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Training and Education Strategies of Mental Health Nursing Personnel in the Era of Artificial Intelligence

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Abstract

With the rapid development of artificial intelligence (AI) technology, its widespread use in various industries, especially in education, has triggered an in-depth exploration of the role of AI in specific fields. Mental health nursing education, as a technology-sensitive and rapidly responsive field, is particularly important for research on the use of AI technology in order to enhance educational effectiveness and efficiency. Based on an in-depth analysis of existing educational models, this study explores how AI technology can revolutionize mental health nursing education, and comprehensively analyses the actual potential of AI technology in enhancing the quality of mental health nursing education through questionnaires, experimental design and the construction and application of statistical models.

Keywords

Artificial Intelligence, Educational Technology Application, Mental Health Nursing Education, Statistical Model, Teaching Effect

1. Introduction

When discussing the impact of artificial intelligence (AI) on mental health education, multiple research perspectives are introduced. Hartman and Phillips [1] emphasize the importance of integrating mental health nursing into the nursing curriculum to provide a foundation for understanding mental health education. Happell et al. [2] studied the role of consumer participation in mental health education and proposed to combine AI technology to enhance the educational effect. San et al. [3] demonstrated the application potential of AI in nursing student education through the international multi-center standardized patient simulation study, while Carr et al. [4] discussed the effectiveness of multi-mode teaching in cultivating mental health concepts and supported the application of AI technology. Danesh et al. [5] studied the value of remote presence technology in mental health nursing education and provided insights for the application of AI in distance teaching.

Compared to current state-of-the-art research, this study adds in-depth understanding and practical applications to the field of mental health nursing education, particularly in terms of the effective integration of AI technology [6,7].

The research includes the following main aspects: Section 1 introduces the background, purpose, and

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importance of the study, setting the tone for the research by clearly identifying the value of the application of AI technology and research gaps in the field of education, particularly in mental health nursing education. Section 2 divided into two parts, explores the theoretical foundations of AI technology in education, including the principles and methods of educational applications of AI technology. Focusing on the theory and practice of mental health nursing education, it analyses how AI can help the cultivation of mental health nursing talents. Section 3 conducts questionnaire design and implementation to collect educators' and learners' views and feedback on the application of AI technology to mental health nursing education.

2. Theoretical Exploration and Application

2.1 Theoretical Discussion of AI Technology in Education

The main role of AI technology is to support the realization of educational goals [8], solve educational problems and optimize the educational process through technology, tools, programs or systems [9,10]. Cognitive theory explores how to improve the learning process through personalized learning paths and adaptive learning systems to meet the needs of different learners [11].

2.2 Theory and Practice of Mental Health Nursing Education

The theory and practice of mental health nursing education aims at in-depth analysis and understanding of educational concepts, teaching methods and practical challenges in this field [12].

At the theoretical level, mental health nursing education focuses on a comprehensive understanding of mental illness [13], covering biological, psychological and sociological factors, emphasizing the integration of traditional and recent research results [14], teaching learners ways to diagnose, evaluate and treat mental health problems, and ethical and legal issues of patient care [15].

3. Questionnaire Design and Implementation

3.1 Questionnaire Construction and Design Concept

The questionnaire was designed to assess the use of AI in mental health education, with a particular focus on its impact on educational outcomes, learning experiences, and educational strategies. The content and structure of the questionnaire are shown in Table 1.

Table 1. Questionnaire

Questionnaire section	Problem sample	Response option
Basic information	Occupation	Educators/learners
Attitude and acceptance	Views on the application of AI in education	Very supportive to very unsupportive
Educational effect	The view that AI technology improves learning efficiency	Strongly agree to strongly disagree
Practical challenge	Challenges encountered when using AI technology	Multiple choice question

3.2 Data Collection and Preprocessing

This study collected data on the use of AI in mental health education through online questionnaires, educational institution partnerships, and paper questionnaires. Sample selection ensures diversity and randomness, covering educators and learners from different regions, different educational institutions, and different backgrounds (Table 2).

