Research on Cluster Analysis of Process Evaluation Integrated into Teaching

YongjianWang[1], Nie Zhou[2*], Pengfei Hu[3*]

[1]Teaching and Research Support Center, Army Logistics Academy, Chongqing 401331, China
[2]Teaching and Research Support Center, Army Logistics Academy, Chongqing 401331, China
[3] International Training Department, Army Logistics Academy, Chongqing 401331, China

*Corresponding author: 22653526@qq.com; 857682490@qq.com

Abstract : The process evaluation integrated into teaching is aimed at promoting learners' development. It takes "efficient learning" as the basic starting point and follows the course learning method of "evaluation methods being various, but not fixed", to accurately grasp the immediate evaluation in the teaching process. This paper aims to analyze the characteristics of process evaluation integrated into teaching, expounds on the comparative advantages with traditional learning evaluation, and proposes the implementation strategy of process evaluation by adapting big data cluster analysis to improve learners' thinking ability.

Keywords : process evaluation; learning characteristics; cluster analysis; teaching quality; practical exploration

1 Introduction

The "Three-Whole Education" system focuses on constant teaching quality evaluation of "whole-process education", which means learners' learning outcomes and feedback are grasped in time by real-time teaching evaluation. Using big data mining technology to collect, analyze, and process learners' learning behavior is helpful to facilitate teachers' digital-based teaching and to improve learners' comprehensive quality[1].

2 Characteristics of process evaluation integrated into teaching

Completed during the learning process, the process evaluation showcases the outcome of the learning activity and emphasizes the development and changes of learning[2]. Under the new situation of the reform in higher education institutions, the process evaluation integrated into teaching showcases distinctive characteristics.

First, attaching equal importance to process and goal. The process evaluation attaches equal importance to the "process" and "goal" so that the evaluation and

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teaching process can be integrated. Paying attention to the continuity and phases of learning is conducive to the comprehensive and dynamic evaluation of the learning development process. In a goal-oriented learning process with the information technology, the set goal determines the learning process. The process evaluation can be used to evaluate if the actual learning outcome matches the set goal so that the learning behavior can be corrected or improved to meet the set goals[3]. Based on the analysis of goals and processes, a KAPO model is constructed, and it is believed that each teaching process and goal should be interrelated and integrated, as shown in Figure 1.

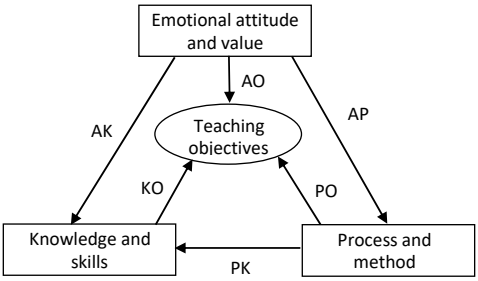

Fig. 1. Model of correlation and integration between teaching objectives and processes

Second, advocating the evaluation with diversified subjects. The process evaluation not only pays attention to the evaluation of learners by teachers and learning partners but also to the cultivation and development of learners' introspection and self-evaluation of their self-learning behaviors, attitudes, and values. By collecting learning data, we can analyze the explicit learning effect and implicit learning motivation of learners during the learning process, and feedback on the analysis results to each evaluation subject promptly, forming diversified evaluation methods such as teachers' comments, learners' self-evaluation, and peer mutual evaluation. This kind of internal and external combination and diversified evaluation method makes the learning process coordinated and the diversified evaluation function is highlighted.

Third, prioritizing the trinity evaluation featuring "motivation, process, efficiency" of learning. The process evaluation takes the learners' development as the fundamental starting point, and comprehensively considers the three dimensions of learners' learning motivation, process, and effect to encourage and guide their learning behavior. Through big data, it accurately analyzes learners' learning motivation such as attitudes, emotions, and values[4], pays attention to their learning development dynamics, promotes the interactive integration of the evaluation process and learning process, stimulates learning motivation, and improves learning quality.

Fourth, advocating the "spiral" improvement of evaluation subjects and objects. The process evaluation emphasizes the interaction and joint participation of the evaluation subjects and objects so that learners can change from passive recipients of evalua-

tion to active participants. Thanks to big data, all kinds of data such as homework tests, learning reflections, and thematic discussions can be collected, and the data analysis results can be fed back to all evaluation subjects. It facilitates not only the evaluation by teachers and learners but also promotes the evaluators and evaluation objects to participate in evaluation activities together to agree on learning development goals.

