Reform and Practice of the Assessment Method of "Big Data Analysis" Course for Competence Cultivation

Yaoyi Xi, Yufei Chen(✉), Zhihui Yue, Bo Wang, and Yu Nan

PLA Information Engineering, University of Strategic Support Forces, Zhengzhou 450001, China
chenyf202010@163.com

Abstract. Aiming at the problems of traditional course assessment methods, such as single method and not effectively reflecting the quality of the learning process and the level of competence cultivation, a two-factor multi-dimensional course assessment index system is explored and established, and a one-to-one graded daily evaluation model adapted to small class teaching is proposed, and then the two are combined and practiced throughout the whole process of students' course learning. Using correlation analysis techniques to analyze the practice results, the results show the effectiveness of the course assessment method, and have some significance for the assessment of other courses.

Keywords: big data analysis · competency development · course assessment · relevance analysis

1 Introduction

The course assessment method plays the role of a baton and a guide. It is not only to urge students to study well, but also to reasonably test the learning effect of students and give a fair and just ranking. At present, in some schools, some students have the phenomenon of passively coping with the exams, and these students do not study seriously in general, but hold the idea of "temporary Buddha's feet" before the exams, and recite and review in a sudden manner. Most of them have already adapted to this method, and some of them are able to pass many courses successfully. For these students, they basically have not really mastered the core contents of the courses, but just take exams for the sake of exams, which is far from the competence-oriented training goal of the new engineering. The above phenomenon is not unrelated to the rigid and single assessment method, because the "learning or not" and "good or bad" in general are not fully equivalent to whether they pass the exam or not. If we can reform the assessment method of the course and focus on the students' ability in the assessment to see whether they can apply what they have learned, then we can not only give students a fair and just grade, but also have positive significance for the cultivation of students' ability.

P. Qi and Z. Chen (Eds.): ICBDIE 2023, AISR 178, pp. 836–847, 2024.
https://doi.org/10.2991/978-94-6463-238-5_108

This paper mainly studies the assessment methods suitable for the course "Big Data Analytics", realizes the fair and impartial evaluation and objective quantitative measurement of students' performance, effectively plays the role of the baton and guiding value of the course assessment, and strives to promote the improvement of students' ability with the change of assessment methods. The course "Big Data Analysis" is a new course, and although there are not many direct studies on the assessment methods of the course "Big Data Analysis", there are more studies on the reform and innovation of similar course assessment methods [1, 2]. Huang Junlian et al. [3] pointed out that most colleges and universities simply adopt a final paper approach for assessment, which is not comprehensive for students and the students' learning effect is not satisfactory, and students should be evaluated by combining the usual assessment with the final course assessment and using the process assessment. Guixia Fu et al. [4] believed that the total score of the assessment should be composed of four parts: final exam, usual performance, on-line experiments and practical ability assessment to realize the investigation of students' practical programming ability from multiple levels, which is in line with the goal of training applied talents. Zhou Fengyan et al. [5] similarly explored the process assessment approach and proposed a detailed assessment item design method, scoring method, and the total score relying on the carrier. Wei Yudong [6] constructed assessment standards for computer practical training courses based on CDIO, but many indicators in the standards are not easy to achieve fair and objective quantification. Yan Fangfang et al. [7] also adopted the assessment method of "process + result" in response to the existing course assessment method, which is biased towards the result assessment and leads to the problems of students' surprise before the examination and poor learning motivation. Xu Jingxue et al. [8] proposed a multidimensional assessment and evaluation system combining online and offline, and combining process assessment and final examinations, based on the characteristics of hybrid teaching and the main problems faced by the current assessment and evaluation system.

The above-mentioned studies either still focus on the reform of the result assessment method, or adopt the "process + result" assessment method for optimization. Secondly, the process assessment is easy to be formal due to the large number of students, for example, it is mainly based on the submission of lab reports, which cannot discover the problems of students' learning in time, and there are even some students fishing in the water; Thirdly, due to the limitation of assessment time, the result assessment may still adopt the theoretical assessment method of memorizing and reciting knowledge points, which cannot effectively assess students' ability to apply theory to practice. The ability of applying theory to practice is not effectively assessed.

