



Analysis of classroom teaching innovation characteristics of science and engineering teachers

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Abstract. Classroom teaching is a key factor affecting the quality of teaching in colleges and universities. This study adopts a qualitative research method, using NVivo11 software, to analyze the teaching strategies in the final debriefing video of the National College Teachers' Teaching Innovation Competition in terms of process and method dimensions, and to sort out the details of teaching implementation of the 11 award-winning science and technology teachers, aiming at optimizing the design of teaching links, enriching the means of teaching and practically improving the quality of teaching.

Keywords: Teaching Innovation; Teaching Sessions; Nvivo11.

1 Introduction

The National Teaching Innovation Competition for Teachers in Universities is guided by the Department of Higher Education of the Ministry of Education and sponsored by the Chinese Society of Higher Education, which is the only teaching competition for teachers in universities that is included in the "List of Three Evaluations and One Competition Reserved for the Ministry of Education"^[1]. Summarizing the finalists' videos, we found that they all have the common point of adhering to the "student-centered" teaching philosophy and creating an integrated learning experience for students according to the learning location, course content and teaching style^[2]. To this end, this paper summarizes and summarizes some of the winning entries of the National Teaching Innovation Competition for College Teachers based on an overall analysis of the entries with a view to providing experience and ideas for college teachers' teaching.

2 Research design

2.1 Source material

Taking the final award-winning works of the National University Teachers' Teaching Innovation Competition in the past two years as the research object, the class type is mainly science and technology courses, and the collection of 37 relevant original materials (including 11 debriefing videos, 11 debriefing PowerPoints, 4 debriefing scripts of teaching innovations, 5 award-winning teachers' series of lectures, and 6 classroom teachings) was completed.

2.2 Research Methods

In this study, we adopted the qualitative research method of rooted theory to analyze the raw data of the National College Teachers' Teaching Innovation Competition using the NVivo11 software from QSR Australia^{[3][4]}. NVivo11 is one of the powerful computer-aided analysis software for qualitative research developed based on rooted theory, which can edit, integrate, summarize, and analyze a variety of data materials such as text, pictures, audio, and video; by establishing nodes at all levels, it can realize meticulous coding, editing, integrating and summarizing; and realizing meticulous coding by establishing nodes at all levels. In this study, we mainly used the data coding, exploring charts and matrix coding query functions of NVivo11.

3 Discussions

3.1 Coding stage

Using NVivo11 qualitative analysis software, open coding and selective coding were used to analyze the word frequency of 37 videos and teachers' lectures, resulting in a "vocabulary cloud", which can visualize the frequency of vocabulary appearing in the text, and obtain the textual word cloud of innovative features of the classroom teaching of science and engineering teachers, as shown in Fig. 1^[5]. Among them, words such as "students", "problems", "teaching" and "thinking" appear with high frequency, indicating the teachers' teaching concepts of "student-centered" and "focusing on inspiring students to think about problems".



Fig. 1. Teacher Reporting Text Vocabulary Cloud

3.2 Create nodes

3.2.1 open coding

Based on the scoring standard table of "National Teaching Innovation Competition for College Teachers", 1030 reference points were coded from 37 original materials (including 11 report videos, 11 report PowerPoints, 4 report scripts on teaching innovation, 5 lecture series of award-winning teachers, and 6 classroom teachings), and the coding coverage reached 72.77%.

3.2.2 spindle code

The initial categories obtained from the open coding were repeatedly compared and categorized, and the main category of "process and method" was finally obtained after the categorization.

3.2.3 selective coding

Through the above analysis, the five sub-nodes of "collaborative learning", "teacher-student interaction", "after-class homework", "blended learning platform" and "assessment and evaluation" are derived, as shown in Table 1.

