ISSN 2522-6398 Vol. 7, Issue 2: 62-70, DOI: 10.25236/FER.2024.070210

# Analysis of Microcourse Resource Development Strategies for Computer Education Based on Cognitive Diagnostic Approach

**Qian Chen**[1,a,*]

[1]*Fuzhou University of International Studies and Trade, Fuzhou, China*
[a]*plant988@163.com*
[*]*Corresponding author*

***Abstract:*** *With the development of education informatization, microteaching resources are more and more widely used in the field of computer education. Cognitive diagnostic methods, as an effective assessment tool, can provide important guidance for the development of microcourse resources, and at the same time, can provide targeted suggestions for the development of microcourse resources by analyzing the cognitive process and thinking mode of students in the learning process. Through the evaluation of the existing microcourse resources, it is found that the existing resources are insufficient in diagnosing the cognitive level of students and cannot accurately understand the knowledge mastery of students. Therefore, this paper will analyze the development strategy of microcourse resources for computer education based on the cognitive diagnosis method. By analyzing the application process and effect of the strategy, this study provides a useful reference for the development of computer education microcourse resources.*

***Keywords:*** *Cognitive diagnostic methods; computer education; microteaching resource development*

## 1. Introduction

With the continuous advancement of education informatization, micro-teaching resources are more and more widely used in the field of computer education [1]. As a kind of short, concise and targeted teaching resources, microteaching can meet the learning needs of different students. However, in the current development process of microteaching resources, some problems are found, such as the inability to accurately diagnose the cognitive level of students, resulting in less targeted resources. To address this problem, this study adopts the cognitive diagnosis method, aiming to develop microteaching resources with more diagnostic accuracy and relevance [2].

Cognitive diagnostic methods are a psychology-based research method that can assess an individual's cognitive processes and knowledge structure [3]. By analyzing students' question-answering data, we can understand students' knowledge mastery and provide a scientific basis for resource development. This study adopts the cognitive diagnostic method and combines the knowledge in the field of computer education, aiming to develop microcourse resources that meet the cognitive characteristics of students, so as to improve the learning effect of students.

In implementing this study, a combination of questionnaire and interview methodology was used to analyze, develop and evaluate the data of micro-lesson resources with a view to providing more valuable micro-lesson resources in the field of computer education [4]. In addition, the author will pay attention to the replicability, usability and sustainability of microteaching resources to ensure the practical significance and long-term value of the study. Ultimately, this study will provide a useful reference for the development of microcourse resources in computer education and promote the development of education informatization [5].

## 2. Literature review

### *2.1. Overview of microlearning resources for computer education*

Micro-teaching refers to teaching resources presented in a short and concise form through new media technology [6], usually including video, audio, PPT and other forms, with high content quality

ISSN 2522-6398 Vol. 7, Issue 2: 62-70, DOI: 10.25236/FER.2024.070210

and large amount of information, which can be learned independently at any time and any place [7], and it is a kind of efficient and convenient way of learning. Compared with traditional classroom teaching, microteaching has the characteristics of strong timeliness, strong learning initiative and strong interactivity, which adapts to the personalized needs of learners and shapes a new learning mode [8]. Therefore, microcourse in computer education is of great significance, which can not only provide rich learning resources, but also effectively solve the problem of lack of timeliness of traditional teaching. Through microcourses, learners can obtain the required knowledge anytime and anywhere, strengthening the autonomy and initiative of learning; at the same time, teachers can also carry out the integration of learning resources and knowledge output more effectively, promoting the innovation and development of teaching mode. The application of microteaching in computer education not only enhances the learning experience of learners, but also improves the teaching efficiency, which has an important role in promoting [9].

Microteaching resources can be categorized according to content characteristics, including types such as knowledge point explanation, experimental demonstration, case study, etc., which are applicable to different teaching scenarios [10]. They are characterized by concise content, diverse forms and strong interactivity, which can stimulate learners' interest in learning and provide personalized learning and teaching services. In addition, micro-teaching resources are also characterized by strong timeliness and flexibility, which can meet the needs of learners for rapid access to information and better promote the dissemination of knowledge and deepening of learning [11]. In the process of making micro-teaching resources, it is first necessary to clarify the teaching objectives and audience needs, combine teaching theory and practice, and use a variety of technical means for content creation and production to ensure the quality and effectiveness of the resources. At the same time, in the process of promotion, we can make full use of network platforms and social media to carry out publicity and promotion activities, improve the exposure and influence of resources, attract more learners to participate in them, and achieve good teaching results.

