

Research on the Structural Design of Micro-Course Resource Package and Its Impact on Learning Behavior

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Abstract

The emergence of micro-courses has brought new opportunities for traditional teaching. However, looking at the development of micro-courses, it is found that there is a lack of uniform standards in the content composition and organization of their resource packages, which directly affects the learning effect of students. In this paper, starting from the resource structure of existing high-quality Micro-course platforms, based on the student demand survey and literature analysis, we explored the structural model of Micro-course resource packages in terms of content composition and organization. Based on this model, the supporting resource packages of two courses were developed and applied to teaching practice. The effectiveness of the structural model of the Micro-course resource packs was also explored from both objective and subjective dimensions by collecting objective data on learning behavior and questionnaire surveys. The study shows that the model can effectively support students' learning and improve their learning outcomes.

Keywords

Micro-Course Resource Package, Content Composition, Organization, Structural Model

1. Issues and Background

With the increasing popularity of education informatization in China, micro-courses with micro video as the core play an increasingly important role in daily teaching and learning, and are more and more valued by education researchers. Micro-courses serve students with the advantages of being short, concise, knowledge-oriented, and targeted, and are of great value to talent cultivation. However,

in the process of micro-courses serving learning, some problems have emerged, which directly affect the quality of learning supported by micro-courses.

1.1. Background of the Study

The National Medium and Long-Term Education Reform and Development Plan (2010-2020) clearly states that the development and application of high-quality educational resources should be strengthened. The Ten-Year Development Plan for Education Informatization (2011-2020) proposes to “help solve the difficult problems of education reform and development through the sharing of high-quality digital education resources, the comprehensive and deep integration of information technology and education, and the promotion of innovation in education teaching and management”. At the same time, micro-courses, with micro-video as the core of teaching and learning, include multiple forms of information expression, including graphics, text and sound, and can reorganize the content of teaching materials into scenarios and fragments, which not only supports regular classroom applications, but also promotes students’ independent learning and personalized learning. Driven by these combined forces, this new resource model and teaching support mode centered on micro-video has attracted extensive attention from educational researchers and front-line teachers, and has become a research hotspot and focus in the era of education reform and informatization.

However, there are still deficiencies and limitations in the process of teaching practice. Analyzing the teaching practice based on Micro-course resource packages in the existing literature, it can be seen that many scholars agree with the view that Micro-course resource packages are composed of micro-video and other supporting teaching resources, but there are fewer studies on the specific components of “other supporting teaching resources”, or there has not been a more unified model of resource structure. However, there is less research on the specific components of “other supporting teaching resources”, or a more unified model of resource structure has not been formed. This has led to the arbitrary structure of the Micro-course resource packages provided to students, which is very likely to be of little use and poor practicality. The theory of correlating and systematizing micro course resource packs has been relatively mature, but there is still a lack of practical and empirical discussions on whether the design, construction, practice and use of various types of resources in the micro course resource packs have met the requirements and expectations of students. Therefore, while the construction and development of Micro-course resource packages are in full swing, researchers still need to speak with practical teaching practice and data, and need to put the construction and teaching practice of Micro-course resource packages into practice.

1.2. Research Questions

Based on the wide application of Micro-course in flipped classroom and collaborative learning, in order to better play the role of Micro-course teaching and improve the learning efficiency, this study will carry out theoretical and empirical

research on the internal composition form and external organization of Micro-course resource packages, and based on this, we will gradually make the content composition and organization of Micro-course resource packages clear and stable, so as to improve the quality of the construction of Micro-course resource packages and the level of Micro-course teaching. Based on this, we will gradually clarify and stabilize the content composition and organization of Micro-course resource packages, so as to improve the quality of Micro-course resource package construction and micro-teaching level.

The core research questions of this study are mainly in the following three aspects:

- 1) Micro-course resource packages are composed of a wide variety of content, but how should they be composed?
- 2) How to solve the problem of fragmentation of knowledge brought about by the miniaturization of resources?
- 3) How effective is the teaching practice of the structure of Micro-course resource packages?

2. Literature Review

2.1. Concept Definition

2.1.1. Micro-Course Resource Kit and Its Structure

The meaning of micro course resource package in this study refers to a synthesis of resources presented in some way explicitly in the context of micro course, guided by instructional design, with micro video as the core and combined with other resources. Among them, the structure of the Micro-course resource package mainly includes 2 dimensions, one of which is the content composition of the Micro-course resource package, i.e., the collection of various types of resources in a single resource package; and the other is the organization of the Micro-course resource package, which includes the organization between the components in a single resource package, and also between the resource package and the resource packages, i.e., the way in which the resource package is structured and presented to students. Therefore, the internal composition reflects mainly the basic components within a single micro course resource package, while the organization is expressed at two levels, including the logical relationship and organization between the components within a micro course resource package, as well as the organization between micro course resource packages.

2.1.2. Knowledge Visualization Theory

Visualization refers to the use of computer-supported, interactive, visual representations of abstract data to enhance people's knowledge of such abstract information. Knowledge visualization, on the other hand, promotes knowledge dissemination and innovation through visual means, often using diagrams, animations, and other forms to present knowledge and its relationships to help students quickly clarify the logical relationships between knowledge points and achieve meaningful learning. In order to present the logical relationship between knowledge points, concepts such as knowledge maps and concept maps and their supporting tools such as *MindMan-*

ager and *iMindMap* are widely used in the development of e-learning resources. In contrast, single, isolated micro-classes cut and fragment the knowledge points in the course content, forming independent islands of information, ignoring the intrinsic connection between knowledge, and hindering students' systematic learning. Based on the theory of knowledge visualization, the use of knowledge map tools can improve this shortcoming, re-establish the logic and connection between knowledge points, and promote students' meaningful learning.