Table 1. Coding of the children of the parent node "Processes and Methods"

Core node	Tree node	List of reference point contents	Material source	Reference point	Percentage
Process and method	Collaborative learning	Each report uses the applet to randomly select a student to report on stage, and his performance represents the performance of the whole group.	22	245	23.8
	Teacher-student interaction	Avoid students not actively participating in classroom interactions by doing objective questions where students make answer choices by holding up their cell phones or standing up to increase student participation.	18	210	20.4
	After-class assignment	Enhancing academic thinking skills through rich after-school learning activities, encouraging students to actively upload stage-by-stage and detailed mind maps at the end of class.	14	155	15.1
	Hybrid teaching platform	"Rain Classroom" is a mobile intelligent terminal accessed through WeChat small program. Through WeChat code scanning, Rain Classroom can realize the functions of classroom check-in, real-time question and answer, Q&A pop-up and data analysis.	20	195	18.9
	Appraisal and Feedback	At the end of the semester, we set up a project debriefing meeting, where we expressed our advertising ideas in the form of a roadshow with a proposal, and our company's first party came to	20	225	21.8

		the site to listen to the debriefing and score the points.			
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3.3 General Analysis

After manual coding of the 37 primary data, the coding nodes were analyzed qualitatively using the existing analytical functions in the NVivo11 software to count the coding reference points of the core nodes of "process and method", and the results are shown in Fig. 2. Averaging the percentage of coding coverage of the set sub-nodes yields a cluster bar chart of the average of the percentage of coding coverage. The overall coding coverage of the competition debriefing videos was 48.9%, with a maximum of 74.7%, indicating that collaborative learning, teacher-student interaction, post-class assignments, blended learning platforms, and assessment and evaluation were mentioned^[6].

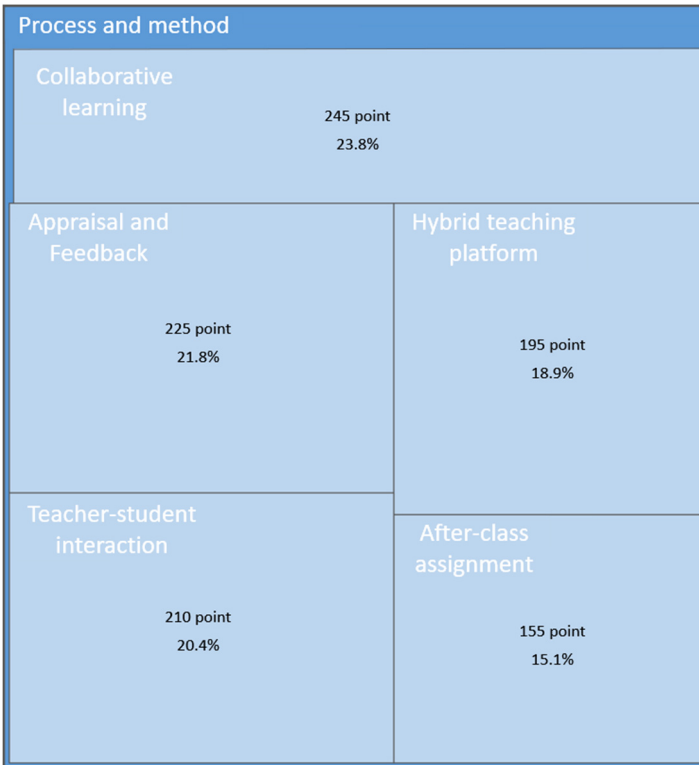


Fig. 2. Percentage of coverage of "process and evaluation"

From the coding hierarchy diagram of "Process and Method", it can be seen that teachers emphasize collaborative learning in classroom teaching, and there are 245 reference points in 22 materials, accounting for 23.8% of the total. This fully reflects the concept of "teacher-led, student-led", in which the teacher hands over the classroom to

the students, and the students work in small groups to carry out classroom learning around problems or tasks^[7].

In the assessment and evaluation of the 20 materials, there are 225 reference points, accounting for 21.8%. Teachers guide students to evaluate the learning process and learning methods. Evaluation of teaching should not only be carried out at the end, but also at each stage of learning, through the holistic design of multiple evaluation and process evaluation, in order to give positive evaluation to the excellent learning process and method^{[8][9]}. The usual process of knowledge accumulation also needs to be tested so that students' learning can be monitored in a timely manner and teachers are able to adjust the teaching progress appropriately in order to achieve better teaching results.