### *2.2. Overview of cognitive diagnostic methods*

Cognitive diagnostic methods play a crucial role in the development process of microteaching resources [12]. Through the use of cognitive diagnostic methods, developers can better understand the cognitive status of students in the learning process, including cognitive level, cognitive diagnostic results, cognitive strategies, etc. This helps developers to more accurately grasp the cognitive needs and characteristics of students. This helps developers to grasp students' learning needs and characteristics more accurately and ensure that microlearning resources are better adapted to students' cognitive characteristics and learning habits. In addition, the cognitive diagnosis method can also provide strong support for the personalized development of microteaching resources [13], making the resources more targeted and effective. Therefore, the application of cognitive diagnostic methods in the development of microteaching resources is of great significance.

Cognitive diagnostic methods can be specifically applied in the process of microteaching resource development in a variety of ways. First, the data of students at the cognitive level can be collected and analyzed through their online assignments or the Q&A feedback in the learning process. Second, cognitive monitoring and assessment of the learning process can be carried out through students' learning performance and interaction data [14], combined with professional cognitive psychology principles and methods. In this process, developers can gain an in-depth understanding of students' individual differences, cognitive strategies and learning modes, so as to adjust and improve the design and development of microlearning resources. In addition, cognitive diagnostic methods can also be used in the evaluation and optimization of teaching resources, through the feedback mechanism to continuously adjust the design of microteaching resources to ensure that the resources can better meet the cognitive needs and learning habits of students. In summary, cognitive diagnostic methods have multiple specific applications in the development of microteaching resources, which provide a strong guarantee for the quality and effectiveness of microteaching resources [15].

### *2.3. Cognitive Diagnostic Model*

#### *2.3.1. DINA model*

In the DINA model, there are M students, N questions, and K knowledge points. The response of the jth student answering question i is denoted by $R_{ji}$ where j=1,2,...,M and i=1,2,...,N. A correct response is indicated when $R_{ji}$ =1 and an incorrect response is indicated by $R_{ji}$ =0. $q_{ki}$ denotes whether

ISSN 2522-6398 Vol. 7, Issue 2: 62-70, DOI: 10.25236/FER.2024.070210

question i examines the kth knowledge or not, and $q_{ki}$ =1 denotes that the answer to question i requires the knowledge point k, and $q_{ki}$ =0 indicates that it is not required, where k=1,2,...,K. $\alpha_{jk}$ indicates whether student i has mastered the kth knowledge point, $\alpha_{jk}$ =1 indicates mastery and $\alpha_{jk}$ =0 indicates no mastery. The potential response of student j on topic i is shown in Equation 1:

$$n_{ji} = \prod_{k=1}^{K} \alpha_{jk}^{q_{ki}} \tag{1}$$

If $n_{ji}$ =1, it means that the student answered the question correctly. The DINA model assumes that the student needs to master all the knowledge points examined in the question in order to answer the question correctly; if $n_{ji}$ =0, i.e., the student did not answer the question correctly, it means that the student j has not mastered at least one of the knowledge points examined in the question i. In the DINA model, the Q matrix is used to represent the association between questions and knowledge points, and it is assumed that each knowledge point is independent.

#### *2.3.2. IRT model*

Common IRT models are the 2-PL model and the 3-PL model, which are models with two and three parameters, respectively. The one-dimensional IRT model uses a continuous variable $\alpha_j$ to represent the latent characteristics of student j. The likelihood of a student answering a question correctly is modeled using a logistic Steele function. Let $\alpha_i$ be the differentiation parameter of the question and bi be the difficulty parameter of the question. Then the 2-PL model of IRT is shown in Equation 2:

$$p_{ji}(\alpha_j) = \frac{1}{1+\exp(-Da_i(a_j-b_i))} \tag{2}$$

In Equation 2, $p_{ji}$ is the probability that student j answers question i correctly, where D = 1.702 is a constant.