According to the characteristics of "Big Data Analysis" course and the teaching goal of highlighting "ability cultivation", this paper analyzes and refines the assessment criteria of "Big Data Analysis" course in response to the problems of existing research, and explores and establishes a two-factor multi-dimensional course assessment index system, which introduces factors including the completion time of assignments, and is capable of grading grades according to The paper also explores and establishes a two-factor multi-dimensional course assessment index system, which introduces factors including homework completion time, and is capable of grading grades according to the early and late completion of homework assignments and their quality; around how

to improve the quality of formative assessment, the paper researches and practices a one-to-one graded daily assessment model adapted to small class teaching, and gives students an objective formative assessment through a one-to-one check between students and teachers, combining student explanations and teacher questions.

2 Two-Factor Multi-dimensional Course Assessment Index System Construction

Focusing on how to improve students' ability to apply the theory of big data analysis to practice, we analyze the influence of course assessment on the cultivation of ability, analyze two aspects of daily assessment (formative assessment) and final assessment (summative assessment), summarize the key elements, and then establish a "two-factor multi-dimensional course assessment index system ". Among them, the two factors refer to "formative assessment" and "summative assessment" respectively. The two factors are evaluated from multiple perspectives, forming a "two-factor multi-dimensional course assessment system" (Fig. 1).

2.1 Formative Assessment Factors

In the formative assessment, we should highlight the "process quality", not simply "classroom performance and lab report", and not according to the lab report or homework "one size fits all".

- Classroom Dimension

In both traditional and online classrooms, the classroom is the place where formal communication between teachers and students takes place. In general, the classroom is the main channel for students to acquire knowledge. Both instructors and students have a clear understanding of the seriousness and effectiveness of the classroom. Therefore, daily assessment of students based on their classroom performance is a common practice in most courses, differing only in the weight of classroom performance in the overall grade. Commonly used elements of classroom performance assessment include answering questions, classroom activity, etc.

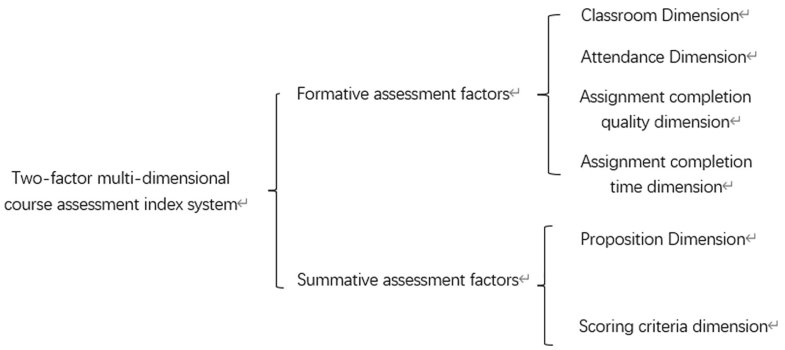

Fig. 1. Two-factor multidimensional course assessment system

- Attendance dimension

In order to maintain the seriousness of the class, the attendance factor should be incorporated into the course assessment. Given that there may be special reasons for students' non-attendance, and that some students, even if their attendance is low, still master the course content well through self-study in class, the attendance factor should not be overly weighted in the overall grade, and usually accounts for only a small part. It is important to note that even if attendance only accounts for a small part, it is still an essential part of the course assessment because it plays an important role in maintaining the seriousness of the class, urging students to take the course seriously, and ensuring fairness and impartiality.

- Assignment completion quality dimension

Assignments come in a variety of forms, including lab reports, codes, summary reports, etc. No matter which form is used, it is necessary to ensure the completion quality of the assignment, both in terms of quality and quantity. The quality of the same assignment completed by different students is different, behind which is reflected the different level of understanding and mastery of the course content studied. In fact, the quality of completion of assignments is also a factor that is considered in most traditional course assessments.

Table 1 gives one of the quality level evaluation criteria used for the course "Big Data Analytics".