2.2. Content Composition of the Micro-Course Resource Kit

Foreign micro-teaching platforms such as Khan Academy, TED-ed, etc. are mainly for different groups of people, with micro-video as the main focus, supplemented by exercises, extended content, etc. Some platforms also have learning monitoring, tasks and discussion functions. In China, Hu Tiesheng first proposed the composition of micro-teaching, that micro-teaching contains teaching video and teaching design, material courseware and other related resources (Hu, 2011), and further proposed that micro-teaching is a short and complete teaching process, including micro-video, micro-teaching plan, micro-exercises, and other generative and expansive resources, to form a "Very 6 + 1" resource structure (Hu, Huang, & Li, 2013). Zhou Xianbo combined the results of his own survey with the results of his own survey, and then proposed that micro-teaching is the most important part of teaching. Zhou Xianbo combined the results of his own investigation with Hu Tiesheng's "Very 6 + 1" resource structure, pointing out that the supporting resources for micro-courses should include teaching design, micro-course task list, related exercises, knowledge answers, related courseware, passing tests, knowledge extension, etc., but the existing micro-courses network resource construction is obviously insufficient (Zhou, 2015). Ma Xiulin, in his teaching practice and validation, formed a "Very 6 + 1" resource structure. Practice and validation, he formed a diagram of the internal composition of the Micro-course resource package with micro-video as the core, supplemented by resources such as guides, graphic materials, self-diagnostic exercises, etc., which is a leader in the exploration of the structure of the Micro-course resource package (Ma, Li, Liang, & Su, 2018).

2.3. Organization of the Micro-Course Resource Kit

Observation of typical foreign micro-teaching platforms reveals that their resources are mostly divided by subject or grade and presented in the form of hyperlinked text or picture lists, making it easy for students to click and use. However, the shortness and conciseness of micro-courses is both an advantage and a shortcoming. Individual micro-courses cut and fragment the knowledge points, forming information silos and failing to realize knowledge connectivity and integration. Zheng Xiaojun pointed out that this shortcoming can be compensated by associating micro-courses according to the topic or course order to realize the association and systematization of micro-courses (Zheng & Zhang, 2014). According to Xie Yongpeng, the fragmented learning of micro-courses easily leads to students not being able to grasp knowledge coherently and systematically, while

mind maps can re-present the knowledge linkage, so that the micro-courses can present an overall structure of flowing water and integration while maintaining their advantages (Xie & Xu, 2015). Lu Xingwei pointed out in his research that by fragmenting and hierarchizing the course content to form independent and related knowledge points, then developing micro-courses and constructing knowledge maps, a systematic Micro-course resource package can be formed (Lu, Li, & Tian, 2017). Ma Xiulin proposes to draw concept maps with logical relationships as knowledge maps to help students understand the prerequisite and subsequent knowledge of the micro-resource packages, promote the migration and association of knowledge points, and avoid learning barriers (Ma, Su, & Liang, 2018). All these studies show that the shortcomings of micro course can be compensated by effectively organizing and associating micro course resources to achieve systematic learning and transfer of knowledge.

3. Research Design

This study is organized using design-based research, i.e., exploring the contingent structure of micro-teaching resource packages on the basis of a thorough literature survey, and constructing a structural model of micro-teaching resources following the paradigm of design. It also analyzes and examines the contingent structural model of Micro-course resource packages based on learning surveys and questionnaires for well-known Micro-course teaching platforms and for students.

3.1. Research Methodology

This study organizes research activities with design-based research (DBR) interspersed with research methods such as questionnaires and responsive interviews. The questionnaire method involves designing the questions to be investigated in advance, forming a questionnaire, distributing it to the respondents, and retrieving the data and analyzing the data to obtain information. In this study, two questionnaires were designed for the research. One is the questionnaire of students' demand for resources, which is mainly used in the period of model construction; and the other is the questionnaire of students' recognition and feedback on the designed and constructed resource packages, which is mainly used in the period of re-investigation and optimization.

3.2. Research Program

3.2.1. Main Processes for the Implementation of the Study

This study focuses on the exploration of the structural model of Micro-course resource packages, which will be carried out from the dimensions of literature analysis, learning support platform survey, learning behavior data analysis (objective data), questionnaire survey (subjective data), etc. By organizing effective teaching practice activities and analyzing students' actual learning behaviors, we will explore the specific needs of frontline teachers and students for the Micro-course resource packages to support their learning activities, and thus finally form a valuable structural model, as shown in **Figure 1**.