Teacher-student interaction is also a focus of the teacher's instructional process. Among the 18 profiles, 210 reference points are included, accounting for 20.4%. Positive and effective interaction is conducive to building a good teacher-student relationship, promoting students' thinking, and promoting classroom teaching and teaching quality^[10]. However, the traditional teacher-student interaction is that teachers ask questions and students answer, and only individual students participate. Currently, in classroom teaching activities, the teacher-student relationship is unidirectional and weak, and it is usually only observed that the teacher unilaterally transmits information to the students, and it is difficult to obtain effective feedback from the students.

195 reference points from 20 sources indicated that faculty use of blended learning platforms helped to integrate online and traditional face-to-face instruction. By combining different teaching methods, the learning needs of different students are met.

Assigning after-school homework is likewise necessary. 14 profiles showed 155 reference points, or 15.1%. What students learn in class, teachers assign after-school homework to consolidate and test students' learning, through rich after-school learning activities can enhance learning thinking skills^[11].

4 Summary

Teaching innovation reform makes teachers and students grow together. Teachers of science and technology actively explore new teaching models by learning from the advanced experience of teachers who won the National Teachers' Teaching Innovation Competition in the teaching process.

Therefore, the following conclusions are drawn:

- (1) In the Collaborative learning, teachers can use blended teaching and collaborative learning with the help of information technology, focus on improving students' higher-order abilities, and integrate them into the whole design process before, during and after class. For example, students are randomly grouped in the form of drawing playing cards, and those who draw the same number are placed in the same group, with fixed seats in class. This method not only increases the fun, but also has the potential to make the same level of students in a group, the ability to get a greater improvement. Alternatively, a student is taken to represent the group for a group report. The student's report represents the whole group. The results of

the student's report represent the results of the whole group, thus mobilizing the positive elements of mutual help within the group.

- (2) In terms of teacher-student interaction, to increase student engagement, the word matching method is used - focusing on testing students' understanding of concepts. Holding two different colored slips of paper, one with a proper noun and the other with an explanation of the noun, students match the two colored slips of paper. Alternatively, design basic discussion questions for each core video in the online classroom, unlimited iterative testing, and set up cross-campus discussion and Q&A sessions. Set up multi-dimensional teaching sessions such as classroom debriefings, debates, and focus on current events.
- (3) In order to enhance students' learning thinking skills through rich after-school learning activities, students take the initiative to upload stage-by-stage detailed thinking maps after class and push pre-study thinking questions to the teacher. The different cycles of learning are synthesized and appropriate levels of questions are pushed. At the same time, in order to test the learning effect of the students, each class is set up to consist of two PBL discussion sessions and one centralized summary session, and the two centralized discussions are followed by a stage examination and mind mapping exercises.
- (4) When using a blended learning platform, teachers can build a series of courses on the path of new engineers using Python as a tool. Teaching practices are conducted through the Python123 online practice platform, an online assessment platform with a large shared question bank that automatically corrects objective and programming questions and receives instant feedback. Teachers can create assignments, practice and exam units by selecting questions from the question bank according to their lesson plans. Meanwhile, the multi-platform cooperation approach is also applicable to blended teaching. Utilizing "Rain Classroom", "Pair Score Easy", Huawei Network Simulation Platform ENSP (Enterprise Network Simulation Platform (ENSP)), and SIP Education Open Experiment Cloud Platform U-SaaS, the specific operation, configuration, and protocol analysis of the network are operated and verified.
- (5) In the assessment and evaluation stage, the teacher can evaluate the other members of the group in a closed manner. In order to promote students' understanding of the logic of the questions, marks for wrongly answered questions can be returned to students who verbalize the reasons for their mistakes, and design contextualized, life-like, non-standard answer test questions. Multi-dimensional evaluation is set up in the assessment and evaluation: (1) intra-group evaluation, the evaluator is a member of the group, who gives feedback to the other members on the "soy sauce" phenomenon in the learning process by means of a private letter to the lecturer; (2) inter-group evaluation, the members of the group evaluate each other's assessment works; (3) project results reporting, expressing the advertisement creativity suggestions by means of a reporting hall roadshow; (4) enterprise cooperation, the tutor and the lecturer work together to the students' Evaluation.

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