In conducting the data processing component of the Mental Health Nursing Education Study, three key steps were taken to ensure the accuracy and reliability of the data: data cleansing, missing value processing, and data coding. First, the data cleaning step involved the removal of inconsistent or contradictory responses in the dataset.

Table 2. Data processing

Data processing procedure	Description	Give an example
Data cleaning	Delete inconsistent answers	2% of the answers were deleted because the answers were contradictory.
Missing value processing	Fill in or delete missing values	The missing values of 3% were filled in using the mean.
Data coding	Qualitative to quantitative	The "Very supported" code is 5, and the "very unsupported" code is 1.

3.3 Statistical Analysis and Interpretation

The statistical analysis was conducted to reveal the effects and potential challenges of the application of AI in mental health care education.

(1) Descriptive statistical analysis: The horizontal bar graph provides information on two different aspects related to AI applications, focusing on mean values and their respective standard deviations (Fig. 1).

(2) Frequency analysis: The bar graph illustrates responses to two elements critical to the theme of mental health care training and education strategies in the AI era. The attitudes towards AI applications and the perceived impact of learning efficiency on perception are compared across four response categories: "Very much," "Support/agree," "Neutrality," and "Do not" (Fig. 2).

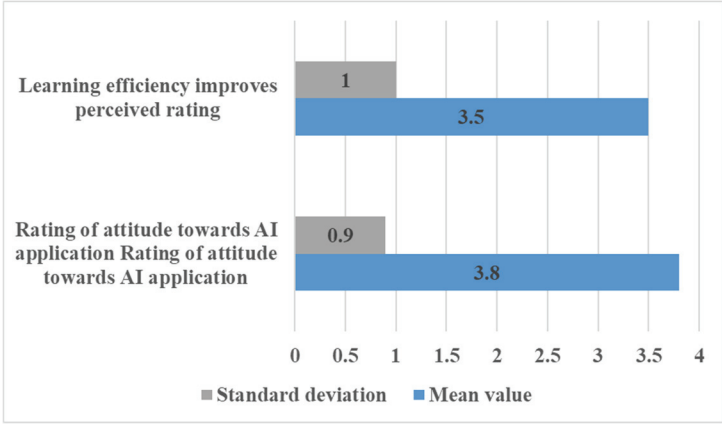

Fig. 1. Descriptive statistical analysis.

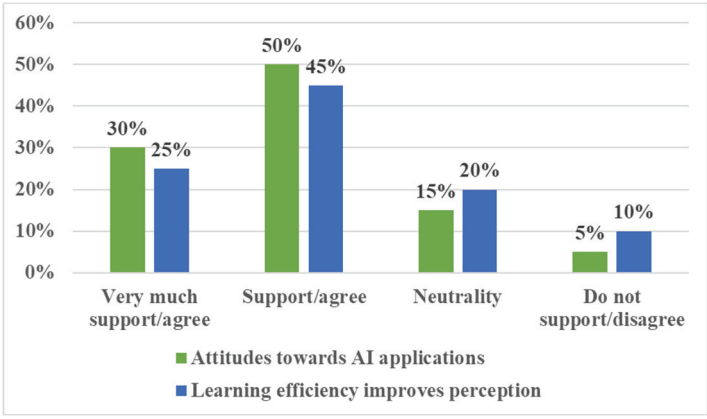

Fig. 2. Frequency analysis.

4. Experimental Design and Implementation

4.1 Experimental Framework and Hypothesis Setting

This study designed an experiment to validate the effects of AI in mental health education, measuring the differences between AI technology and traditional teaching methods in terms of learning outcomes and learning engagement.

4.2 Experimental Procedures and Operating Procedures

Verify the effect of AI in mental health education, as shown in Table 3.

4.3 Processing and Analysis of Experimental Results

After the experiment is completed, the experimental results are processed and analyzed to verify the experimental hypothesis (Fig. 3).

