Research Article

Data Analysis and Processing Application of Deep Learning in Engineering Cost Teaching Evaluation

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Received 19 December 2021; Revised 7 January 2022; Accepted 12 January 2022; Published 9 March 2022

Academic Editor: Naeem Jan

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Based on the poor quality of engineering cost teaching, this paper puts forward the application method of in-depth learning in engineering cost teaching evaluation. This study aims to construct the engineering cost teaching evaluation system, optimize the engineering cost teaching evaluation algorithm combined with the in-depth learning method, standardize the evaluation index of the engineering cost teaching system, and realize the research goal of engineering cost teaching evaluation. Finally, the experiment proves that the application effect of in-depth learning in engineering cost teaching evaluation is obviously better, which can better guide the quality of engineering cost teaching.

1. Introduction

The focus of in-depth learning research returns to people themselves, advocates studying learning in real school and classroom situations, and emphasizes the “problem-driven” educational science research paradigm [1]. The project cost teaching activity mode is very compatible with the development of the “five education concurrently” education system for the growth of students’ core literacy and the direction of educational assessment in the new age. The direction and baton of classroom teaching improvement is classroom teaching evaluation [2]. The current classroom teaching of engineering cost teaching urgently needs to construct a classroom teaching evaluation system of “evaluating teaching by learning,” and promote students’ “effective development.” Under this background, the application of in-depth learning in engineering cost teaching evaluation is studied [3].

2. Application of Deep Learning in Engineering Cost Teaching Evaluation

2.1. Construction of Project Cost Teaching Evaluation System

Guided by the deep learning theory and combined with many years of practical experience in classroom teaching design of engineering cost teaching, this paper summarizes the characteristics of teaching design based on deep learning in the intelligent era, as shown in Figure 1. The engineering cost teaching evaluation index method is based on engineering cost teaching and geared at nurturing students’ in-depth understanding. It is used to assess whether engineering cost teaching can reach the engineering cost teaching objective system. Teachers must master not only professional knowledge, but also information technology knowledge, integrate new teaching techniques at the appropriate moment, and achieve successful teaching, according to the TPACK knowledge framework [4]. Students may eventually attain high-order thinking via shallow learning, according to the deep learning paradigm. Therefore, in the project cost teaching, based on the in-depth learning theory and the TPACK knowledge framework, the
constituent elements of the project cost teaching evaluation index system are determined (as shown in Figure 2), and the teachers’ wisdom teaching is integrated with the students’ in-depth learning, so as to promote the development of students’ high-level thinking ability and in-depth learning ability.

In order to guide students to better carry out in-depth learning, we need to select teaching methods that focus on students and fully mobilize their initiative [5]. The most common are heuristic, deep learning, collaborative inquiry, and task-driven. In the teaching process of engineering cost, teachers take students’ learning characteristics and the nature of teaching tasks into account, actively mobilize students’ initiatives, open inspire students’ high-level thinking, and then promote the improvement of in-depth learning levels.

According to the in-depth learning route and goal of project cost teaching, shown in Figures 3 and 4, the design of the engineering cost evaluation index is carried out from two dimensions: qualitative evaluation and quantitative evaluation, which are combined with the ideas of “emphasizing process” and “paying equal attention to both qualitative and quantitative” in the classroom teaching evaluation of in-depth learning. The following framework shown in Figure 5 is built based on the idea of in-depth learning and instructional design, as well as the major features of classroom teaching design based on in-depth learning in the intelligent age.

The teaching goal of engineering cost is not only the starting point and destination of teaching but also the basis of teaching evaluation. The determination of unit objectives needs to be combined with the core literacy of the discipline [6]. In the framework of instructional design based on in-depth learning, the determination of unit objectives needs to be guided by the core literacy of the discipline, based on the needs, cognitive development law, and learning status of learners, and the core concepts and contents of the discipline as an important carrier [7]. Teachers help students master discipline ideas and methods by guiding them to carry out autonomous learning, cooperative learning, and inquiry learning, cultivate students’ critical thinking, transfer and application ability and problem-solving ability.

2.2. Teaching Evaluation Algorithm of Deep Learning of Engineering Cost. Project cost teaching evaluation refers to a series of activities to judge the value of teaching activities, learners’ state, and teaching effects according to certain teaching objectives. It plays a feedback role in the whole learning process and provides important support for how to improve and improve the teaching system [8]. This study uses the method of intelligent evaluation to evaluate the quality of teaching and learning. In the intelligent evaluation, we rely on the intelligent teaching tools to collect the data of students’ learning process or learning results in class to realize the comprehensive evaluation of students. Big data provides an important supporting role for the teaching evaluation of engineering costs [9]. We use the big data generated in the learning process to deeply evaluate the learning effects of students with the help of external factor progress analysis. The in-depth learning evaluation relies on the engineering cost teaching tool classroom to realize the diversification of evaluation subjects, multidimensional evaluation contents, and diversified evaluation methods, as shown in Figure 6.

