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Research on the Consistency of Learning Results and Curriculum Standards Based on SEC Model-Take the Course of "Data Structure" as An Example

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ABSTRACT
In order to test the consistency of learning outcomes and goals in the implementation of professional course standards for applied undergraduate colleges and universities, this article uses the SEC consistency research model, taking the "Data Structure" course as an example, from the content topic and cognitive dimensions To analyze the consistency between learning outcomes and curriculum standards. The results show that the overall level of consistency of learning outcomes and curriculum standards is high; there is a certain difference in the level of consistency in the content topic and cognitive dimension dimensions. It is proposed that the curriculum construction of application-oriented undergraduate colleges should continue to improve the curriculum standards, enrich the evaluation of results, and pay attention to the consistency of execution.
Keywords: *applied universities, curriculum standards, learning outcomes, consistency*

1. INTRODUCTION

Curriculum reform is the core of education reform in applied undergraduate colleges and universities, and it is the foundation of talent training. The construction of curriculum standards is the entry point of curriculum reform [1]. Without curriculum standards to standardize and guide teaching, it is difficult for college curriculum reform to achieve the expected goals. Therefore, in order to ensure the quality of teaching, many application-oriented undergraduate colleges have developed professional curriculum standards under the guidance of school documents, and various teaching activities are carried out based on the curriculum standards [2]. But how is the implementation of curriculum standards? Are the teaching process, learning outcomes and curriculum standard teaching objectives consistent? How to test the achievement of learning goals? These are topics that require empirical research.

This article takes "Data Structure" as an example to analyze the achievement of learning goals in the course standard construction. The "Data Structure" course is the core course of computer related majors. It is the first batch of courses to implement the course standard reform. We specifically analyze and study the consistency of students' learning outcomes and course standard learning goals from the perspective of course content topic and cognitive level.

2. CONSISTENCY STUDY DEIGN

2.1. Research methods

Aiming at the research purpose of this subject, this research adopts Porter SEC consistency research model. The SEC analysis model is developed by the scholar of the Wisconsin Education Research Center in the United States on the basis of the Weber model. It analyzes from the two dimensions of content topic and cognitive requirements. (SEC) data-based consistency research model [3] .

The model is built with the breadth and depth of knowledge as the framework, and is mainly used in the study of curriculum standards, classroom teaching and academic evaluation consistency. In order to evaluate the consistency of the course level, it is first necessary to establish a unified language to effectively form a consistency index, that is, to establish a suitable 2-D matrix composed of two parts: content topic and cognitive level to describe the research content. Then, the research samples and course standards are coded, the data is normalized to form a scale table, and the consistency index is calculated. The formula for calculating Porter's Alignment Index [4] :

$$p = 1 - \frac{\sum_{j=1}^{J}\sum_{k=1}^{K}|a_{jk} - b_{jk}|}{2}$$

In this formula, J represents the number of rows of all numerical units in the table, K represents the number of columns of all numerical units in the table, a_{jk} and b_{jk} represent the proportion values of the units of row j and

column k in the course standard and evaluation test matrix . The total number of units is N = J × K. Calculate the proportion of each unit of evaluation content and course standard, and $a_{11}+a_{12}+\ldots\ldots+a_{jk}=1$, $b_{11}+b_{12}+\ldots\ldots+b_{jk}=1$. Then substitute the formula to calculate the p-value of the Baud consistency index, and conduct a consistency analysis based on the p-value. The p-value range is 0-1, p = 1 means that the learning outcome is completely consistent with the course standard, and p = 0 means the biggest difference between the two [5] .

2.2. Research process

2.2.1 Based on the actual situation of the research objects in this article, drawing on the SEC consistency analysis model, the two dimensions of "content topic" and "cognitive level" are appropriately divided, and a SEC 2-D matrix analysis model suitable for this study is constructed.

2.2.2 According to the constructed SEC 2-D matrix analysis model, separately encode and count the standard learning target part and learning achievement part of the "Data Structure" course, then process the data statistics under the framework of SEC 2-D matrix and data standardization.

2.2.3 Calculate the Pat consistency coefficient according to the data after standardization processing, and analyze the consistency level of the research object from the three dimensions of content topic, cognitive level, and overall, and get the corresponding conclusion.