The 3-PL of IRT is shown in Equation 3:

$$p_{ji}(\alpha_j) = c_i + \frac{1-c_i}{1+\exp(-Da_i(a_j-b_i))} \tag{3}$$

The $c_i$ in Equation 3 is the probability that a student will answer correctly if he/she is completely ignorant of the topic.

### *2.4. Design of Microcourse Resource Development Strategy for Computer Education Based on Cognitive Diagnostic Approach*

When designing a strategy for developing computer education microcourse resources based on cognitive diagnostic methods, it is necessary to take full account of individual differences and cognitive characteristics, as well as combining the characteristics of the subject and teaching objectives for targeted design. In order to ensure the effectiveness and applicability of the resources, the strategy design should fully utilize advanced technological means and integrate the principles of cognitive psychology and the real needs of teaching. This includes the use of intelligent instructional design tools and platforms for better access to student data and resource design and optimization based on cognitive diagnostic results. In addition, with regard to the characteristics of the discipline and teaching objectives, strategy design needs to fully consider the feasibility and effectiveness of data acquisition and analysis to ensure that real-time feedback and guidance can be provided to teachers and developers. Therefore, the strategy design needs to comprehensively combine technical means and teaching needs to facilitate the formulation and implementation of microteaching resource development strategies based on cognitive diagnosis methods.

In the strategy design of computer education microteaching resources development based on cognitive diagnostic methods, personalized teaching needs are an important consideration. The strategy design needs to respect students' learning characteristics and needs, adopt differentiated teaching strategies, and comprehensively improve the teaching effect and practical application of microteaching resources. This includes combining subject characteristics and cognitive diagnosis results to provide students with personalized learning paths and resource recommendations to meet the cognitive needs and learning styles of different students. At the same time, the strategy design also needs to fully consider the guidance and support needs of teachers, and provide teachers with relevant training and resource management tools for better implementation of microteaching resource development strategies based on cognitive diagnostic methods.

In terms of future development outlook, the design of computer education microcourse resource development strategy based on cognitive diagnostic method will more accurately serve the

ISSN 2522-6398 Vol. 7, Issue 2: 62-70, DOI: 10.25236/FER.2024.070210

individualized teaching needs. With the development of technologies such as big data and artificial intelligence, the cognitive diagnostic method will be more widely used in microcourse resource development. In the future, cognitive diagnostic methods will also better promote the intelligent optimization and personalized design of teaching resources, further improving the relevance and effectiveness of resources. In teaching practice, the design of microteaching resource development strategy based on cognitive diagnostic method will bring more innovation and breakthrough for teachers and students, and further promote the development and enhancement of computer education. Therefore, the author is full of confidence in the future development of microcourse resource development strategy design for computer education based on cognitive diagnostic method, and believes that it will bring more innovations and changes to teaching practice.

## 3. Research methodology

### *3.1. What research methodology was used*

The main methods used in this study were questionnaires and interviews.

Questionnaire survey is a method of collecting data by designing and sending a questionnaire. The researcher designed a series of questions that the respondents were asked to fill in and provide information about their knowledge and use of microlearning. Questionnaires are suitable for large-scale data collection and can be statistically analyzed to produce objective quantitative results. The researcher can choose different types of questionnaires according to the purpose of the study, including structured questionnaires, semi-structured questionnaires and open-ended questionnaires.

Interviewing method is a way of obtaining detailed information and opinions through face-to-face and one-to-one conversations with interviewees. The researcher can choose different types of interview forms according to the research purpose, such as structured interview, semi-structured interview and unstructured interview. Interviews can help the researcher to gain an in-depth understanding of the interviewees' views, attitudes, experiences and beliefs. Through interviews, the researcher is able to ask more in-depth questions and interact with the interviewees to obtain more in-depth clues and information.

### *3.2. Reasons for choosing the above methodology*

The reason for choosing the questionnaire method was to collect teachers' feelings and opinions about the use of microteaching by designing relevant questions in order to understand their acceptance of microteaching and their willingness to use it.