The project cost is minimized by using a variety of data sources, and modular analysis technology is used to provide visual analysis findings, as shown in Figure 7. Teacher assessment used to be done by instructors. Teachers are the assessment topic of students in wisdom evaluation. Students are evaluated both as the object and as the topic of the
assessment. They also assess the effectiveness of teaching and learning [10]. Quantitative evaluation is the result evaluation, which evaluates the final effect of students’ learning after a semester of complete teaching activities. The evaluation is mainly to evaluate the students’ mastery of the course content and teaching effectiveness through the final examination results [11]. Therefore, the final test is taken as the primary evaluation index of quantitative evaluation, and the degree of knowledge mastery is taken as the secondary evaluation index of quantitative evaluation.

The differences between deep learning and shallow learning are compared and analyzed from the aspects of learning motivation, learning objectives, knowledge system, and transfer ability, as shown in Table 1.

The perceptron inputs the features $x_1, x_2, \ldots, x_n$ into the calculation unit $p$, and the weighted is $K$. Then, the sum is

$$\text{sum} = p \sum K(a_1 + a_2 + \cdots + a_n).$$

Then, the result is input into the activation function $f$, and the output $R$ is the result of the perceptron.

$$t = R - f(\text{sum}).$$

The activation function of perceptron $Q$ usually adopts the nonlinear function, such as sigmoid function and tanh function:

$$\text{sigmoid}(x, y) = \frac{1}{Q + e^{-x}} - t,$$

$$\text{tanh}(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}} - \text{sigmoid}(x, y),$$

where $e$ is the data index of teaching information. If the assignment matrix is $C = (c_1, c_2, \ldots, c_n)$, then the comprehensive score of each index is
Because the weights of all indicators are the same, the final comprehensive evaluation score $X$ is the average of the comprehensive scores of each indicator; i.e.,

$$A = \bar{X} + \frac{1}{e} \sum_{i=1}^{n} S - \tanh(x).$$

According to weight vector $W$ and comprehensive evaluation matrix $R = (r_{ij})_{mn}$, the fuzzy comprehensive evaluation set of the evaluation object $B$ is calculated:

$$B = W \cdot R - A\left(\bar{X} + \frac{1}{e}\right).$$

The geometric average of all elements of the judgment matrix $a_{ij}$ is calculated, such as the formula

$$\overline{w_i} = \prod_{j=1}^{n} a_{ij} + B - A.$$

The above geometric average is normalized, and the specific formula is as follows:

$$w_i = \frac{\overline{w_i}}{(A + B) \sum_{i}^{n} \overline{w_i}}.$$
The key points of project cost evaluation shown in Table 2 are to evaluate teachers’ teaching with learning science as the basic concept, effectively promoting students’ learning as the basic value pursuit, and students’ learning behavior as the basic index.

According to the constructed evaluation index system of engineering cost teaching, the index system of engineering cost teaching is tested to verify the effectiveness and operability of the index system. The evaluation index system is mainly applied to engineering cost teaching [12]. It examines the hardware environment of engineering cost teaching, instructors’ teaching preparation, implementation process, teaching impact, teaching interaction among teachers and students, students’ learning process, and other features to see whether they adhere to engineering cost teaching. The engineering cost teaching evaluation index method requires a great deal of practice and examination. Three engineering cost instruction courses were chosen for assessment in this research [13]. Before the evaluation, a five-person evaluation team including educational technology experts, college English teaching experts, and intelligent teaching experts should be established. Before the implementation of the evaluation, the team members were familiar with the engineering cost teaching process, as well as the relevant theories such as intelligent teaching, TPACK knowledge framework, in-depth learning, and English subject literacy, so as to fully understand the construction of the engineering cost teaching evaluation index system and the connotation of each index element to form a standardized evaluation standard [14]. Each evaluator will record the observed contents in detail according to each element of the index system and rate each index throughout the assessment process. The real scores of each index element are totaled by SPSS 21.0 when the evaluation is completed, the scores of each evaluator are sorted out, and the findings are eventually summarized [15].
2.3. Realization of Teaching Evaluation of Project Cost.