3. Determination of coding framework and implementation of coding

This study will use the standard text of the core course "Data Structure" of the computer science and technology major and the learning results of each unit as the analysis object, adopt the Porter SEC consistency model, and analyze the major from the content topic and cognitive level In-depth analysis of the consistency between the learning outcomes of the course students and the learning objectives of the curriculum standards is conducted to examine the degree of consistency between the learning outcomes of the students and the knowledge, ability and quality objectives of the curriculum standards.

3.1. Division of content topics

According to the standard part of the "Data Structure" course standard, the content topics are divided into seven parts: basic concept, linear table, stack and queue, tree and binary tree, graphic structure, sorting, search and hash.

3.2. Division of cognitive level

According to the learning objectives of knowledge, ability, and quality classification objectives, from simple to complex, the course outcome objectives are divided into: know, understanding, mastering, and applying.
According to the classification of topics and cognitive levels, a 2-D matrix framework of "content topics x cognitive levels" is obtained [6] .

3.3. Data processing and coding implementation

Train the academic staff of the "Data Structure" course group on the 2-D matrix framework of the "SEC" consistency analysis model in order to reach a consensus on the assessment of content topics and cognitive levels, and determine the knowledge area to which each unit assessment site belongs. Describe the level of cognitive level, correctly encode these learning results, and agree on the differences in coding through discussion.
Course director encodes and standardizes the learning objectives and learning results of the Course Standards based on the results of the discussion. Classify the behavior verbs and the corresponding goals listed in the learning goals of each unit, and use the number of entries as the unit of measurement to assign each cell to the 2-D table of "content topic x cognitive level" The unit's learning achievement information, including test questions, PPT reports, summary reports, etc., covers the knowledge points of classification and coding statistics.
The standard learning objectives and the 2-D matrix of learning outcomes of the curriculum standards are standardized and processed to obtain the standard 2-D matrix scale table (Table 1) and the 2-D matrix scale table of learning results (Table 2) [7] .

Table 1 2-D matrix scale table of course standard

Content Topic	**Cognitive Level**				**total**
	Know	***understand***	***master***	***application***	

basic concept	0.000	0.024	0.048	0.000	0.071
Linear table	0.048	0.000	0.071	0.048	0.167
Stack and queue	0.000	0.048	0.048	0.048	0.143
Tree and binary tree	0.000	0.024	0.095	0.048	0.167
Graphic structure	0.024	0.024	0.095	0.024	0.167
Sort	0.048	0.048	0.048	0.000	0.143
Find and hash	0.024	0.048	0.071	0.000	0.143
Vertical subtotal	0.143	0.214	0.476	0.167	1.000

Table 2 2-D matrix scale of learning achievements

Content Topic	**Cognitive Level**				**total**
	Know	***understand***	***master***	***application***	
basic concept	0.000	0.022	0.022	0.000	0.044
Linear table	0.044	0.000	0.089	0.044	0.178
Stack and queue	0.000	0.044	0.089	0.044	0.178
Tree and binary tree	0.000	0.022	0.089	0.044	0.156
Graphic structure	0.022	0.022	0.111	0.022	0.178
Sort	0.022	0.022	0.067	0.000	0.111
Find and hash	0.022	0.044	0.089	0.000	0.156
Vertical subtotal	0.111	0.178	0.556	0.156	1.000

4. RESEARCH RESULTS AND ANALYSIS

4.1 Analysis of overall consistency

For the 7 * 4 matrix, if it is a two-sided test, in order to achieve significant consistency at the level, the critical value of the consistency coefficient corresponding to 42 "standard points" is 0.861 [8] .

According to the formula for calculating the consistency coefficient in the SEC consistency analysis tool, the consistency coefficient between the curriculum standards and the knowledge points of learning results is 0.889. The consistency p-value is greater than the reference p-value of 0.861, indicating that the evaluation of learning outcomes and the curriculum objectives of the curriculum standards are statistically significantly consistent.

4.2 Content topics

The data in Table 1 and Table 2 is represented in the form of a histogram, which presents a visual comparison of content standards and content topics of learning achievements, as shown in the figure 1.