- Assignment completion time dimension

Not only should we assess whether the assignments are completed in quality and quantity, this paper believes that we should also examine the completion time of the assignments in the assessment. The early or late completion of assignments reflects the students' initiative in learning the course and their understanding and mastery of the learning content. The traditional course assessment may set a deadline and ask the class representative to collect all the assignments and submit them to the teacher before the deadline. This approach does not reflect the importance of the homework completion time dimension, resulting in "the same homework early and late", which is not conducive to screening out students who are really good learners through the assessment, nor is

Table 1. Evaluation criteria for the quality level of "Big Data Analytics" coursework

Quality level	Reference Standards
1 Level (excellent)	Correctly complete the requirements of the topic, code clean and standardized or provide multiple solutions or innovative solutions
2 Level (good)	Correctly complete the requirements of the topic, the code is more concise and standardized
3 Level (general)	Correctly complete the requirements of the topic, the code quality is average
4 Level (failing)	Did not complete the question correctly

Table 2. Example of daily evaluation of "Big Data Analytics" course

Student Name	Classroom Performance	Attendance rate	Assignment 1			Assignment 2
			Layout time	Completion time	Quality of completion	
Zhang San	11	-1	2022.09.07			……
Li Si	9	0	2022.09.07			……
……	……	……	……			……

it conducive to urging students to finish their homework early, but will lead to students trying to use various means to muddle through before the deadline.

In contrast to the traditional approach, the authors link homework grades to the time of homework completion, which is inversely proportional to each other. The later the homework is completed, the lower the homework grade, and vice versa, the higher the grade. In this way, students are urged to overcome bad habits such as procrastination and complete their assignments in a timely manner.

In fact, by taking into account the homework completion time dimension, the authors found that most of the students who excelled in the summative assessment were also those who completed the homework earlier. This shows that students who learn well are motivated to complete their assignments, while those who procrastinate in their assignments are not as likely to excel in the summative assessment.

Combining the above factors, Table 2 gives a complete example of a daily assessment record, which is used by the authors in their daily teaching to record students' regular grades.

2.2 Summative Assessment Factor

The traditional summative assessment is based on written or machine exams. In view of the characteristics of the Big Data Analytics course, this paper selects the machine test assessment method, which focuses on examining students' ability to apply theory to practice. The paper also focuses on how to improve the quality of the questions and examine the students' ability to integrate and apply the course knowledge to solve practical problems within the limited examination time.

- Propositional dimension

To effectively play the role of the summative assessment factor, there must be a corresponding set of proposition questions that can better examine the students' knowledge mastery, especially for the machine examination. The actual big data analysis problems may be very complex, and how to combine the knowledge of big data clustering analysis, classification analysis, correlation analysis, regression analysis and link analysis taught in the course with the actual problems and integrate them into the exam propositions is of great significance to effectively examine the students' ability to solve the actual problems. In terms of the environment involved in the machine test of the "Big Data

Analysis" course, it involves Hadoop big data processing framework, Java language and MapReduce programming. Each of them, if not handled well, will affect the final problem solving.

In practice, the authors have come up with three techniques for proposing questions. The first is to be comprehensive, able to integrate practical problems as well as knowledge from multiple chapters of the course. For the big data analysis course, it should cover both the content of the big data processing framework Hadoop advanced programming, but also reflect the knowledge of big data analysis algorithm parallelization; second is to be targeted, the proposition should focus on examining the key points of the course, it is impossible to examine all the course content in a limited time, it should be on the basis of a comprehensive proposition to examine the key points. In fact, for the machine test, in the examination of the important and difficult points at the same time can also reflect the degree of mastery of students for other knowledge points to a certain extent; third is to have trade-offs, the proposed questions can not be too complex and stuck in trivial details, after all, the examination time is limited, so that students in a limited time, solve all the details is not realistic, but also does not reflect the true level of students. For example, the authors sometimes give part of the code of a real-world problem and omit some key parts of the code for students to fill in on their own, including the design of MapReduce key-value pairs. If students do not have a solid grasp of the code, they may not know how to use it even if it is given. For example, the authors sometimes change the questions based on the students' usual assignments to see if they can improve the code based on their usual assignments. This can avoid the lack of time for the exam, which prevents students from writing a complete code in the limited time available, and can also indirectly examine whether the students have "really learned and understood" the usual work.

- Scoring criteria dimensions

Because of the flexibility of the solutions of the machine test propositions, it is important to have appropriate scoring criteria for the propositions, taking into account both the uniqueness of the results and the diversity of the solutions. Neither the result nor the solution process should be limited. Based on years of experience, the authors found that solution codes with correct results are not necessarily correct, and solution codes with perfectly correct main logic may lead to wrong results or even no results due to a small error. In addition, different people give different solution codes for the same problem. At this point, it is necessary to give due consideration to which code is better optimized and more efficient in execution.