3 Comparative Advantages of process evaluation integrated into teaching to traditional learning evaluation

At present, colleges and universities mainly use information technology platforms to carry out online and offline mixed teaching to meet the diverse, personalized, and fragmented learning needs of learners, take advantage of big data to conduct online learning evaluations and make a comprehensive assessment of student's learning process by digging out the interrelationships hidden behind the data to guide teaching evaluation from empiricism to data-ism, from macro group evaluation to micro individual evaluation, from single evaluation to comprehensive evaluation, to realize data-driven "individualized teaching".

3.1 Traditional learning evaluation focuses on post-assessment, which does not reflect the process evaluation during learners' learning and thinking

The traditional learning evaluation lays particular emphasis on inspection and learning results after class, which is difficult to fully reflect on the learning thinking process. The difficulty of traditional teaching evaluation lies in extracting elements from the complex data background as the main line of teaching, constructing the target task, re-engineering resources, and constantly adjusting. However, the implementation of process evaluation will turn instant acquisition, selection, and processing of data into reality. Learners will get rid of the tedious process of manual inspection and use computer technology for certification, which is helpful to timely evaluate the instant learning performance, promote positive reflection and summary, and realize the cross-integration of evaluation and learning process.

3.2 Traditional learning evaluation overemphasizes the function of screening and selection and fails to reflect learners' learning characteristics and efforts

Emphasizing only the final learning results, it downplays the learners' thinking and reasoning achievements, the formation of assumptions, individual characteristics and efforts, which is not conducive to the full development of learners' potential. The process evaluation has the characteristics of fine granularity. The continuity and immediacy of the data are used to retain the refined activity data of online learning, making it a fresh object that can be collected and quantified at any time. While paying attention to the results, it concentrates more on the unity of knowledge and practice, to achieve both the process and goal of the evaluation.

3.3 Unequal interaction between teachers and learners in traditional learning evaluation does not reflect the process of teachers' comments, learners' self-evaluation, and mutual evaluation

The traditional learning evaluation mostly comes from teachers, and teachers' authority makes learners passively receive feedback. The process evaluation emphasizes the interaction between evaluation subjects and objects, which makes learners change from passive receivers to active participants. Big data can collect all kinds of data such as homework tests, learning reflections, and thematic discussions, and feed back the data analysis results to the evaluation subject. It is not only conducive to the evaluation of learners by teachers, learners themselves, and other learners[5], but also promotes evaluators and evaluation objects to participate in evaluation activities, negotiate learning development goals, and promote the improvement of learners' online learning quality.

3.4 The score-based traditional learning evaluation does not reflect the evaluation of learners' learning methods, abilities, and behaviors in the whole learning process

In traditional classroom teaching, teachers cannot track the learning process of each learner but only evaluate by periodic evaluation means. The evaluation method is broad and simple, which makes it impossible to conduct accurate and personalized evaluations for each learner. It is even difficult to make real-time and dynamic adjustments in the learning process to improve learning efficiency. The process evaluation can fully collect the process data of learners, provide criteria for personalized evaluation with sufficient fine granularity, and promote the evaluation from a single evaluation to a comprehensive evaluation[6].

4 Research steps for cluster analysis of process evaluation integrated into teaching

The evaluation should not only focus on the after-class results, but also pay attention to the motivation, needs, and effects in the learning process, and pay attention to the two-way value orientation of goals and processes to achieve all-round evaluation[7]. This chapter takes a course teaching undertaken by the author as a reference, based on the training of learners' cognition, emotion, and skills, uses the Big data mining platform, finds out the common characteristics of learners' learning behavior with the cluster analysis, and draws conclusions from the analysis of three important links before, during and after class through the visual analysis of data, to provide decision-making advice for improving the learning effect.

4.1 Collecting data based on learners' preview and preparing for teaching

The traditional course evaluation was mainly based on homework and exams, sup-

plemented by discussion in class. However, in the actual teaching process, learners' participation in class and their enthusiasm for after-class learning are insufficient. Due to the difficulty of the course, learners do not fully grasp the knowledge in class, and they feel embarrassed after class. We can release the teaching plan through the campus network. Learners can fully preview before class, master the key and difficult knowledge and the relationship between them, find out the questions and puzzles, and make targeted preparations. The online course formulates the knowledge framework and sets up teaching units according to the syllabus. With the learning task list for each unit in the learning level, including audio and video, chapter quizzes, classic cases, MOOC resources, and so on, learners can conduct a self-study and pre-class quizzes according to their learning progress, and give feedback on knowledge points through study group discussions and forums. Through the statistical summary of learning progress data, teachers can timely master learners' online access status, completion of task lists, and key and difficult points[8]. According to the requirements of learning objectives and learners' demands, feedback information is provided in real-time through live broadcasts, replies in discussion boards, and other forms.