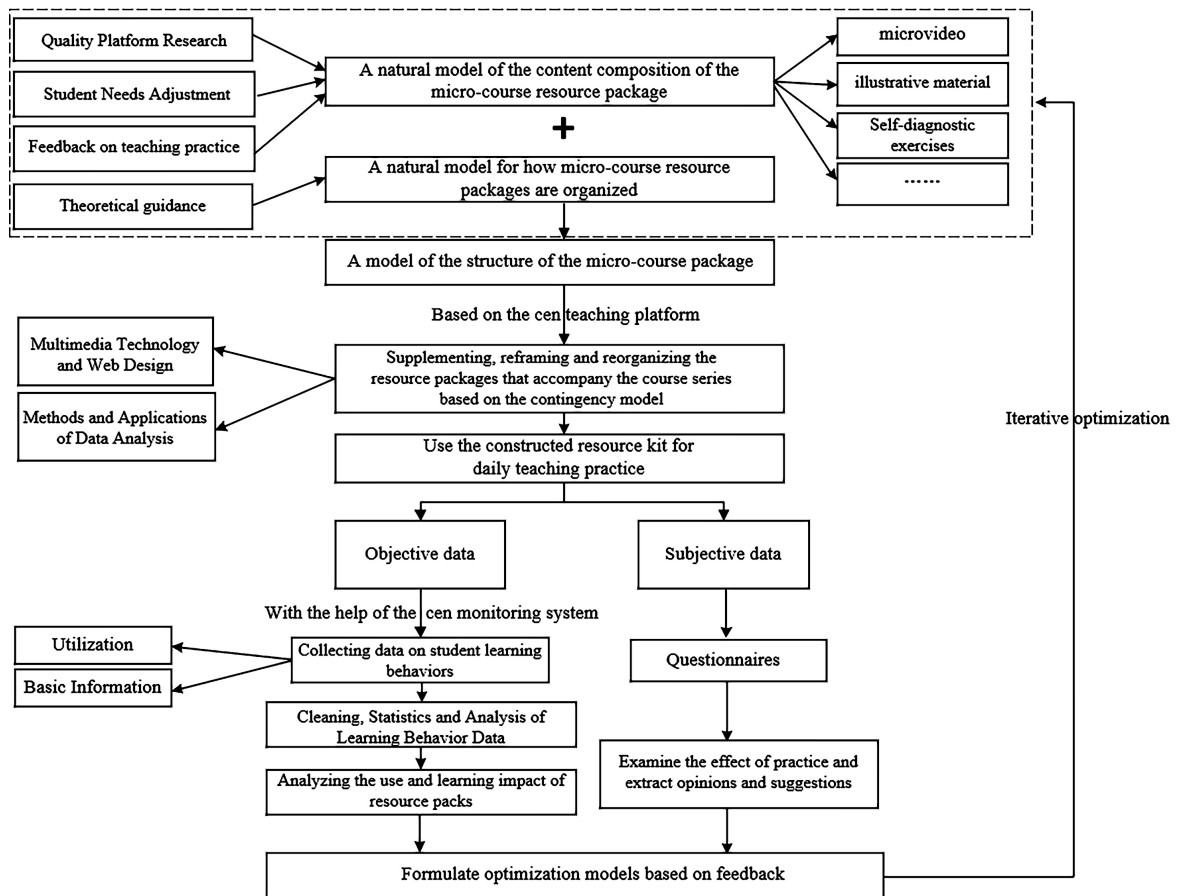


Figure 1. Diagram of this round of modeling and specific research scenarios.

3.2.2. Main Modules and Key Tasks in the Study

The research program consists of 3 main modules, and the key tasks to be accomplished in each module are listed below.

1) Exploration and formation of structural model. The first task of the research is to explore the structure of Micro-course resource packages based on literature analysis, survey of realistic Micro-course platforms and survey of students' needs, and finally form a structural model. Finally, course design and resource construction are carried out based on the structural model.

2) Conducting teaching practice activities to collect objective data on online learning behaviors and investigate student needs.

3) Based on objective and subjective data, carry out data analysis from 2 dimensions, obtain conclusions, and make optimization recommendations.

4. Design of the Contingent Structure Model of Micro-Course Resource Package

The model of the Micro-course resource package is mainly designed based on four aspects: the resource situation of the well-known Micro-course learning support platform, the students' demand for resources, the feedback of teaching practice, and the support of literature analysis to maximize the effectiveness of the struc-

tural model of the Micro-course resource package.

4.1. Survey and Analysis of Well-Known Micro-Learning Platforms

In this part, five well-known micro-learning platforms at home and abroad are mainly selected for the research on resource composition and organization. Through summarization and analysis, the author found that the essential resources on these platforms are micro-videos, and the resources that may be equipped with them are exercises/thinking questions, texts/expansion materials, etc., while the organization among resource packages is mostly presented linearly in the form of text/picture lists with hyperlinks, and the corresponding resource contents can be seen by clicking on the hyperlinks.

4.2. Surveys Geared to the Needs of Students

The author conducted a survey based on **Table 1**. The survey recovered 96 pieces of data, the questionnaire recovery rate of 100%, the validity rate of 100%. The survey sample of 20 male students, accounting for 20.83%, 76 female students, accounting for 79.17%; undergraduate students accounted for 100%; most of the majors are history. From the results of the survey on the content composition and construction demand of Micro-course resource packages, students are more likely to recognize Micro-course resource packages that can be centered on micro-videos and equipped with learning resources such as PPT courseware, text materials, practice questions, and so on. Among them, the micro-video should be a high-quality video within 5 - 10 minutes, preferably in the form of screen without a teacher, screen-capture recording, smooth explanation and clear picture quality.

Table 1. Survey on content composition and construction needs of micro-course resource packages.

| Investigation Term | Serial Number |
|-------------------------------------------------------------------------------------------------------|---------------|
| Sex, grade, major, student number | 1 - 4 |
| Types of learning resources that students prefer to use when learning online | 5 |
| The most indispensable types of resources in a Micro-course resource kit | 6 |
| Students love the micro-video format | 7 |
| What are the requirements that students believe a competent Micro-course resource package should meet | 8 |

4.3. Construction of a Structural Model for Micro-Course Resource Packages

4.3.1. The Design of the Content Composition of the Micro-Course Resource Package

Based on the analysis of the content composition and organization of the resources of well-known Micro-course learning platforms, and on the basis of the research on students' needs and literature analysis, the author makes comprehensive

considerations and proposes the content composition diagram of the Micro-course resource package based on instructional design support, as shown in **Figure 2**.

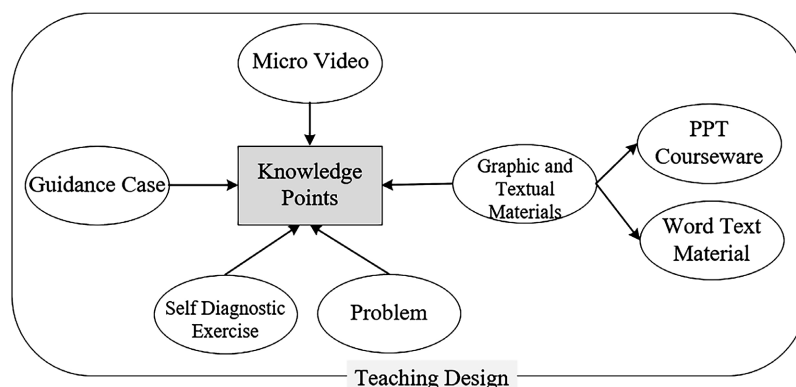


Figure 2. Content composition of instructional design-based Micro-course resource package.

First of all, high-quality micro-video is the core part of the resource package, and it is a necessary building block of the Micro-course resource package because the micro-video has a clear theme, is highly targeted, and is conducive to students' imitation practice and use.

Secondly, it is equipped with an introduction, which is equivalent to the introductory part of the lesson, in order to motivate students to learn and make them understand the content and key points of this knowledge point.

