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Innovative Hybrid Teaching Model Construction for Undergraduate Virtual Simulation Course under the "Golden Course" Criteria

-- A Case Study of Logistics Business Process Experiment Course

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Abstract

This paper explores a teaching mode based on the Project Based Learning method (PBL) and Partially Flipped Classroom method (PFC) for undergraduate virtual simulation courses under the "Golden Course" criteria, named “high level, innovative and challenging”. It incorporates characteristics of virtual simulation courses and features of PBL method, Flipped Classroom with information technology. The teaching centric method is replaced by learning and student's centric method. The overall teaching process is redesigned within the framework of PBL and PFC methods under the "golden course" criteria. The new teaching mode can enhance students’ ability to analyze and solve problems in reality, deep learning, cooperation skills, ability to work autonomously, and innovation.

Keywords

Virtual Simulation Course, Innovative Hybrid Teaching Mode, "Golden Course" Criteria.

1. Introduction

President Xi Jinping stressed to adhere to deepening education reform and innovation, to devote ourselves to implementing innovation-driven development strategies, and to focus on training innovative, interdisciplinary, and practical talents on the Education Conference of China in 2018. In the same year, "Gold Course" was written in the document released by the Ministry of Education of China. Creating "Gold Class" with the criteria "high-level, innovative and stimulating" has become an unavoidable requirement of China's higher education reform. The Virtual Simulation Experiment Course is a major type of five "Gold Courses". It plays a prominent role not only in training the ability to solve practical problems, organizational management, team collaboration, innovation and other high-level skills, but also in training innovative, interdisciplinary and practical talents. At the same time, Virtual Simulation Experimental Course is the backbone for creating "Intelligence + Education" and educating values via specialized courses.

However, there are many problems in present teaching mode, teaching content, teaching evaluation, student learning style, and capacity development of virtual simulation experimental course. A curriculum reform with "Gold Course" criteria is in dire need. We design an innovative and student-centric hybrid teaching model under the competency-oriented education philosophy integrating information technology and values education. Based on the new teaching mode and "Gold Course" criteria, we construct a continuous improvement system of teaching, learning, and evaluation to stimulate students' interest in active and deep learning, to improve teaching effect significantly, and to lay a solid foundation for training innovative, interdisciplinary and practical talents.

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2. Problems of Undergraduate Virtual Simulation Experiment Courses under "Gold Class" criteria

(1) Teaching-centric mode

The teaching mode of most virtual simulation experiment courses follows the mode of theoretical lessons. Teachers teach the basic knowledge of simulation theory and software. Students complete corresponding experiment individually or by teamwork according to experiment instructions. Although students have a large share of time to complete the experiments, the curriculum objectives, curriculum design, teaching process, and evaluation process are still teacher-centric, teaching-centric. This mode does not reflect the student-centric, learning-centric education philosophy. It can't achieve the goal of cultivating students' ability to learn actively, deep learning and lifelong learning. Let alone reach the target to practice the ability for solving practical problems, organizational management, team collaboration, innovation.

(2) Low level adoption of information technology

Virtual simulation experiment courses are the most information technology centralized course in universities, in which various computer technologies are used for teaching. However, only some simulation software and simple management systems are used in vast majority of virtual simulation experiment courses. Although information teaching tools are endless, but they are not used extensively in virtual simulation experiment courses. The existing application can not support the innovation of teaching mode and teaching evaluation methods based on data precipitation required by intelligent education.

(3) Lack of high-level and challenging teaching content

The contents of virtual simulation experiment courses are knowledge about solving real-world problems through simulation based on professional theoretical knowledge. However, in the teaching process, very simple problems and cases are used as examples. The teaching content focuses on the basic operation of the simulation software, and on the low-order goal of memory, understanding and simple application of knowledge. Contents and issues for solving real problems and cultivating high-level goals such as knowledge analysis, evaluation, and creation are inadequate. The existing contents also overlook the connectivity of multidisciplinary knowledge, old and new knowledge, knowledge and issues, etc.. The systematic and overall process integration of values education contents is insufficient. The contents are unable to support the organic integration of the goals of knowledge, ability, quality and nurturing.

(4) Lack multi-dimensional and overall evaluation

The evaluation of virtual simulation experiment courses is based on the subject reports or experiment reports. Although comprehensive evaluations can be conducted with several experimental reports, the evaluation dimension is still over a single, and biased toward results. The non-standard appraisal evaluation, process evaluation, and diversity evaluation of teaching goals, teaching content, teaching organization, are neglected, which are more suitable for virtual lab courses. In particular, it is important and difficult to evaluate the performance of the long period self-study period in virtual simulation experiment courses.

