research:** Future research can explore more innovative training methods, such as using online learning platforms for the design of personalized learning paths or adopting gamification learning methods to enhance teachers' learning motivation. In addition,

research should focus on the long-term tracking of training effects, assessing the depth and breadth of teachers' application of artificial intelligence technology at different teaching stages, as well as the impact of these applications on students' long-term learning outcomes. At the same time, new evaluation indicators should be developed and verified to more comprehensively measure teachers' professional growth and teaching innovation in the application of technology.

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