The reason for choosing the interview method was to understand the teachers' views and suggestions on microteaching through in-depth exchanges with them in order to further improve the development of microteaching resources, while the data analysis was to dig into the impact and effect of microteaching resource development by analyzing the collected data.

### *3.3. Data collection*

#### *3.3.1. Questionnaires and user interviews*

The first questionnaire was mainly for some university teachers in Gansu Province to understand their knowledge of microcourses and the development and use of microcourses through the research.

The second questionnaire was mainly directed to university teachers in Gansu Province who had participated in the National University Microteaching Competition, to understand the current situation of their microteaching design and development as well as the difficulties and problems encountered in the process of microteaching construction through the research.

#### *3.3.2. Survey respondents*

The first questionnaire was sent to a total of 204 teachers from some colleges and universities in Gansu Province; the second questionnaire was sent to 62 college and university teachers who participated in the Gansu Region of the First and Second National Colleges and Universities Microteaching Competition. The questionnaires of these two groups of respondents were collected and organized for the statistical data, so as to complete the analysis of the questionnaires.

ISSN 2522-6398 Vol. 7, Issue 2: 62-70, DOI: 10.25236/FER.2024.070210

#### *3.3.3. Sample data sources*

The questionnaire survey prepared in this study involves a relatively wide range of investigations, so the author used the questionnaire star way to edit and release the questionnaire. Therefore, the author's questionnaire survey samples from the professional questionnaire survey data analysis software "questionnaire star", the questionnaire will be forwarded through the WeChat circle of friends link will participate in the questionnaire teachers to fill in the group.

### *3.4. Data analysis*

#### *3.4.1. The sample distribution of Questionnaire I is shown in Table 1:*

*Table 1: Sample distribution for questionnaire I*

| structural characteristic | | number of people | percentage |
|---|---|---|---|
| distinguishing between the sexes | male | 87 | 42.86% |
| | daughter | 117 | 57.14% |
| length of teaching experience | 1-5 years | 71 | 35.06% |
| | 6-10 years | 57 | 27.92% |
| | 11-15 years | 41 | 20.13% |
| | 16-20 years | 20 | 9.74% |
| | More than 20 years | 15 | 7.14% |
| Type of college or university | undergraduate college | 131 | 64.29% |
| | professional training college | 35 | 16.88% |
| | independent institution | 13 | 6.49% |
| | other than | 25 | 12.34% |
| Type of specialty | educational technology | 36 | 17.53% |
| | calculators | 37 | 18.18% |
| | other than | 131 | 64.29% |

As shown in Table 1, 42.86% of the college teachers who participated in the first stage of the questionnaire survey were male and 57.14% were female, and most of the college teachers who participated in the survey had a teaching experience of between 1 and 15 years. The largest proportion of teachers were from undergraduate colleges and universities, and a relatively large proportion of teachers specialized in computer and educational technology.

#### *3.4.2. The sample distribution of Questionnaire II is shown in Table 2:*

*Table 2: Sample distribution for Questionnaire II*

| structural characteristic | | number of people | percentage |
|---|---|---|---|
| distinguishing between the sexes | male | 28 | 45.16% |
| | women | 34 | 54.84% |
| length of teaching experience | 1-5 years | 18 | 29.03% |
| | 6-10 years | 18 | 29.03% |
| | 11-15 years | 13 | 20.97% |
| | 16-20 years | 10 | 16.13% |
| | More than 20 years | 3 | 4.84% |
| Type of college or university | undergraduate college | 23 | 37.10% |
| | professional training college | 30 | 48.39% |
| | independent institution | 4 | 6.45% |
| | other than | 5 | 8.06% |
| Type of specialty | educational technology | 12 | 19.35% |
| | calculators | 7 | 11.29% |
| | other than | 43 | 69.35% |
| title | teaching assistant | 16 | 25.81% |
| | tutors | 29 | 46.77% |
| | associate professor (university post) | 13 | 20.97% |
| | lecture on | 2 | 3.23% |
| | (sth. or sb) else | 2 | 3.23% |

ISSN 2522-6398 Vol. 7, Issue 2: 62-70, DOI: 10.25236/FER.2024.070210

As can be seen from Table 2, among the university teachers who participated in the second stage of the questionnaire survey: 45.16% were male, which is slightly less than the number of female teachers; in the statistics of teaching experience, the largest percentage of university teachers with 1 to 10 years of teaching experience; and a larger percentage of university teachers who participated in this questionnaire survey were assistant professors, lecturers and associate professors.