Further, supporting graphic materials, mainly referring to the PPT courseware and Word text version of the knowledge content or practical steps, graphic materials can help students find the key indicators and details in the learning content faster, so that students can easily review and control the details;

Finally, self-diagnostic exercises and reflection questions corresponding to the knowledge points are provided to assist students in verifying whether they have truly mastered the knowledge points and to guide their active thinking.

4.3.2. Construction of Logical Relationships between Micro-Course Resource Packages

Based on the support of knowledge visualization theory, the author began to explore the association relationship between the Micro-course resource packages (knowledge points), and introduced the knowledge map type of external organization in the construction of Micro-course resource packages in order to solve problems such as the broken relationship between resources, which is not conducive to the students' realization of positive migration between knowledge points, etc., and the constructed model diagram of the organization of Micro-course resource packages is shown in **Figure 3**.

4.3.3. Construction of the Structural Model of the Micro-Course Resource Package

Based on the above analysis of both the content composition and the organization

of the Micro-course resource package, the content composition model and the organization model of the Micro-course resource package together form a preliminary model of the structure (content composition and organization) of the Micro-course resource package, as shown in **Figure 4**. In the conceptual map, each knowledge point is a node in the conceptual map, a hyperlink labeled with the knowledge point name. When the student’s mouse hovers over the name of the knowledge point, a hover window will automatically pop up as shown in “Micro-course Resource Pack 6”, which contains a series of resource pack links to micro-videos, text materials and self-diagnostic tests related to the knowledge point, and clicking on one of the resources of the knowledge point will allow you to use the resources for learning.

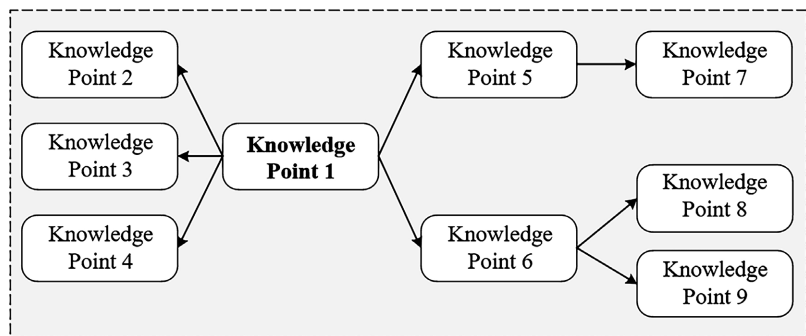


Figure 3. Organization of Micro-course resource packages based on knowledge connectivity.

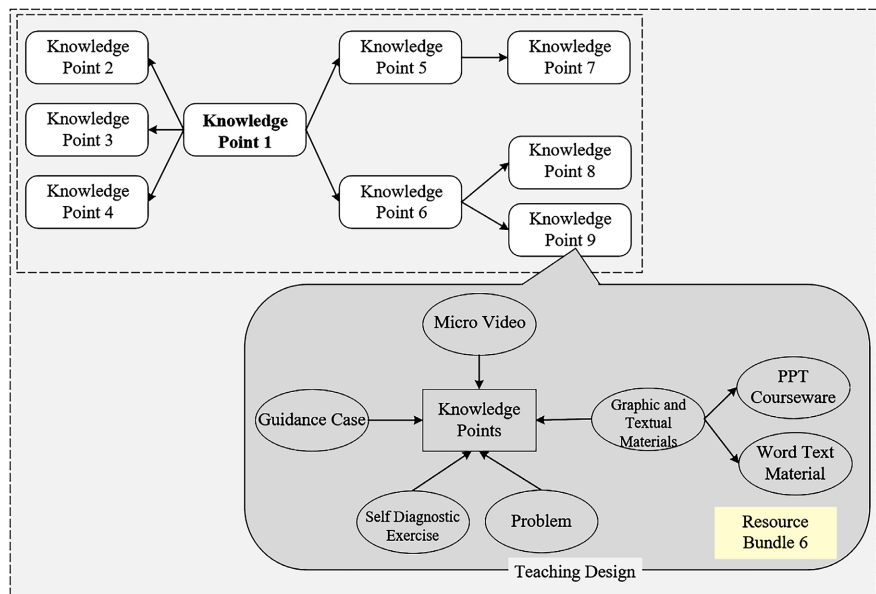


Figure 4. Structural model diagram of the Micro-course resource package.

4.4. Model-Based Learning Support Platform Development

Based on the structural model of the Micro-course resource package, the author designed and developed the Micro-course resource package for the courses Data Analysis Methods and Applications and Multimedia Technology and Web Page Design.

4.4.1. Design and Construction of the Content Composition of the Micro-Course Resource Package

The chapters and knowledge points of the course have been sorted out and divided as a whole to form a number of clearly positioned knowledge points suitable for presentation in the form of micro-courses. The specific design steps are as follows:

First, according to the teaching design for each knowledge point, based on the prepared materials, the author's team completed the production of micro-video (screen capture recording) for each knowledge point.

Secondly, for each knowledge point, it is equipped with an introductory plan for that knowledge point, which is used to introduce the main content and key points of that knowledge point.

Thirdly, each knowledge point is equipped with exercises, which, depending on the nature of the course content, may consist of reflection questions or practical work design questions, the purpose of which is to consolidate knowledge points.

Fourth, each knowledge point is equipped with PPT courseware and Word version text materials, which are used to introduce the teaching objectives, teaching contents, and the operation methods and steps of relevant cases of the knowledge point. The construction effect of the text material for a knowledge point of Data Analysis Methods and Applications is shown in **Figure 5**.