In practice, the authors propose three considerations for the scoring criteria. First, functional integrity, mainly to consider whether to complete the requirements of the topic, usually according to the completion of the code in steps to give points; second is the realization of logic, mainly to consider whether the topic itself to examine the knowledge points to complete the requirements of the topic, the same recommended according to the completion of the code in steps to give points; third is the quality of the code, mainly to consider whether the program is simple, the code is standardized.

3 One-to-One Graded Daily Evaluation Model Adapted to Small Class Teaching

In order to effectively improve the learning effect of students and ensure the quality of students' homework completion, the authors combine the characteristics of the current professional class teaching in small classes and make full use of the opportunity of one-to-one communication between teachers and students in the practice course to achieve face-to-face and face-to-face checking of students' homework completion. In the check, reasonable scores are given according to students' homework completion in grades, and the usual grades are accumulated with the teaching progress to finally complete a fair and just formative assessment.

The one-to-one graded daily assessment model adapted to small class teaching works closely with the aforementioned two-factor multidimensional course assessment index system throughout the course of learning, and strives to maximize the effectiveness of this assessment index system. In addition, the authors believe that the adoption of the above model can not only improve the quality of assessment, but also bring the following three benefits:

First, teachers can impart knowledge and demonstrate explanations in one-on-one, face-to-face assessments with students.

Second, through one-on-one communication and other ways to communicate with students in person, it is easy to understand the difficulties and doubts of different students, so that teachers can give targeted advice and personalized counseling according to the characteristics of different students.

Third, through face-to-face inspection of assignments can indirectly achieve daily supervision of students, reduce delays and even falsification, avoid the laboratory report is turned in, eliminate the indiscriminate, and urge students to do "really learn and really understand".

4 Final Score Calculation Method

Taking into account the factors of each dimension in the two-factor multidimensional course assessment index system, the authors gave the final grade $score_j$ calculation for the jth student, as shown below:

$$score_j = formative\_assess_j * 0.6 + final\_exam_j * 0.4$$

$$formative\_assess_j = class\_perform_j - attend_j + \sum_i e^{-\left(t_{end_{ji}} - t_{start_i}\right)} * quality_{ji} * task_i$$

where, $formative\_assess_j$ represents the formative assessment score of the jth student; $final\_exam_j$ represents the jth student's summative assessment score; $class\_perform_j$ represents the classroom performance of the jth student in the entire course of study; $attend_j$ represents the attendance deduction for the jth student for the entire course; t_{start_i}

Table 3. Score of different quality level operations

Level	Same Day Completion	Postponed one day	Postponed two days	Postponed three days	……
1 Level	5 points	4.95 points	4.90 points	4.85 points	……
2 Level	4 points	3.96 points	3.92 points	3.88 points	……
3 Level	3 points	2.97 points	2.94 points	2.91 points	……
4 Level	2 points	1.98 points	1.96 points	1.94 points	……

represents the assignment time of the *i*th assignment. $t_{end_{ji}}$ represents the completion time of the *i*th assignment for the *j*th student; $quality_{ji}$ represents the quality level of the *j*th student's *i*th assignment. where the values taken from level 1 to level 4 are 1.0, 0.8, 0.6, and 0.5, respectively; $task_i$ represents the percentage score of the *i*th assignment.

It can be seen from the above equation that, $e^{-(t_{end_{ji}} - t_{start_i})}$ actually represents the time decay factor, the longer the interval between assignment and completion time represents the longer it took for the student to complete the assignment, and therefore the smaller the time decay factor, the lower the final score for that student. Taking each practical assignment as an example of 5 points, the score of each practical assignment varies with the quality level and completion time, as shown in Table 3. It should be noted that due to the specificity of the above calculation, the calculated scores need to be rounded off at the end.

5 Experiment

Currently, the course assessment method has been practiced in eight different shifts in three majors, and certain effects have been achieved. In order to further illustrate the effectiveness, rationality and recognition of this course assessment method, this section gives some situations after practicing this course assessment method by means of correlation analysis.

Summative assessment uses objective examination results as the evaluation criterion, avoiding the influence of factors such as teachers' personal subjective impressions, and is an important tool commonly used to ensure fairness and impartiality. In view of the role status of summative assessment, this paper takes the summative assessment results of big data analysis courses as the reference system, and verifies the validity and rationality of the two-factor multidimensional course assessment index system by analyzing the consistency and correlation between the factors of formative assessment dimensions and summative assessment results.