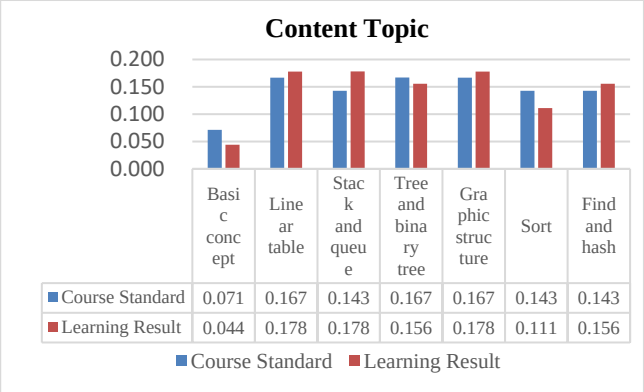

Figure 1 Comparison chart of curriculum standards and learning results (via content topic)

In terms of content topics, the knowledge points of the learning outcomes have a high degree of consistency with the teaching objectives of the curriculum standards, and they all emphasize four units: linear tables, trees and binary trees, and graphical structures. The proportion of knowledge points of each content topic in the course standard is as follows: "Basic concepts" (0.071), "Linear table" (0.167), "Stack and queue" (0.143), "Tree and binary tree" (0.167), " Graph structure "(0.167)," sort "(0.143)," find and hash "(0.143). The proportion of the scores of each content topic in the assessment of learning achievements is as follows: "Basic concepts" (0.044), "Linear table" (0.178), "Stack and queue" (0.178), "Tree and binary tree" (0.156), " Graph structure "(0.178)," sort "(0.111)," find and hash "(0.156). The content deviation is mainly reflected in: Compared with the course standard, the evaluation of learning results increases the examination of the content topics of "stack and queue" and "find and hash", and reduces the content topics of "basic concepts" and "sorting" The examination intensity of the evaluation of the results of the "linear table", "tree and binary tree", and "graphic structure" is basically consistent with the proportion of the number of knowledge points contained in the three content topics in the curriculum standards.

4.3 Cognitive level

The data shown in Table 1 and Table 2 is represented in the form of a histogram, which visually presents the comparison of the content standards and the cognitive level of learning achievements, as shown in the figure 2.

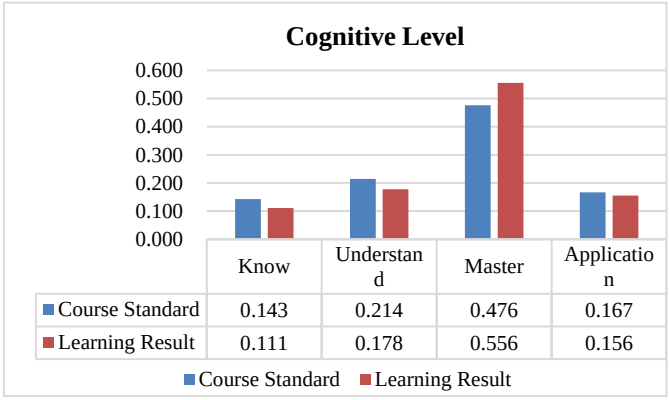

Figure 2 Comparison chart of curriculum standards and learning achievements (via cognitive level)

On the cognitive level, the knowledge points of the learning outcomes are relatively consistent with the teaching objectives of the curriculum standards. The proportion of the knowledge points of various cognitive levels in the curriculum standards as follows: "know" (0.143), "understand" (0.214), "Master" (0.476), "Application" (0.167). The percentages of test in the evaluation of achievements that test various cognitive levels as follows: "know" (0.111), "understand" (0.178), "master" (0.556), "application" (0.156). It can be seen that the results evaluation focuses on increasing the examination of the cognitive level of "mastery", while reducing the examination of the cognitive level of "knowing" and "understanding". Explain that in the specific assessment, teachers pay more attention to students' ability to use knowledge.

5. CONCLUSION AND SUGGESTIONS

5.1 Research conclusion

5.1.1 Overall consistency level characteristics

According to the research results, "Data Structure" has a statistically significant consistency between the evaluation of learning results and the overall consistency coefficient of course standards of 0.899, which is higher than the critical value of 0.861.

5.1.2 Content topic consistency level characteristics

According to the research results, the consistency of the evaluation of the learning results of the course "Data Structure" and the course standards in the content topic dimension is high. Especially the consistency of linear table, tree and binary tree and graphic structure module is good. Compared with the curriculum standards, the evaluation of learning outcomes has increased the examination of the content topics of "stack and queue" and "find and hash", and reduced the examination of the content topics of "basic concepts" and "sorting".