(5) Inactive learning, low-level learning, low-level ability exercise

In the process of virtual simulation experiment courses, students will get a lot of time for self-study, self-experiment and solving the problems encountered. However, most students do not know how to use these time efficiently, and they just proceed with the experiment according to the manual schedule and complete the report. Even so, most students do not think deeply about the content of the study and the issues that need to be addressed, nor do they seriously think about how to arrange the entire process of an experimental project and how to collaborate with their fellow students. These are because students are not good at active learning. This learning

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method and process is not only unable to achieve the deep learning purpose of knowledge application, analysis, evaluation, and creation, but also unable to reach the high-level ability of solving practical problems, organizational planning, team collaboration, effective communication and innovation.

3. Comparison and integration of PBL and FC method

The most obvious characteristics of PBL are "project-based, teacher-guided, student-oriented", which changes the passive teaching mode of "teacher-speaking and student-listening", and creates a new teaching mode for students to participate actively, collaborate autonomously and explore innovation. The core aspects of PBL include the establishment of classroom culture, designing and planning, correspondence with curriculum standards, managing teaching activities, evaluating students' learning, building learning brackets, participation and guidance. Core design elements include challenging questions, ongoing inquiry, authenticity, student voice and choice, reflection, critical feedback and modifications, publicly presented outcomes.

FC flips the process of a traditional teaching mode, in which teachers teach in the classroom and students solve problems after class. In FC, students study basic knowledge before having classes by videos and information technologies. In the classroom, students carry out problem-solving, cooperative inquiry and other deep learning activities under the guidance of teachers. The heart of this process is the flipping of traditional classrooms, to move a lot of teaching stuff out of the classroom, and to free up valuable classroom time for meaningful deep learning. The core aspects of FC class includes objective, preparation, video, review, testing, activities, summary.

According to the above comparison, both teaching modes take students as subjects, change passive teaching mode, pay attention to cooperative inquiry and deep learning as common ideological guidance. The core links between these two modes include corresponding preparation stage, designing objectives, testing assessment, managing teaching activities, summary, reflection. Virtual simulation experiment courses bias on students' hands-on activities, and cultivate students' problem solving ability, innovation ability. These features could be coupled into the PBL and FC methods naturally. As a result, we combine these two teaching modes to design a project-based partial flip classroom hybrid teaching model under the “Golden Course” criteria appropriately.

4. Design Hybrid Teaching Mode for Virtual Simulation Experimental Course

(1) Design teaching mode

In order to design better teaching mode, we firstly summarize the practice data and experience of logistics business process experiment course. Next, we investigate the problems and difficulties in the process of teaching virtual simulation experimental course in several Universities to find the common pain points. Then, we analyze the differences between the requirements of virtual simulation "Gold Course" and the current state of the teaching mode. We analyze the professional development objectives and the status of the course throughout the curriculum. Finally, we clarify the gap between the teaching practice and the construction requirement of "Gold Course” and training requirements of talents.

Combining the features of virtual simulation experimental courses, PBL and FC, we design a new hybrid innovative teaching mode under “high level, innovative and challenging” standard. The new mode is problem-oriented, and based on projects carefully designed depending on contents and training objective. The classroom is partially flipped. We conduct the overall process evaluation. The objective of the mode is to improve the students' ability to solve

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practical problems, innovation, collaboration, project management, self-management. According to the mode and the "Golden Course" criteria, we elaborate the teaching goal, material preparation, teaching content, teaching process, teaching evaluation to strengthen the training of deep learning ability and high-order ability, to make the course to be high-level and innovative.

(2) Refactoring Teaching Contents

Combing the main contents of logistics business process course, we organize the context according to two different logic process. The first one is the process of logistics: market-production-distribution-inventory-warehousing-supply chain-services. The other one revolves around simulation modeling methods: Multi-agent Modeling- Discrete Event Modeling-System Dynamics Modeling-Hybrid Method Modeling. We analyze the core knowledge points in experimental projects and their relationship to projects and analyze the relationship between functions of simulation software Anylogic, logistics business, simulation knowledge, to build the relationship network between knowledge, software, and projects.

Next, under the standard of "high-level, innovative and challenging", we refactor the teaching contexts by several methods. The first one is designing projects from real problems originated from the investigations of logistics companies, manufacturers, and commercial enterprises. These projects are designed carefully by considering the knowledge, software function and knowledge, and the "Golden Course" criteria. The second one is periodically updating the simulation theory knowledge, the simulation software functions, and adding higher level knowledge and software functions. The third one is re-compiling the experiment instructions by diminishing the operation contents and adding the contents on real problem analysis and solving, and relationship between knowledge, especially creation and innovation contents. The fourth one is adding content on the abilitity of project organization and management, teamwork, display and other related content requirements. The last one is enriching the course resources, including video resources such as tutorials, official tutorials, Anylogic cloud platform model resources, and documentation resources such as simulation, programming, etc.