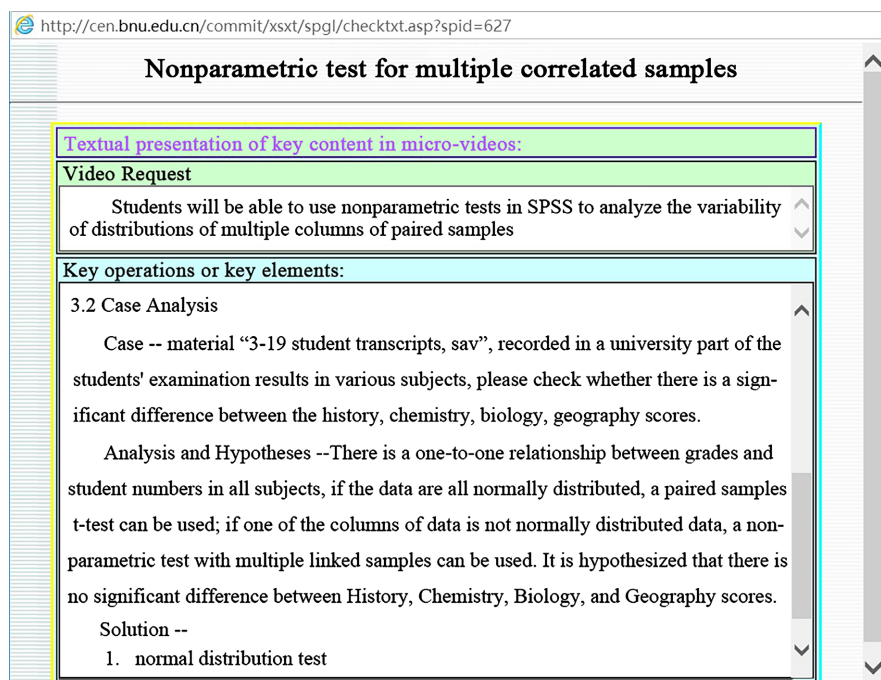


Figure 5. Word version of text material for a knowledge point.

Finally, in order and logic, we completed the design and construction of 2 course resource packages for Data Analysis Methods and Applications and Multimedia Technology and Webpage Design, including micro-videos, introductory lesson plans, PPT courseware, Word text materials, self-diagnostic exercises and reflection questions.

4.4.2. Design and Construction of Self-Diagnostic Exercise Banks

Providing students with online exercises and self-diagnostic question banks is an important part of the construction of Micro-course resource packages. In order to cooperate with the construction of the Micro-course resource kit, according to the learning objectives and course content requirements, the author provides students with self-diagnostic exercises supporting the knowledge points, with the help of the automatic scoring function of the learning platform to help students find out their learning deficiencies in a timely manner.

In this paper, the self-diagnostic questions of *Dreamweaver* web design in Multimedia Technology and Web Design are used as an example to illustrate the construction idea. The author directly presents the actual environment of *Dreamweaver* to the students in the question-answering interface, and provides the topic requirements, supporting materials and samples in the form of small pop-up windows at the bottom of the interface. With the help of this platform, students can complete the design of works in the real software environment, and really use the “do learn” and “use learn”.

This platform has a powerful built-in automatic grading function. After students have completed the design of their works and submitted them to the system, the system will automatically evaluate the students' works according to the requirements of the topic and the principles of software design, and then give a detailed analysis report of the work done. The interface of the test paper analysis part is shown in **Figure 6**. As can be seen from **Figure 6**, the self-diagnostic feedback system gives a detailed evaluation of the students' answers: whether the operation of each small step is correct or not, and the scores of the key operation steps and key operation points. For some difficult questions, the automatic scoring system can even give the answer analysis or suggestions.

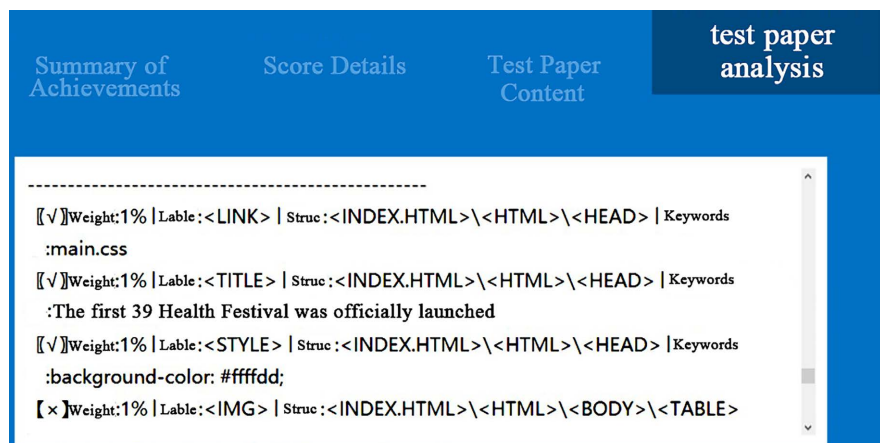


Figure 6. Self-diagnostic evaluation interface for computer-based courses at BNU.

In addition to the self-grading and diagnostic functions, for the online problem sets, this system also provides data such as grade summary, grade details, and test paper contents, which can provide comprehensive support for students to independently check and analyze their own learning status and learning progress from

multiple perspectives.

4.4.3. The Design and Construction of Micro-Course Resource Packages Organizational Approach

In order to better present the knowledge system and knowledge structure, and reduce the fragmentation of resources in micro-teaching, the author drew the knowledge map of each chapter according to the logical relationship between the knowledge points, that is, using the mind map as a carrier, and applying the technology in the webpage, we can hook up the micro-video/PPT classroom materials/Word text materials and other learning resources to the corresponding knowledge points in the mind map, and then we can jump to the corresponding resource interface for learning by clicking the name of any resource hooked up to the knowledge points in the webpage. On the webpage, by clicking the name of any resource linked to the knowledge point, you can jump to the corresponding resource interface for learning.

On the basis of the static knowledge map, the resource packages corresponding to the knowledge points are hung up to form a dynamic knowledge map with on-demand resources at any time. The resource composition and organization of the chapter “Audio and Video Processing Technology” of the course “Multimedia Technology and Web Design” is shown in **Figure 7**. As can be seen from **Figure 7**, the chapter presents the knowledge structure of the whole chapter in the form of a concept map, which serves as the navigation map of the whole module. In the concept map, each knowledge point is a node in the concept map, which is a hyperlink labeled with the name of the knowledge point. When the student’s mouse hovers over the resource pack marker, a hover window will automatically pop up as shown in “Micro-course Resource Pack 6”, which contains a series of links to micro-videos, text materials, and self-diagnostic test questions related to the knowledge point. The arrow lines between the Micro-course resource packages express the predecessor or successor relationship between the Micro-course knowledge points, helping students to complete the correlation between the knowledge points, so as to correlate and systematize the knowledge of the whole chapter.