Specifically, students were ranked in order of their summative assessment scores, and the student's classroom performance, assignment completion time, and assignment completion quality were also given, and the trends of the above factors were observed to be generally consistent with the trend of the summative assessment scores. Since the attendance factor is only used to ensure fairness and the majority of students are in full attendance, the attendance factor is no longer taken out separately for analysis.

- Validation of the validity of classroom performance dimensions

Take the big data analysis results of students in a certain semester as an example, there are 21 students in this major, and after sorting 21 students according to their final grades, the classroom performance grades of each student are given in order, as shown in the figure below. The horizontal axis number represents the final grade of 21 students, and the smaller the number, the higher the final grade. The vertical axis of the graph is the classroom performance of each student (Fig. 2).

As you can see from the graph, most of the students who usually perform well in class also have high final grades. Of course, there are also exception factors, such as students who have a mid- to upper-range final grade, but average usual classroom performance scores, or students who have a lower final grade, but better usual classroom performance scores. After analysis, some of these students were introverted, which affected their classroom performance scores (because classroom performance is measured mainly by classroom responses to questions and activity), and some were usually good, but were too nervous during the exams, which led to their test scores being affected. In either case, it is clear that neither the summative assessment results alone nor the classroom performance alone should be used to score students, but rather a combination of multidimensional factors should be considered.

Although the classroom performance grade is not exactly in a decreasing trend compared to the final grade, this paper suggests that the classroom performance dimension be retained in the course assessment due to its small percentage of the total grade and its reference factor for most other course assessment indicators.

- Validation of the validity of the quality dimension of assignment completion

Taking the above-mentioned 21 students' big data analysis results as an example, the quality of completion of all nine assignments for each student is given in turn after sorting the 21 students by their final grades, as shown in the figure below. The horizontal axis number represents the final grade of 21 students, and the smaller the number, the

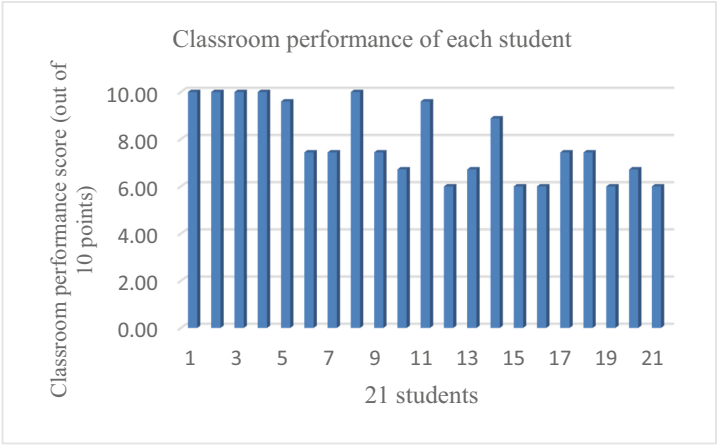

Fig. 2. Correlation between Classroom Performance and Final Grade

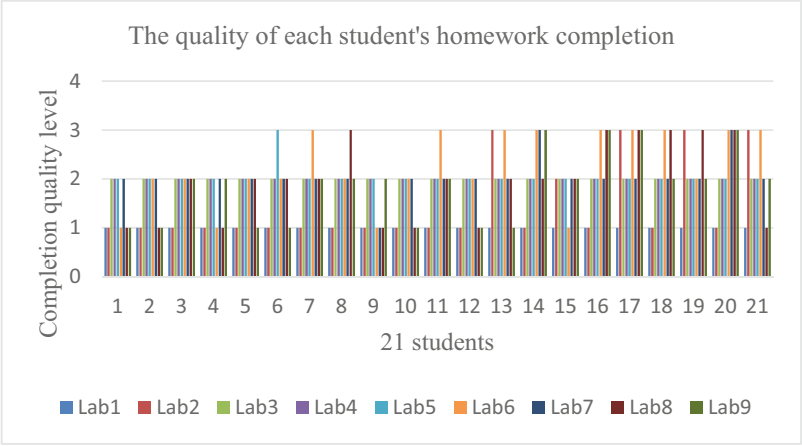

Fig. 3. Correlation between Quality of Assignment Completion and Final Grade

higher the final grade. The vertical axis of the graph shows the completion quality rating of all assignments for each student. As mentioned before, the lower the grade, the higher the quality of completion of the assignment (Fig. 3).