Deep learning theory attaches importance to the long-term development of learners, encourages learners to promote their own understanding and construction of knowledge through dialogue and cooperation based on their personal learning characteristics, and finally integrate all kinds of information, solve practical problems, and enhance creativity [16]. In fact, all this ultimately points to the learners’ own learning level, requiring their learning process to have depth and breadth, so as to finally realize in-depth learning. In the teaching process, it is necessary to shape the creative teaching situation. Simultaneously, it is necessary to design teaching objectives with high-level thinking, deliver instruction around complex, cooperative, and challenging deep learning tasks, and emphasize objective, comprehensive evaluation methods that point to the process and developmental high-level for in-depth learning evaluation [17]. According to the five teaching links of the traditional scaffolding teaching model, and based on the analysis of the characteristics of deep learning, guided by the deep learning theory, combined with the above-mentioned scaffolding teaching principles for deep learning and the types and functions of learning scaffolding, this study systematizes and deepens the core elements of scaffolding teaching model [18]. A scaffolding teaching model for college students’ in-depth learning is constructed to guide the specific curriculum teaching design and implementation, as shown in Figures 8 and 9.

Teachers design and develop preview resources and release preview tasks to inspire students’ in-depth learning [19]. Students individually preview, remember, and grasp the content, complete exam questions, apply what they have learned, discuss, and communicate to evaluate difficulties, as indicated in Figure 5, in order to gain knowledge and master skills and improve in-depth learning [20]. The discussion and communication link might be a conversation on a specific subject defined by the instructor, or students can talk freely about the difficulties they faced in advance, depending on the teaching material, in order to encourage students’ in-depth learning.

| Table 1: Comparison between deep learning and shallow learning. |
|-----------------|-----------------|-----------------|
| **Comparison items** | **Deep learning** | **Shallow learning** |
| Learning motivation | Learners’ internal knowledge needs | It mainly comes from the external pressure of non-self-demand |
| Learning objectives | Focus on learners’ ability to understand, transfer, apply, and solve problems, mainly the development of high-order thinking ability | Focus on the acquisition of learners’ basic knowledge and skills, mainly the development of low-level thinking ability |
| Learning style | Meaning construction, memory, and learning based on understanding | Do not use mechanical learning with simple knowledge |
| Learning environment | Learning resources are very rich and diverse | Learning resources are relatively single |
| Learning effectiveness | High effect, but low efficiency | High efficiency, but the effect is poor |
| Knowledge system | New and old knowledge practice, meaningful learning as the goal, deep processing knowledge, etc. | A simple concept that is simple, and easy to understand |
| Focus | Pay attention to the internal relationship between core knowledge and seek a breakthrough point to solve problems | Basic knowledge of focusing on simple problems |
| Migration ability | Flexible use of knowledge | Mechanical learning cannot effectively transfer to the solution of practical problems |
| Evaluation method | Process evaluation and qualitative evaluation | Summative evaluation and quantitative evaluation |
| Learning attitude | Positive emotional state | Negative emotional state |

| Table 2: Key points of classroom teaching evaluation based on learning science. |
|-----------------|-----------------|-----------------|
| **Evaluation content** | **Evaluating indicator** | **Focus** |
| Instructional design | The design of teaching objectives conforms to the law of students’ cognition | Existing knowledge |
| | The design of teaching activities reflects students’ independent construction | Active learning |
| Teaching process | Create a knowledge center environment and build a learning support | Forward support understanding |
| | Highlight the systematicness of knowledge and promote understanding and application | Core concept |
| | Creating deep learning situations to promote high-level thinking | Metacognition |
| | Pay attention to learning transfer and promote "five education and mutual education" | Migration ability |
| Teaching effectiveness | Clear problem representation can effectively promote learning generation | Target |
| | Grasp the essence of discipline and effectively form learning strategies | Mode |
| | Achieve smooth extraction and effectively enhance cognitive ability | Effect |
Based on reflection, the essence of deep learning is to cultivate learners’ reflective consciousness and ability and actively carry out reflective activities in the process of deep learning [21]. Model construction is to add reflective factors to the general process model of deep learning to make it run through the whole learning process, as shown in Figure 10.