At this point, the content composition and organization of the resource packages corresponding to the two courses “Data Analysis Methods and Applications” and “Multimedia Technology and Web Page Design” have all been reconstructed and reorganized.

5. Empirical Analysis of the Impact of Micro-Course Resource Package Structure Model on Learning Effectiveness

To analyze the data on the learning impact produced by the structural model of the Micro-course resource pack, the author focuses on 2 aspects. One, to collect the most authentic and reliable objective learning behavior data of students using the Micro-course resource packages in their daily learning, in order to explore the students’ use of the resource packages and their impact on their learning; and two, to obtain the students’ subjective data through questionnaires, in order to explore

the students' recognition and optimization of the structural model as a whole.

3. Audio and video processing technology

When you hover your mouse over any "?", the system will pop up the options list (when the mouse points to the [Close] button within the options list, you can close the current options list). Using the options list, you can watch the micro-video related to this knowledge point, view the text of the key steps. And can be generated for this knowledge point of the work submitted to the system for teachers to keep abreast of your learning progress.

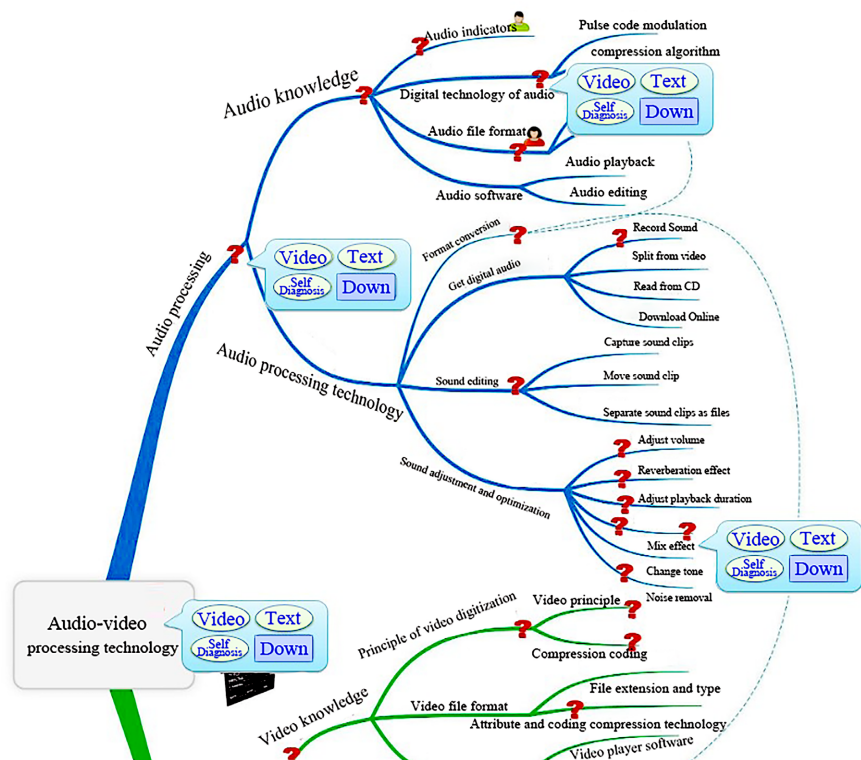


Figure 7. Effectiveness of the audio video processing technology chapter resource kit.

5.1. Collection and Normalization of Data on Learning Behaviors

The author retrieved the behavioral data of students' learning with the help of the platform's resource packages from March 2022 to February 2023, about 80,000 records. In order to focus on the research questions, the author selected all the learning behavior data of the students of the class of 2021 who carried out online 2 courses with the help of cen.bnu.edu.cn in the spring semester of 2022-2023 as the research object of this study. After data cleaning, a total of 5683 records of students of grade 2022 using the Micro-course resource package in the spring semester of 2022-2023 were obtained, with a total number of 405 students and 39 majors covered.

5.2. Exploring the Importance of the Components of the Resource Kit from the Perspective of Student Applications

5.2.1. The Overall Situation of Students' Application of Micro-Course Resource Packages

The descriptive statistics of the overall usage of the Micro-course resource packs are shown in Table 2. The overall usage data show that the majority of students

carried out online independent learning after class with the help of the Micro-course resource packs, and the students were willing to spend a certain amount of time to utilize the online resources to support their learning. Compared with not being equipped with online resources, the Micro-course resource packs provide good support for students' independent learning. Therefore, it is necessary to provide students with online Micro-course resource packages.

Table 2. Descriptive statistics of overall usage of micro-course resource kit.

| Resource type | Number of persons/person | Number of uses/session | Number of uses per capita | Hours/Minutes of use | Hours of use per capita |
|---------------|--------------------------|------------------------|---------------------------|----------------------|-------------------------|
| resource kit | 405 | 5683 | 14.03 | 182,583 | 450.82 |

Note: Resource kit refers to the overall status of the use of micro-videos, graphic materials, etc.

5.2.2. Analysis of the Use of Guided Tutorials

In most online learning resources construction, the importance of the guided learning plan is highly emphasized, and the guided learning plan is the core content of the Micro-course resource package construction. However, from the learning behavior data extracted from the cen.bnu platform, most of the teaching classes have very low access to the guided lesson plans, and only class 3 of the "Multimedia Technology and Webpage Design" course had a high access to the guided lesson plans in the "Audio and Video Processing Technology" module at the end of April 2023, and the access to the guided lesson plans was very significantly different from that of the other modules and other classes. There is a very significant difference. The author initially suspected that the "Flipped Classroom Teaching Mode" caused the high usage of the guidebook.

In order to verify this conjecture, the author extracted Teaching 3 class's use of the guided learning program on other knowledge modules, and the results are shown in **Table 3**. The author found that before using the flipped classroom teaching mode, there was no significant difference between Teaching 3 class and other classes in terms of the use of guided notes. In the subsequent animation production module (which no longer uses the flipped classroom teaching mode), the total amount of use of guided notes by Teaching 3 class is still slightly higher than that of other teaching classes, but the difference with the flipped classroom teaching mode is also very significant.