As you can see from the graph, most of the students with higher quality of homework completion also have high final grades. Of course, there are also exception factors, for example, there are also students whose final grades are in the middle of the range, but whose completion of a particular assignment is better, which is also more common in daily teaching. Overall, the quality of homework completion of the top 50% of students in the summative assessment is significantly higher than that of the bottom 50%. Therefore, it is reasonable to consider the dimension of homework completion in formative assessment, especially after the simultaneous adoption of the one-to-one graded daily assessment model adapted to small class teaching, which makes students easily dare not to muddle through the homework and make "indiscriminate use" due to the need for face-to-face inspection, and helps students complete each assignment with high quality and standard.

- Validation of the validity of the homework completion time dimension

Taking the above-mentioned 21 students' big data analysis results as an example, the final grades of the 21 students are sorted and the completion time of each student is given in turn, as shown in Fig. 4. The horizontal axis number represents the final grades of the 21 students, and the smaller the number, the higher the final grade. The vertical axis of the graph is the average completion time of all assignments for each student.

The following equation gives the calculation of the average completion time Avg_time_j for the jth student, which is the difference between the final completion time of each assignment and the assignment time, and then the difference is summed and averaged by the number of assignments.

$$Avg\_time_j = \frac{\sum_{i=1}^{N} t_{end_{ji}} - t_{start_i}}{N}$$

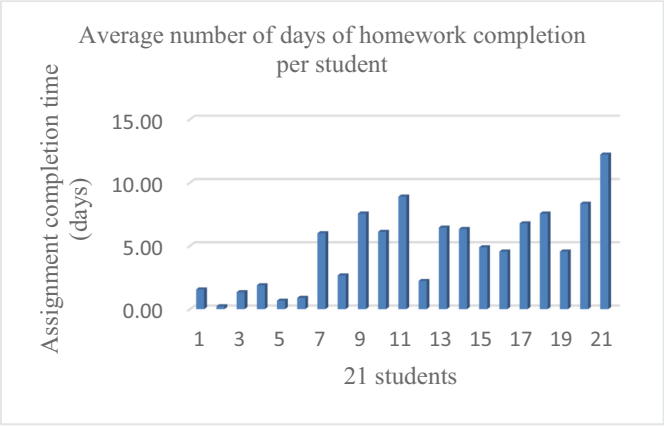

Fig. 4. Correlation between Assignment Completion Time and Final Grade

Among them, The meanings of t_{start_i} and $t_{end_{ji}}$ are the same as before, and N represents the total number of jobs.

As can be seen from Fig. 4, the average time spent by the top 50% of students in the summative assessment to complete the homework is significantly shorter than that spent by the bottom 50% of students, which laterally indicates that students with higher final grades also have a strong initiative to study in general and are able to proactively complete the homework. Therefore, it is reasonable to consider the homework completion time dimension in the formative assessment, which helps to urge students to study and complete homework actively.

6 Summary

In view of the course characteristics of big data analysis, this paper constructs a two-factor multi-dimensional course assessment system, which does not simply adopt the "formative assessment + summative assessment" approach, but focuses on the general goal of cultivating students' ability, and analyzes the components of the course assessment from multiple perspectives to maximize the role of course assessment in cultivating students' ability. In addition, the thesis proposes a method to adapt to the needs of small classes. In addition, the one-to-one graded daily assessment model proposed in the thesis can make full use of the advantage of small class size to achieve one-to-one communication and face-to-face inspection between teachers and students. It helps both to realize personalized guidance and to urge students to complete their assignments, reduce delays and even falsifications, and create a favorable atmosphere where students dare not fool and cannot fool.

The reform of course assessment is not an objective, but a way to promote the formation of students' learning habits and the improvement of their real ability. Through the combination of the above-mentioned course assessment system and daily evaluation mode, the status of "process quality" in the course assessment is enhanced, which helps to achieve the goal of promoting students' competence development and has certain

significance for the reform of other course assessment methods. In the future, the authors will further explore the components of competency, explore the practice and optimize the assessment methods, and establish a more comprehensive course content system.

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