4.2 Comparing data based on key points of the learning process and adjusting the teaching process accordingly

Classroom teaching is the core process for teachers to impart knowledge and skills to learners. It is not only an important place to connect the understanding and feelings between teachers and learners but also a bridge for two-way communication between them. Mastering knowledge points is the first key link to open up learners' learning ideas[9]. The online preview has solved the problem of mastering simple and basic knowledge points, so classroom teaching can focus on the key and difficult points and knowledge application. During the teaching, learners' attention can be closely attracted by answering key knowledge points, questionnaires, voting, etc., and their enthusiasm and creativity can be fully mobilized, so that teachers can know learners' learning status, capture learning information, master learners' psychological changes, timely adjust teaching methods and organizational forms, and provide targeted encouragement to enhance the self-confidence of learning. Teachers can also objectively analyze learners' mastery of the course through the platform data, adjust the teaching content and progress in time, more effectively regulate the whole teaching process, and improve the quality of classroom teaching. The author attempts to pre-process the collected data by WEKE software and use a clustering analysis algorithm to associate the above learning behavior data with WEKE software data mining attributes, as shown in Table 1. The data preprocessing interface of WEKE software is omitted.

Table 1. Correlation between learning behavior data and WEKE software learning behavior attributes

Attribute	Name	Age	Course participation	Speech in class	Searching course materials	Homework	Chapter test
Learning behavior	Name	Age	Coursing	Talking	Reading	Working	Testing

data							
WEKE software	Name	Age	Scanning	Visiting	Reading	Working	Testing

4.3 Conducting cluster analysis based on the completion rate after class to realize knowledge transfer

The teacher use explicit learning behavior attributes to establish objective functions based on the task objectives corresponding to the comprehensive completion after class. Through data comparison, calculations, and solutions, analytical conclusions are drawn. Taking the course undertaken by the author in 2021 as an example, the explicit learning dimensions of 53 trainees were collected. In data processing, delete the two invalid attributes such as Name and StuIDl, import various attribute values from the explicit learning behavior dimension into the data mining software at once, and select data from each dimension for K-Meana cluster analysis. The cluster analysis in WEKE data mining software uses error values to verify the accuracy of the results. The larger the difference, the farther the analysis result is from the actual value, and vice versa, the closer it is[10]. As shown in Table 2.

Table 2. Analysis of the results of explicit dimension clustering for each cluster center

Attribute	Full Date(53.0)	0 (17.0)	1 (3.0)	2 (2.0)	3 (16.0)	4 (15.0)
Coursing	0.9632	0.9778	0.9892	0.7783	0.9982	0.9981
Talking	92.356	140.667	97.333	46.6	49.558	317.876
Reading	0.9607	0.998	0.76	0.54	1	0.996
Working	0.9678	0.9456	0.64	0.675	0.9978	0.996
Testing	0.987	0.965	0.897	0.999	0.615	1

Note: Tables 0-4 represent the 5 categories obtained by clustering the entire data.

The analysis results show that the central values of the 5 attribute clusters are represented by Full Date, and the remaining items (0-4) represent the values obtained from the clustering analysis of their respective attributes. Taking one of the sub items (working) as an example, the value of item 0 is 0.9456, with a clustering number of 17, which indicates that 17 learners' homework completion is closest to 0.9456. By this analogy, the analysis shows that 3 learners are close to 0.64, 2 learners are close to 0.675, 16 learners are close to 0.9978, and 15 learners are close to 0.996. Through WEKE clustering numerical and structural analysis, it was found that the average completion rate of homework of learners was 97%, mainly concentrated at around 92%, accounting for 91% of the total number of learners. The other values basically meet the requirements, but there are also some learners whose behavior does not meet the requirements. If some learners have low completion rate, intervention and correction can be carried out. Corresponding corrections can be made for other learning behaviors that do not meet the requirements, and then comprehensive applications can be made to better promote teaching.

5 Conclusions

The practice has shown that strengthening the deep-level mining of process evaluation, especially through comprehensive information technology methods, using data mining and cluster analysis to obtain specific parameters of learners' explicit learning behavior, to provide targeted auxiliary evaluations and develop personalized evaluation plans, plays a key role in stimulating learners' learning interest and improving learning efficiency.

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