Table 3. Use of guided learning by teaching classes in other modules in spring semester.

| | Teaching 1 class/session | Teaching 2 classes/session | Teaching 3 classes/session | Teaching 4 classes/session | Teaching 5 classes/session |
|------------------|--------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| Image processing | 3 | 3 | 2 | 2 | 3 |
| animation | 2 | 3 | 28 | 3 | 4 |
| web design | 2 | 3 | 17 | 2 | 3 |
| (grand) total | 7 | 9 | 47 | 7 | 10 |

Overall, the number of times per capita that the resources of the guided learning program are used is not very high on the whole, which is somewhat different from the desired effect. Specifically, the number of times per capita that the guided learning plan was used in daily learning support was lower than the number of times per capita that it was used in the flipped classroom teaching mode, which indicates to a certain extent that the necessity of the guided learning plan varies in different learning modes, and that it is more necessary to provide students with a guided learning plan in the flipped classroom teaching, which is based on students' independent learning, in contrast to that of a flipped classroom teaching, which is based on students' independent learning.

5.2.3. Comparative Analysis of the Use of Micro-Video and Graphic Materials

The frequency and duration of students' use of micro-video and graphic materials are shown in **Table 4**. From the specific data on the use of micro-video and graphic materials, it can be seen that the number of people using micro-video is more than the number of people using graphic materials, and the frequency and duration of micro-video per capita is higher than that of graphic materials per capita, which suggests that the use of micro-video as a core component of the micro course resource kit is correct and essential, and the availability of graphic materials is also of some necessity.

Table 4. Descriptive statistics on the use of micro-video and graphic material resources.

| Resource type | Number of persons/person | Number of uses/session | Number of uses per capital | Hours/ Minutes of use | Hours of use per capital |
|-----------------------|--------------------------|------------------------|----------------------------|-----------------------|--------------------------|
| Micro video | 401 | 3922 | 9.78 | 129,662 | 323.35 |
| illustrative material | 242 | 1761 | 7.28 | 52,921 | 218.68 |

5.2.4. Analysis of the Use of Reflection Questions

In order to have a comprehensive picture of the students' attention to the reflection questions, I did descriptive statistics on the students' use of the reflection questions in nine classes of Multimedia Technology and Web Design and five classes of Data Analysis Methods and Applications during the spring semester of 2022-2023, as shown in **Table 5**. From the point of view of the use of the questions throughout the semester, the overall per capital use of the reflection questions in the semester was not very frequent.

Table 5. Overall student use of reflective questions by instructional class in both courses.

| Person-time | Number of times used | Average number of times |
|-------------|----------------------|-------------------------|
| 964 | 9894 | 10 |

5.2.5. Analysis of the Use of Online Self-Diagnostic Exercises

In order to assess the value of self-diagnostic exercises in the learning process, the

author retrieved online self-diagnostic status data from the learning platform for five classes of Data Analysis Methods and Applications and nine classes of Multimedia Technology and Web Page Design. The author coded the classes of “Data Analysis Methods and Applications” according to S1, S2, S3, S4 and S5, and the classes of “Multimedia Technology and Webpage Design” according to D1, D2, D3, D4, D5, D6, D7, D8 and D9. The descriptive statistics of students’ self-diagnosis of exercises and examination results in the three weeks before the final semester are shown in **Table 6** in descending order with “self-diagnosis per capita” as the keyword.

Table 6. Descriptive statistics of students’ self-diagnosis of exercises and test scores in three weeks near the end of the semester.

| classes or grades | Number of persons | Self diagnosis times per person | Average score (Grade point) | 90 points or more | Number of 80 - 90 | Number of 60 - 80 | Number of less than 60 |
|-------------------|-------------------|---------------------------------|-----------------------------|-------------------|-------------------|-------------------|------------------------|
| D7 | 102 | 105 | 80.7 | 37 | 32 | 18 | 15 |
| D3 | 99 | 104 | 85.5 | 44 | 35 | 18 | 2 |
| D1 | 104 | 101 | 79.9 | 33 | 35 | 21 | 15 |
| D2 | 92 | 77 | 76.4 | 18 | 29 | 30 | 15 |
| S5 | 81 | 73 | 77.6 | 18 | 23 | 31 | 9 |
| D5 | 87 | 72 | 78.4 | 21 | 31 | 23 | 12 |
| S2 | 82 | 71 | 79.6 | 18 | 29 | 31 | 4 |
| D4 | 75 | 69 | 77.8 | 18 | 21 | 27 | 9 |
| D8 | 93 | 67 | 77.0 | 28 | 16 | 33 | 16 |
| D9 | 90 | 58 | 75.2 | 16 | 25 | 33 | 16 |
| S4 | 24 | 52 | 75.4 | 2 | 8 | 12 | 2 |
| D6 | 99 | 51 | 76.5 | 21 | 24 | 41 | 13 |
| S1 | 34 | 43 | 72.9 | 2 | 11 | 15 | 6 |
| S3 | 67 | 21 | 63.8 | 2 | 11 | 38 | 16 |
| Average value | 81 | 69 | 76.9 | 20 | 24 | 27 | 11 |

As can be seen from the overall data, the number of self-diagnostic exercises per student is 69, which is at a high level, indicating a high demand for the use of self-diagnostic questions, which fully justifies the value of self-diagnostic questions in learning support.

5.3. Analysis Based on Questionnaire Data

At the end of the spring semester of 2022-2023, the author issued and recovered the “Questionnaire on the Use of Micro-course Resource Packages and Subsequent Construction” by filling in and snowballing online, 123 questionnaires were issued and 123 questionnaires were recovered, with a recovery rate of 100%, and a validity rate of 100%.