5.1.3 Cognitive level consistency level characteristics

According to the above research, the evaluation of the learning results of the course "Data Structure" and the course standards have a high level of consistency in the cognitive dimension. In particular, the two have a good level of consistency in the "applied" cognitive level. The evaluation of results focused on increasing the examination of the cognitive level of "mastery", while reducing the examination of the cognitive level of "know" and "understanding.

5.2 Suggestions

5.2.1 Course standards Improvement

The construction of curriculum standards for application-oriented undergraduate colleges is a dynamic process [9] .We must maintain the relative stability of curriculum standards, and appropriately adjust and revise the standards and evaluation requirements according to the development of market demand and the actual teaching effect. Taking the course of "Data Structure" as an example, it is concluded from the evaluation of the learning objectives and learning results of the course standards that the two have a high degree of consistency, but there are still some inconsistencies, and the course group should discuss this, especially for the impact revise the teaching goals. According to the development of disciplines, majors and courses, and according to the professional and curriculum standards of the Computer Science Teaching Steering Committee of the Ministry of Education, the curriculum group should strengthen the research on talent training programs and adhere to the student-centered and output-oriented teaching concept. Find out the functional positioning of this course and adjust the teaching content of the course according to the actual situation.

Improving the curriculum standards is not only reflected in the appropriate revision of the teaching content, but also should consider whether the process of learning evaluation is reasonable, combine the evaluation with the teaching objectives, highlight the difficulties, and make the assessment content and evaluation knowledge more standardized ,rigorous.

5.2.2 Enrich results evaluation

Achievement evaluation is an important indicator that can reflect the achievement of learning goals. Therefore, the manifestation of learning results is the focus of the curriculum standards. In the process of compiling course standards for application-oriented undergraduate colleges, problems such as single achievement evaluation and weak operability can be found. For example, each unit uses PPT report presentation, course thesis and other forms. Academic evaluation should adopt diversified and rich evaluation methods. It is recommended that on the basis of theoretical testing, we should pay attention to the operation of practical ability and the evaluation system of inquiry, increase the evaluation of the comprehensive application ability and discipline quality of solving practical problems, and establish the evaluation of special skills and discipline quality. Taking "Data Structure" as an example, the process of assessment includes unit testing, group reporting, and summary reports. The unit testing focuses on the theoretical knowledge points of each unit that students should master, and the group reports on the key assessment students ’practical knowledge points. Master and operate ability, and summarize the report to assess students' comprehensive application ability.

Therefore, combining the teaching content of the course to establish an assessment index system and assessment standards consistent with knowledge, ability, and quality objectives, and using high-tech media to achieve an operable, measurable and diverse assessment of learning outcomes breakthrough.

5.2.3 Focus on execution consistency

The construction of curriculum standards must maintain consistency with execution to ensure the achievement of teaching goals.

The construction of curriculum standards requires the participation of the entire curriculum group. Curriculum standard construction is a complex and systematic project. In the process of organizing, formulating, implementation, practice testing and revision, it was found that the compilation of part of curriculum standards is only from the course director, and the group members did not contribute in the compilation and their implementation did not follow the teaching objectives of the curriculum standards. The preparation and implementation of curriculum standards require the contribution of the whole group. The relationship between the weavers and implementers should be definite and clear in the organization and implementation of the curriculum standards.It can perfectly meet the requirement of curriculum and professional construction and give full play to its programmatic teaching purpose and to achieve the goal of cultivating application-oriented undergraduates who have both ethics and competence and social demand [10] .

5.3 Conclusion

Regularly carry out consistency checks on the implementation of curriculum standards. Each course group should collect and organize the opinions and suggestions in the course standard implementation in time. Through timely data analysis such as the class participation, the course satisfaction, and the achievement of the core competence goals, the course standards are tracked, fed back and revised to improve the quality of the course standards and the effectiveness of construction. As teaching managers, they should also study a set of research models suitable for the consistency of curriculum standards of applied undergraduate colleges. At the same time, the content of consistency research should be actively expanded, not only limited to learning evaluation and curriculum standards, but also broadened to textbooks, test questions and Consistency research on curriculum standards.

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