## 4. Applications

### *4.1. Take the application of Gansu Province universities as an example*

Regarding the application of microteaching in classroom teaching by university teachers in Gansu Province, the following figure is shown in figure 1:

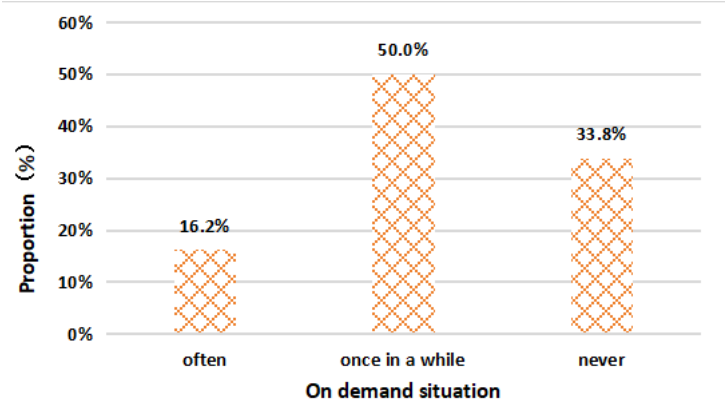


*Figure 1: Microclasses on demand*

Through the data in the figure the author found that the proportion of teachers who have made microcourses is larger among those who use microcourses, from which it can be inferred that the practical process of microcourse design and development makes college teachers who have made microcourses have a better understanding of the advantages and value of the use of microcourses compared to those who haven't made microcourses, and the awareness of the active use of microcourses to assist teaching is also stronger.

The extent to which microlearning is used in the classroom is shown in figure 2:

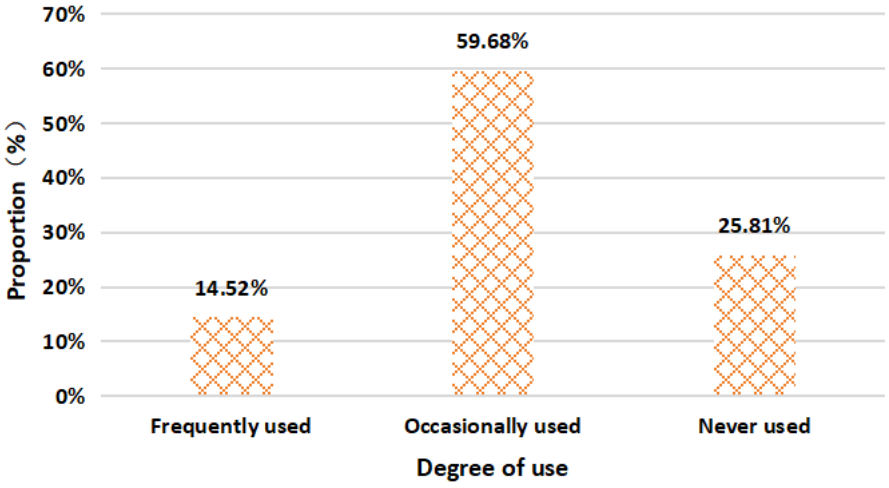


*Figure 2: Extent of micro-teaching use in the classroom*

Through the data in the figure, it can be found that the number of microclasses produced by college teachers who use microclasses in classroom teaching is slightly higher than that of college teachers who have not used microclasses in classroom teaching, which to a certain extent also reflects that college teachers who have produced more microclasses have a more in-depth understanding of the advantages and value of using microclasses.