The important stage is the learning preparation stage. This stage requires students to creatively guide and plan the next learning activities on the basis of reflecting on their original knowledge and experience and create a real situation to stimulate students’ high learning investment [22] using self-assessment form and other methods to promote students’ reflection before learning. The main stage is the key
stage of learning [23]. This stage requires students to reflect on the learning process in real-time, find and solve problems, and ensure the smooth progress of learning. In order to achieve in-depth learning, students need to add in-depth knowledge, and the key link is to construct and transform knowledge [24]. This study, when combined with the analysis, creates a preliminary action plan for classroom assessment that points to deep learning. The action path is based on three pieces of evidence: the deep learning occurrence route, the essential content of classroom assessment to facilitate learning, and the notion of deep learning classroom evaluation. These three proofs are listed above. Now, we will look at how they play a part in path creation.

First, the deep learning occurrence road is the foundation of the classroom assessment action path leading to deep learning. When it comes to classroom assessment that leads to deep learning, evaluation should not be done separately, but rather as part of the teaching and learning process. Classroom assessment can only be effective if it is integrated into the whole educational environment. In other words, there are few opportunities for in-depth study. As a result, depicting it as the central axis of the whole action path and boosting classroom assessment is the first step in fostering in-depth learning. Teaching and learning should always be accompanied by and conducted via evaluation. To put it another way, the assessment of boosting deep learning should go along deep learning path. Therefore, the evaluation should be drawn as an external driving circle closely surrounding deep learning. Third, classroom evaluation at different stages faces different "missions," such as diagnosing learning situations, determining objectives, collecting evidence, adjusting teaching, promoting understanding, and reflective learning. In order to have a clear direction and problem-solving direction in operation, it is necessary to distinguish between each classroom evaluation form. Therefore, the evaluation is given different names according to the stage and functional differences, i.e., comprehensive diagnosis, classroom pretest, and formative evaluation. In a comprehensive view, the action path can fit the classroom evaluation concept, pointing to deep learning. The integrated in-depth learning route and classroom evaluation are an inseparable whole, in which goal, learning, teaching, and evaluation form an integration, which reflects the concept of consistency. The path emphasizes the formative evaluation of real-time and dynamic interaction in class, which reflects the concept of "paying attention to the sharing between teachers and students." Designing learning day standards and learning content is the starting part of the action path; that is, we should first design the task according to the goal, which reflects the concept of "paying attention to task guidance." In the process of promoting (dotted arrow) deep learning, classroom evaluation circulates with the cycle of deep learning, which reflects the concept of "cycle."

As shown in Figure 11, the classroom evaluation action path pointing to deep learning is mainly composed of two teaching circles: the outer ring and the inner ring. The inner ring is the deep learning generation circle integrating "goal learning teaching evaluation," and the outer ring is the classroom evaluation promotion circle composed of different evaluation types, so as to improve the quality of teaching evaluation and promote teaching effect.

3. Data Analysis and Processing of Experimental Results

Data analysis, teaching implementation, homework statistics, teaching administration, and other tasks are included in the experimental detection platform of the teaching environment. Many teaching aids supporting virtual teaching environments are classified, examined, and compared, as indicated in the table, based on the teaching demands of this study course. Based on the analysis, the intelligent teaching tool classroom shown in Table 3 is selected as the support of the virtual teaching environment.

By externalizing students’ internal knowledge structures through graphics, we can directly observe the changes of students’ knowledge structures. It is proposed to use deep learning to evaluate students’ deep learning. It judges whether students have deep learning according to the changes of structure, content, and connections of concept map drawn by students before and after learning.

This study compares the characteristics of deep teaching and shallow teaching across the dimensions of teaching concept, teaching objectives, knowledge system, teaching methods, students’ investment, thinking level, teaching evaluation, teaching reflection, and teaching results, as shown in Tables 4 and 5.
Take the classes with almost no difference in usual performance as the control. Take class A, which offers the course of modern educational technology, as the experimental class and class B as the control class. Experimental class A uses the "3 + 1" intelligent teaching mode designed in this paper to verify the teaching effect of this mode. Control class B still adopts the traditional teaching method to study the theory course and experiment course. After the semester course, class A and class B with basically the same initial conditions are compared and analyzed, and the examination and test are conducted from two dimensions: test papers and micro class works. The same test paper is designed for examination. Teachers grade the micro class video works made by students at the end of the semester. The comparison results are shown in Table 6.