In the context of training and education strategies for mental health care in the AI era, the bar and line graph reflects the efficacy of an experimental educational approach compared to a control group.

Table 3. Experimental operation steps

Procedure	Description	Experimental group	Control group
Preparatory phase	Recruit volunteers and assign them randomly Prepare teaching materials	50 students AI teaching software and simulation tools	50 students Traditional teaching materials
Teaching implementation	Implement a 4-week teaching program	Ai-assisted instruction	Traditional teaching method
Effect evaluation	After the end of the exam and comprehension test	Test scores and comprehension tests	Test scores and comprehension tests
Engagement evaluation	Learners' engagement and motivation were assessed through questionnaires	Engagement questionnaire	Engagement questionnaire
Data collection and analysis	Collect and analyze data	Data analysis	Data analysis

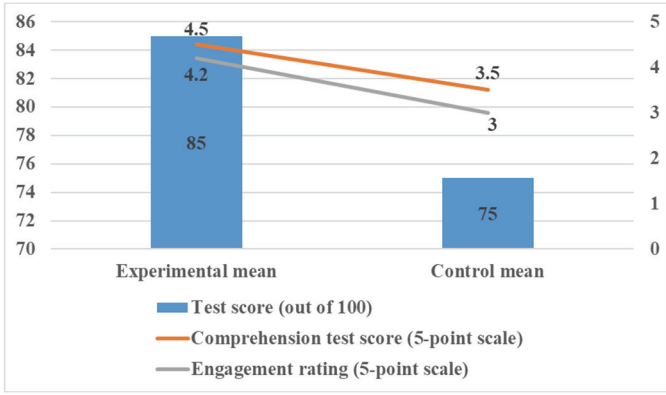

Fig. 3. Analysis of experimental results.

5. Model Construction and Application

5.1 Model Design and Construction Methods

Regression analysis models were used to estimate the impact of AI application on learning outcomes. The Formula (1) is shown:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1 X_2 + \beta_4 X_3 + \beta_5 X_1^2 + \beta_6 X_2^2 + \beta_7 X_3^2 + \beta_8 X_1 X_3 + \beta_0 X_2 X_3 + \epsilon \quad (1)$$

X_1^2 and X_2^2 are squared terms for the degree of AI technology adoption and learner engagement, respectively, and are used to examine the nonlinear effects of these variables on learning outcomes.

X_3^2 is the squared term for other factors (e.g., level of learner prior knowledge), again used to assess nonlinear effects.

$X_1 X_3$ and $X_2 X_3$ are interaction terms to explore the interactions between the extent of AI technology adoption and the level of learner prior knowledge, and learner engagement and the level of learner prior knowledge.

Model description is shown in Table 4.

- Learning effect (test score): 85
- Degree of AI technology adoption: 4
- Level of learner engagement: 4
- Level of learner prior knowledge: 3 (assuming a quantitative range of 1–5 as well)
- Model parameters (assumed values):

$$\beta_0 = 50, \beta_1 = 5, \beta_2 = 3, \beta_3 = 2, \beta_4 = 4, \beta_5 = -0.5, \beta_6 = -0.3, \beta_7 = -0.4, \beta_8 = 1, \beta_9 = 1.5 \quad (2)$$

$$Y = 50 + 20 + 12 + 32 + 12 - 8 - 4.8 - 3.6 + 12 + 18 \quad (3)$$

$$Y = 50 + 20 + 12 + 32 + 12 - 8 - 4.8 - 3.6 + 12 + 18 \quad (4)$$

$$Y = 129.6 \quad (5)$$

The results of regression analysis are as follows: $\widehat{\beta_0} = 50, \widehat{\beta_1} = 5, \widehat{\beta_2} = 3$.