ISSN 2522-6398 Vol. 7, Issue 2: 62-70, DOI: 10.25236/FER.2024.070210

### *4.2. Analysis related to micro-teaching development*

The number of micro-courses developed is shown in the figure3 below:

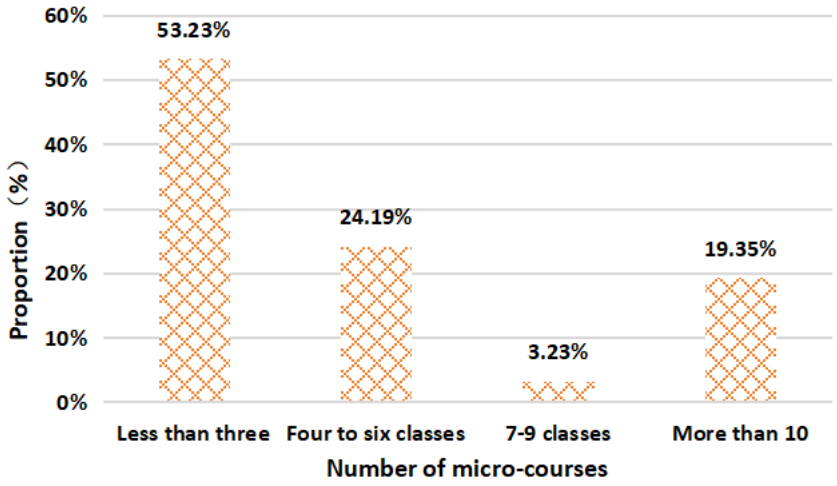


*Figure 3: The number of micro-lessons developed*

It can be seen from the above figure: most college teachers do not have a deep enough understanding of the way of designing and developing microcourses and their significance, and their enthusiasm for microcourses is not yet high; most college teachers design and develop microcourses to cope with the requirements of their schools or produce microcourses only for the purpose of competition, and the construction of microcourse resources in Gansu colleges and universities is still in the beginning and exploratory stage.

The length of a single production microcourse is shown in figure 4:

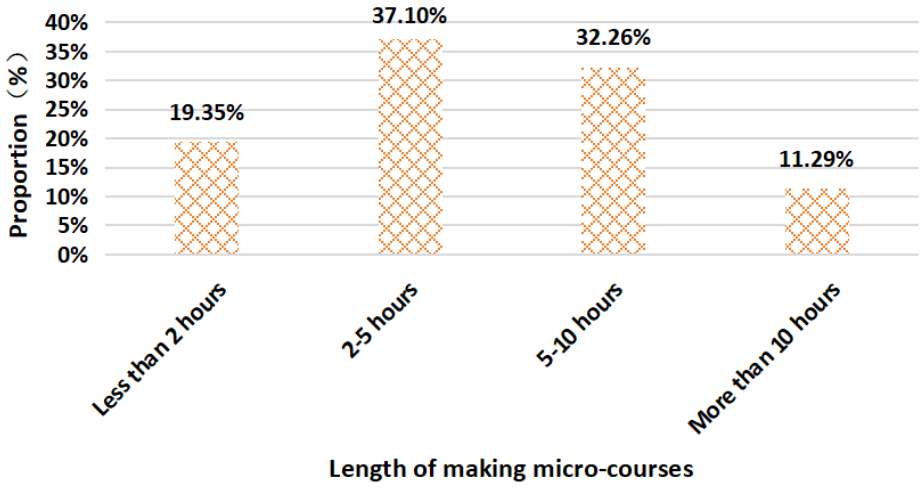


*Figure 4: Duration of a single production micro-lesson session*

Through the data in the above figure, it can be found that the number of microclasses produced by teachers whose production time is less than two hours is also relatively high, which shows that the production time of microclasses has a great relationship with the proficiency level. Most of the college teachers are relatively rusty in microcourse production techniques due to the lack of professional and systematic training related to microcourse design and development, so the time spent on producing a single microcourse is longer.