The key points to systematically reconstruct the teaching contents is to establish correlation between the knowledge points, the experiment projects, and the logical relationship graph of the knowledge points, to integrate the theoretical knowledge and the software operating knowledge into each project, and to set the order of the experiment projects, to restructure the curriculum knowledge systematically.

5. Design Overall Teaching Process

Under the new teaching mode, the primary process will change from "Learning + After Class Review, Problem Solving" to "Pre-Course Study + Problem Solving + Discussion, Communication, Display + Deepening After Class Review."

For pre-class section, we firstly set double-level goals, the low-level goals and the high-level goals. Then we prepare teaching materials, recording videos, experimental reports, scoring criteria, auxiliary reference tutorials, project lists, content arrangements, evaluation methods and other materials to be uploaded to online learning platforms or systems in advance. Next, we develop classroom culture, motivate students to actively participate in classroom teaching, establish learning-centric learning rules. Finally, we arrange pre-class learning and familiarize students with the course content. The pre-class learning is not mandatory as we will spend time on the basic knowledge through teaching, questions and answers etc. This is why we say partially flipping the classroom.

In the class, it is agreed with the students to promote interactive classroom culture, whole-process evaluation and classroom organization, and let students choose their own experimental projects to enhance the student's consciousness, and to create a student-oriented environment

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and atmosphere. This course adopts partial FC, the pre-class learning part is not mandatory to figure out the problem of excessive time after class. Project management and implementation is an important sector to combine PBL and FC, mainly through group discussion and exploration, where students organize their own project implementation, while teachers participate in the problem-solving and management process of each group.

After the class, on one hand, students keep on solving the projects and discussing with the team or on the online system or go to investigate and understand the real problems under the guide for teachers. On the other hand, when each project is finished, students are asked to provide comprehensive feedback, summary and reflection on the learning situation, teaching status, teaching progress, teaching content, teaching form, teaching evaluation arrangement, etc. We will adjust and optimize the teaching mode and process of individual projects based on student feedback and teacher's assessment of the whole teaching process, the student's learning situation, etc. The teaching process will also be adjusted and optimized, through continuous iterative optimization, gradually improve the stability and teaching effectiveness of this teaching mode.

For evaluation part, we introduce an overall process evaluation system to change one time evaluation to a whole process, multidimensional evaluation method, including the performance in pre-class learning, in-class experiment solving, in-class interactive communication, presentation and after-school consolidation of learning evaluation, using e-learning platforms such as Xuexitong and analyze the entire process and multi-dimensional data. Especially for the evaluation of students self-study and hands-on stage, we use online data, group mutual assessment, self-assessment, project contribution, completion of different process of the experiment to construct a comprehensive evaluation.

Multidimensional evaluations are based on full process data. We evaluate students' learning, absorbing, application, evaluation, innovation of the knowledge, which belong to different levels of learning goals. At the same time, students are evaluated on different aspects such as study time, knowledge mastery, contribution to the organization and completion of experimental projects, innovative ideas to solve practical problems, and understanding of the content of the course.

Feedback iterative optimization section, during the implementation of the teaching process, we will optimize and adjust the teaching mode, the key points, the sequential of the projects and the contents of the projects based on the analysis of feedback information, teaching effects and teaching process data, especially for the creation of student-centred, learning-centred classroom environment.

6. Conclusion

This paper transforms teaching-centric modes into learning and student-centric teaching modalities. A hybrid teaching mode based on PBL and partial FC is designed. Under the "Golden Course" criteria, named “high level, innovative and challenging”, we reconstruct the teaching contents in combination with the practical cases and problems of the times and frontier to improve the systematic, challenging, and innovative level of teaching contents. We also design teaching strategy, teaching implementation process carefully by integration of information technology. We build a multi-dimensional evaluation system based on online teaching system, and the evaluative dimension includes all learning processes such as pre-class learning, interactive process, project organization, project presentation, all experimental reports, after-class learning, and teaching feedback. Finally, we develop the implementation path of the new teaching mode, and give a framework to optimize the innovative teaching mode iteratively optimized. The innovative hybrid teaching mode for virtual simulation experiment courses strengthen the development of deep learning and high-level competence, improves the

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advanced, challenging and innovation level, and also lay a solid foundation for training, innovative, interdisciplinary and practical talents..

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