5.3.1. The Need for Courses to Be Equipped with Micro-Course Resource Packages

The results of the survey on “It is necessary to equip courses with corresponding Micro-course resource packages on the school’s learning support platform” are shown in **Table 7**. It can be seen that the majority of students believe that all courses, regardless of arts and sciences, need to be equipped with corresponding Micro-course resource packages, and the percentage of them is as high as 89.43%. To a certain extent, this shows the necessity and importance of providing students with online learning resource packages, as well as the students’ recognition of the Micro-course resource packages provided online.

Table 7. Findings on the need for micro-course resource kit.

| Equip the course with the appropriate resource kit | Percentage |
|---------------------------------------------------------------------|------------|
| All courses require | 89.43% |
| Required for science courses, not required for liberal arts courses | 4.07% |
| Required for liberal arts courses, not required for science courses | 4.88% |
| Not required for all courses | 1.63% |

5.3.2. Reasons for the Use of Micro-Course Resource Packages

The results of the survey on “The most important reason why you would use the Micro-course resource packs on the learning support platform for learning” are shown in **Table 8**, which shows that the Micro-course resource packs provided on the learning support platform are recognized by students as having a more important role and impact on students’ checking of deficiencies, completion of assignments and assessments, and learning skills.

Table 8. Results of the survey on the most important reasons for students to use Micro-course resource packages for learning.

| Top reasons why students learn with the help of Micro-course resource packages | Percentage |
|-----------------------------------------------------------------------------------------------------------------|------------|
| Sometimes deserting the class or the teacher explaining faster, not keeping up with the knowledge points | 39.02% |
| Completing the usual assignments with some new problems that need to be solved through micro-learning resources | 32.52% |
| Instant reinforcement after class to get a good grade at the end of the semester | 14.63% |
| The platform is rich in resources, and you can solve many problems and improve many skills through learning | 13.01% |
| (sth. or sb.) else | 0.81% |

5.3.3. Main Stages of Use of the Micro-Course Resource Kit

“At what stage of learning would you use the micro-course resource packs on the BNU Computing Learning Support Platform” Overall, a proportion of students use the micro-course resource packs at every point in their learning. However, the

proportion of after-school use is especially obvious.

5.3.4. Preferences for the Use of Micro-Course Resource Packages

The author conducted a survey and statistics on the students' preference for using Micro-course resource packages, with topics as shown in **Table 9**.

Table 9. Micro-course resource kit usage preference survey topics.

| Serial Number | Theme |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | What is the first thing you use when using microlearning resources on a computerized learning support platform? |
| 2 | What is the microlearning resource on the computerized learning support platform that you still use or favor after using it for some time? |
| 3 | What do you consider to be the most indispensable micro-learning resources for this learning support platform during your use? |

It can be seen from the above 3-question survey that the students' preferences for the Micro-course resource packages are PPT courseware, micro video, Word text and practice problems in that order. From the statistical results, it can be seen that in the construction of graphic materials, graphic texts, which can be used in the class following the teacher's explanation, and concise and good PPT courseware are highly valued.

5.3.5. Expectations for the Content Composition of Micro-Course Resource Packages

In response to the question "In addition to the micro-teaching resources available on the current learning support platform, what other resources still need to be added?", 93.50% of the students thought that the resources on the current platform (micro-video, PPT courseware, Word text, practice questions, knowledge maps, etc.) were sufficiently rich, and 6.50% thought that additional resources such as error training for individual cases, targeted explanations by teachers on key points, etc. could be added. 6.50% of the students thought that there could be more training on wrong questions for individual situations and targeted explanations by teachers on important and difficult points.

5.3.6. Helpfulness of Micro-Course Resource Packages for Students

"Overall, I feel that the Micro-course resource packages on the computer learning support platform of BNU have provided great help to my learning effectiveness". It can be seen that the percentage of their agreement is 77.24%, which to a certain extent indicates the necessity and importance of providing students with online learning resource packages, as well as the students' recognition of the online recognition of Micro-course resource packages provided.

5.3.7. Analysis of the Identity of the Organizational Approach in the Structural Model

In the "Questionnaire on the Use of Micro-course Resource Packs and Subsequent Construction of Micro-course Resource Packs", there are 5 questions on the or-

ganization of Micro-course resource packs, which are 5-level scale questions (strongly disagree, disagree, generally, agree, strongly agree), and the author summarizes the results of the survey into 3 situations: disagree, generally, and agree.

The results show that about 70% of the students have a recognized and agreeable attitude towards the reorganized knowledge map style of guidance and presentation, and they believe that the knowledge map style of organization is of some importance in creating learning paths, clarifying the connection of knowledge points, and integrating; moreover, the degree of agreement with the necessity of adopting the knowledge map style of organization among the micro course resource packages reaches 75.61%. Therefore, the reconstruction and construction of the organizational way of presenting Micro-course resource packages with knowledge maps is effective.

6. Conclusion and Outlook

The structural model of the Micro-course resource package formed this time has high validity and value. Based on the teaching practice activities, the author got the following 3 main conclusions. First, compared with the absence of online learning resources, the corresponding course resource packs on the learning support platform bring strong support to students' learning, which demonstrates the effectiveness and value of the resources constructed in this study. Second, from the viewpoint of the content composition of the Micro-course resource packs: high-quality micro video is the core of the Micro-course resource packs, and students recognize high-quality micro video more than classroom videos and other common forms of learning support; the supporting graphic materials (especially PPT courseware) are very important to the knowledge points; the self-diagnostic exercises for the students are very crucial for them to check the shortcomings and make up for the omissions; the introduction will play an important role under the flipped classroom teaching mode; and the guide will play an important role for the students to learn the content of the Micro-course resource packs. The guided study plan will play an important role in the flipped classroom teaching mode, and the reflection questions with certain depth and expandability can play a better role in the courses with higher critical thinking ability. Third, from the viewpoint of the organization of Micro-course resource packages: the structuring and organization mode between related micro videos is extremely critical, and the organization mode of resource packages based on concept maps (or mind maps) is more effective for students to grasp the knowledge system from the whole picture. The organization of Micro-course resource packages can better present the knowledge system and knowledge structure of the chapter, which is of great significance in helping students realize the meaningful construction of the knowledge system and break through the shackles of "Micro-courses leading to fragmentation of knowledge".

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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