### *4.3. Analysis related to micro-teaching production*

The profile of those involved in the production of microlearning is shown in figure 5:

ISSN 2522-6398 Vol. 7, Issue 2: 62-70, DOI: 10.25236/FER.2024.070210

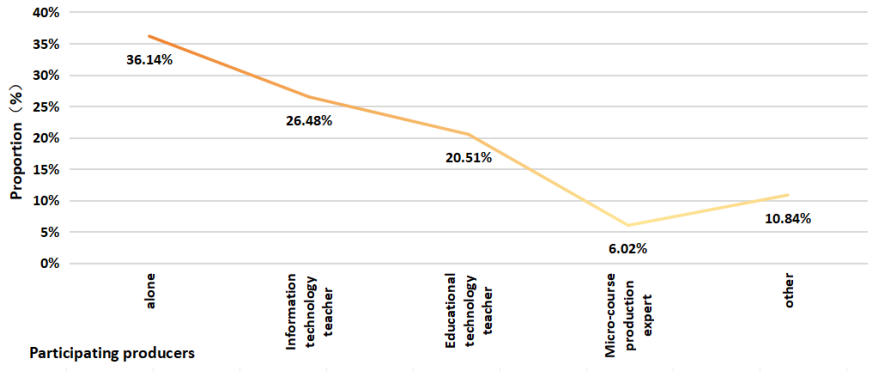


*Figure 5: Participants in micro-teaching*

From the above figure, it can be seen that most college teachers complete the design and development of microclasses with the help of others, and nearly half of them create microclasses with the help of computer or educational technology teachers, which shows that the technical difficulty of microclass development, especially the post-editing stage, is greater, and most college teachers need the help of educational technology or computer teachers due to technical problems. Most of the college teachers need the help of teachers specialized in educational technology or computer to complete the design and development of microcourses because they have technical problems.

The selection of microcourse development methods is shown in figure 6 below:

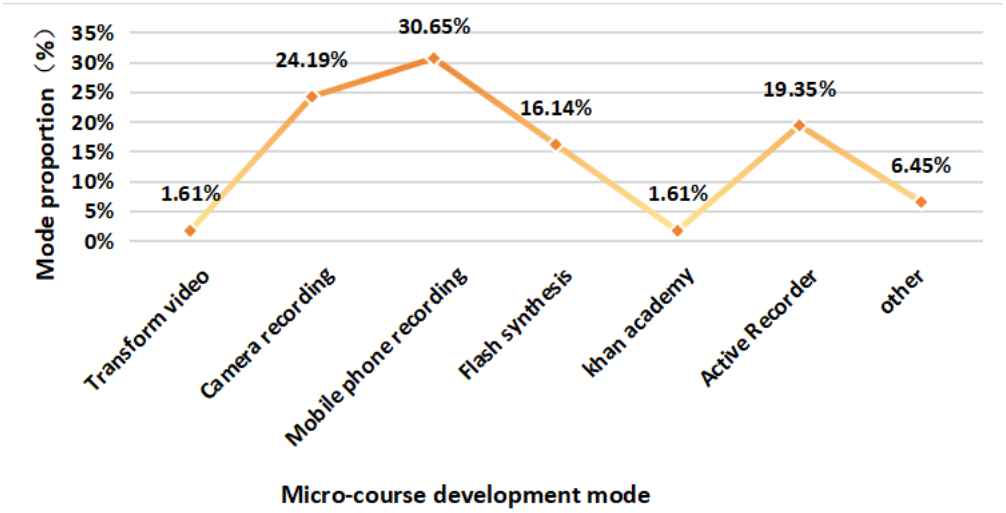


*Figure 6: Selection of microteaching development methods*

From the data in the figure, it can be seen that the majority of college teachers use professional equipment such as screen recording software and recording and broadcasting system to record microclasses, the reason is that compared with cell phones and video cameras, the screen quality of microclass videos recorded by screen recording software and recording and broadcasting system is better, and the operation is relatively simple.

## 5. Conclusion and outlook

With the continuous progress of big data and artificial intelligence technology, cognitive diagnostic methods will more accurately serve the needs of personalized teaching. Through more advanced means of data analysis and intelligent algorithms, teachers and developers will be able to more comprehensively understand the cognitive characteristics and learning needs of students, so as to provide them with more personalized and accurate microteaching resources. This not only helps to improve the relevance and effectiveness of student learning, but also promotes students' learning initiative and motivation.