Then the model can be expressed as follows:

$$Y = 50 + 5X_1 + 3X_2 \tag{6}$$

Table 4. Description of model variables

Variable	Description	Data range
Learning effect (Y)	Examination result	60–100
AI application (X_1)	Degree of application of AI technology	1–5
Degree of participation (X_2)	Learner engagement	1–5

5.2 Model Verification and Optimization

Cross-validation and residual analysis were adopted in this study, as shown in Table 5.

Table 5. Model verification

Validation index	Value	Explain
Average cross-validation score	0.75	The average performance of the model on different data subsets is good.
Normality test of residual	Conform to	The residual distribution conforms to the normal distribution and satisfies the hypothesis of linear regression.
R^2 value	0.70	The model can explain 70% of the variability.

The optimization results are shown in formula (7):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon \tag{7}$$

Added independent variable X_3: Complexity of course content

The statistical indicators of the optimized model are shown in Fig. 4.

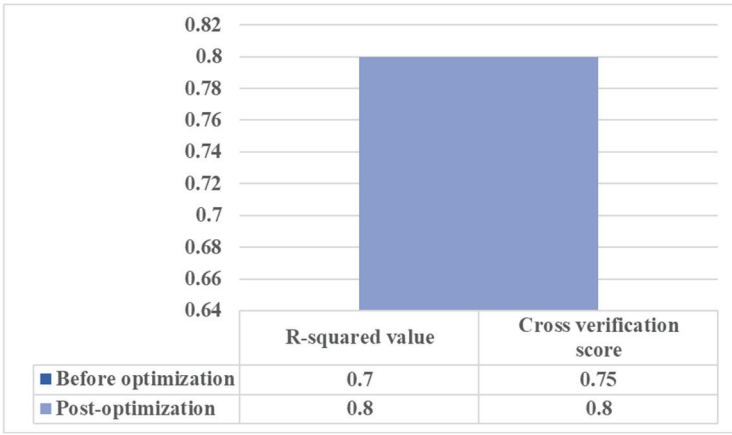

Fig. 4. Statistical indicators of model optimization.

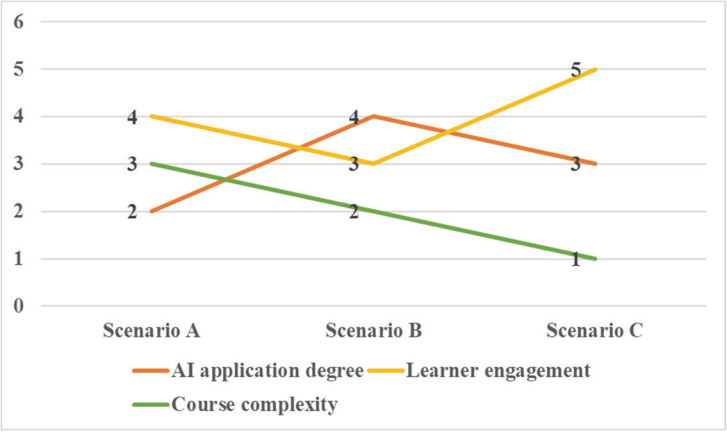

Fig. 5. Application effect analysis.

5.3 Model Application and Effect Analysis

The model is used to predict the impact of different AI applications on learning outcomes. The model formula is shown in Formula (8):

$$Y = 50 + 5X_1 + 3X_2 + 2X_3 \tag{8}$$

Among them, Y is learning effect (test score), X_1 is application degree of AI technology, X_2 is learner engagement, and X_3 is complexity of course content.

The model effect analysis is shown in Fig. 5.

6. Strategy Discussion

Firstly, educational institutions need to identify the most suitable AI instructional tools by assessing their technological infrastructure and the technological proficiency of their teachers. After selecting the tool, special training sessions should be organized to ensure that teachers are proficient in using AI technology for instructional design and implementation. The results of this study showed that the introduction of AI technology into mental health nursing education significantly improved learning outcomes and engagement.

Conflict of Interest

The author declare that they have no competing interests.

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