The results show that class A and class B have basically the same initial conditions. Class A adopts the engineering cost teaching mode based on in-depth learning for teaching practice. At the end of the course, there will be an obvious gap between the two classes. Class A has a higher excellent rate than class B in terms of test paper scores and micro class works, and the highest and lowest scores are higher than class B. First, this research examines the final assessments of students in the experimental and control groups in order to...
compare the teaching impacts of regular classroom teaching and scaffolding teaching for in-depth learning. The test will last 120 minutes and have a maximum score of 100. Students’ scores are classified into five categories according to administrative methods for evaluating the academic accomplishments of undergraduates in a university: A, B, C, D, and E. The test questions of the experimental group and the control group are completely consistent, and they are all computer operation questions, including the learning points of six chapters of the teaching material. The test questions cover a wide range and highlight the key and difficult points. It is mainly a comprehensive investigation of the mastery and application ability of students’ knowledge, so as to reflect the students’ in-depth learning. Statistics and comparative analysis of the final test scores of the two classes are shown in Figure 12.

It can be seen that the scaffolding teaching model for in-depth learning in this study helps students in grades B, C, and below to move forward to grade A. In order to better grasp the changes of students’ in-depth learning status in the course, the “College Students’ in-depth learning evaluation scale” was distributed to 27 students in the experimental class before and after the teaching experiment. Students filled it out truthfully according to their actual learning situation and made use of SPSS software. The pretest and post test data after the questionnaire are collected for an independent sample t-test to compare the mean. The results are shown in Table 7.

It can be seen that the promotion of deep learning motivation is relatively fast after the implementation of scaffolding teaching. In addition, there are significant differences in these four dimensions, and their p values are 0.00 < 0.01. It indicates that there is a significant difference in the in-depth learning level between the experimental class before and after the curriculum implementation. It fully reflects that the scaffolding teaching mode for in-depth learning has significantly improved the in-depth learning level of the students in the experimental group, especially in the dimension of in-depth learning motivation, which is more inclined to actively collect learning materials for

| Table 5: Comparison between deep teaching and shallow teaching. |
|---------------------------------------------------------------|
| **Depth teaching**                                            | **Shallow teaching**                                    |
| Teaching concept                                             | Student center                                          | Teacher center                                         |
| Teaching objectives                                          | From easy to difficult hierarchical expression         | Focus on basic knowledge and skills                    |
| Knowledge system                                             | Emphasize the connection between old and new knowledge | Knowledge points are isolated and scattered            |
| Teaching method                                              | Proper selection of teaching methods                    | The method is single and inflexible                    |
| Student involvement                                          | Active participation and high investment                | Passive participation and low investment               |
| Thinking level                                               | Higher order thinking                                   | Low order thinking                                     |
| Teaching evaluation                                          | Diversified ways and pay attention to students’ multiple intelligences | The evaluation method is single, mostly performance evaluation |
| Teaching reflection                                          | Be able to adjust the teaching state according to reflection | Reflection is simple and not systematic               |
| Teaching results                                             | High quality, pay attention to the sustainable development of students | Low quality, emphasis on student achievement          |

| Table 6: Results comparison of class A/B.                     |
|---------------------------------------------------------------|
| **Class** | **Number of people** | **Test paper score** | **Micro class works** |
|           |                      | Excellent rate (%)  | Pass rate (%) | Highest score | Lowest score | Excellent rate (%) | Pass rate (%) |
| Class A   | 103                  | 46.35               | 86.35         | 100           | 55           | 56.32              | 87.65         |
| Class B   | 102                  | 31.23               | 71.31         | 95            | 42           | 28.96              | 45.32         |

Figure 12: Statistics of final test scores of experimental group and control group.
autonomous learning than before, showing that the students’ learning consciousness and initiative are significantly enhanced.

### 4. Conclusion

Along with the goal and route of deep learning, this paper constructs the evaluation system of deep learning teaching, designs three-level evaluation indexes from the two dimensions of qualitative evaluation and quantitative evaluation, and determines the corresponding weights. The evaluation system runs through the whole process of a preclass, classroom, after-class, and final examination, comprehensively reflects teachers’ teaching preparation, teaching organization, and management ability, and comprehensively examines students’ autonomous learning, individual thinking, problem-solving and inquiry, and innovation ability. At the same time, according to the evaluation system, this paper makes an empirical study on the effectiveness of in-depth learning classroom practice teaching. The research shows that most students are satisfied with the teaching mode and their autonomous learning ability, and their final grades have been greatly improved, but there are also some problems. Therefore, the author believes that the construction of a teaching evaluation system is a long-term, interactive, and continuous improvement process. In the future, the flipped learning practice teaching process, according to the basis and characteristics of students, cooperate with other teaching strategies and means to constantly improve the evaluation system in order to comprehensively improve students’ autonomous learning, application skills, and lifelong learning abilities and improve the teaching quality of engineering cost teaching.

### Data Availability

The data used to support the findings of this study are included within the article.

### Conflicts of Interest

The authors declare that they have no conflicts of interest.

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