In the future, with the continuous innovation of teaching platforms and tools, microteaching resources based on cognitive diagnostic methods will present more intelligent and personalized features.

ISSN 2522-6398 Vol. 7, Issue 2: 62-70, DOI: 10.25236/FER.2024.070210

By combining big data analysis and intelligent recommendation algorithms, teachers and students will be able to more conveniently access and use high-quality teaching resources that meet their cognitive characteristics and disciplinary needs, thus improving learning effects and teaching quality.

In addition, the cognitive diagnostic method will promote further innovation and change in teaching practice. In the future, with the deepening research of cognitive psychology theory and teaching technology, cognitive diagnostic methods will be better combined with teaching practice, and continuously promote the development and enhancement of computerized education microteaching resources. In practice, cognitive diagnostic methods will provide teachers with more accurate teaching feedback and guidance, promote the implementation of personalized teaching strategies and effect feedback, and thus promote the continuous innovation and progress of teaching practice.

**Acknowledgements**

The authors would like to show sincere thanks to those techniques who have contributed to this research.

**References**

*[1] Azrai, E. P., Rini, D. S., & Suryanda, A. (2020). Micro-teaching in the Digital Industrial Era 4.0: Necessary or not. Universal Journal of Educational Research, 8(4A), 23-30.*
*[2] Ledger, S., & Fischetti, J. (2020). Micro-teaching 2.0: Technology as the classroom. Australasian Journal of Educational Technology, 36(1), 37-54.*
*[3] Wilson, B. G., & Myers, K. M. (2000). Situated cognition in theoretical and practical context. Theoretical foundations of learning environments, 57-88.*
*[4] Huong, L. T. T., Thi Thuy Quynh, N., Thi Ngoc, N., & Mau Duc, N. (2021). Applying the Lesson Study Model in Developing Teaching Capability for Young Teachers in Vietnam. European Journal of Educational Research, 10(4), 1755-1768.*
*[5] Yang, Z. (2022). Analysis on the Development Strategy of Computer Education Microcourse Resources Based on a Cognitive Diagnosis Method. Wireless Communications and Mobile Computing, 2022.*
*[6] Fitria, T. N. (2022). Microlearning in teaching and learning process: A review. CENDEKIA: Jurnal Ilmu Sosial, Bahasa Dan Pendidikan, 2(4), 114-135.*
*[7] He, L., Sanocki, E., Gupta, A., & Grudin, J. (1999, October). Auto-summarization of audio-video presentations. In Proceedings of the seventh ACM international conference on Multimedia (Part 1) (pp. 489-498).*
*[8] Khan, S. N. (2015). Microteaching in Pakistan: Perspectives of Novice Higher Education Faculty about the Contribution of Microteaching to their Learning and Practice, University of Massachusetts Amherst.*
*[9] Onwuagboke, B. B. C., Osuala, R. C., & Nzeako, R. C. (2017). The impact of microteaching in developing teaching skills among pre-service teachers in Alvan Ikoku College of Education Owerri, Nigeria. African Research Review, 11(2), 237-250.*
*[10] Kurt, G. (2016). Technological pedagogical content knowledge (TPACK) development of preservice middle school mathematics teachers in statistics teaching: A microteaching lesson study.*
*[11] Darling-Hammond, L., Hammerness, K., Grossman, P., Rust, F., & Shulman, L. (2005). The design of teacher education programs. Preparing teachers for a changing world: What teachers should learn and be able to do, 1, 390-441.*
*[12] Perlberg, A. (1972). Microteaching. International Review of Education, 547-560.*
*[13] Lim, C. P., & Chan, B. C. (2007). MicroLESSONS in teacher education: Examining pre-service teachers' pedagogical beliefs. Computers & Education, 48(3), 474-494.*
*[14] Pozzi, F., Manca, S., Persico, D., & Sarti, L. (2007). A general framework for tracking and analysing learning processes in computer-supported collaborative learning environments. Innovations in Education and Teaching International, 44(2), 169-179.*
*[15] Cochran-Smith, M., & Fries, K. (2008). Research on teacher education: Changing times, changing paradigms. In Handbook of research on teacher education (pp. 1050-1093). Routledge.*