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Curriculum Design of "Integrated Navigation Systems and Applications" Based on "Learning-centered, Consistent Construction"

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ABSTRACT
Aiming at the drawbacks of the traditional theoretical and practical teaching in the course of "Integrated Navigation Systems and Applications", this paper analyzes the causes of the drawbacks. In accordance with the teaching philosophy of "learning-centered", teaching design is carried out in accordance with the principle of "consistent-construction", learning objectives are set in accordance with the classification framework of meaningful learning, and elements such as scientific research results, information teaching means, curriculum thinking and politics are effectively incorporated into the curriculum design to improve the teaching quality of the classroom.
Keywords: *learning-centered, consistent construction, curriculum reform*

1. INTRODUCTION

The traditional "teaching-centered" classroom teaching mode is gradually exposing more disadvantages. With the development of the times and the continuous progress and innovation of education methods and ideas, the society has been developing with each passing day since the opening of the information age, and the demand for talents has also undergone profound changes. The progress of the country and society needs the positive help of more innovative and comprehensive high-quality talents, and the cultivation of these talents should be carried out in a more independent and "people-oriented" teaching environment.

"Learning-centered" teaching reform is a fundamental reform. In 1995, Barr and Tagg, two American scholars, published their paper "Transition from Teaching to Learning - A New Paradigm of Undergraduate Education" in "Change", a teaching journal of major American universities [1]. The paper points out that the learning-centered teaching reform is a fundamental reform. Under these two paradigms, universities and faculty have very different goals and missions. Because of the far-reaching significance of this reform, it often encounters the resistance of traditional thinking and practice inertia in its implementation. Decades later, the international higher education sector and top universities are still working on this. "The Department for Education's Higher Education White Paper", published in 2016, once again argues that excellence in teaching is more learning-centred on improving quality. In 2015, "Stanford University 2025 Plan" released by Stanford University also proposed that the focus of the new round of undergraduate education reform should not only point to what and how universities should teach; Also focus on how students should learn and how well they learn.

From the perspective of "learning-centered", the key to teaching quality is not teaching itself, but the learning quality directed by teaching. For this reason, John Biggs, an Australian educational psychologist, proposed a curriculum design principle: consistency construction [2]. Consistency construction integrates the concepts of "constructivism" and "consistency". The so-called constructivist learning believes that learning is a process in which students construct their own knowledge. Students do not simply passively accept information, but actively construct the meaning of knowledge, that is, they select, process and process external information according to their own experience and background, and generate their own understanding. This is also the origin and background of the concept of "learning-centered". And consistency refers to the consistency among learning objectives, learning activities and learning assessment. When designing the curriculum, teachers should first specify the expected learning objectives. This is the core of the whole curriculum design. Teachers need to clearly and clearly define what knowledge and ability they want students to learn, and then design corresponding learning activities and learning assessment, which are directly related to and consistent with this goal. Aiming at the disadvantages of the traditional teaching method of "Integrated Navigation Systems and Applications", this course adopts the curriculum design method of "learning-centered and consistent-construction" to optimize the curriculum design and improve the teaching quality of the classroom.

2. THE DRAWBACKS OF TRADITIONAL TEACHING METHODS

"Integrated Navigation Systems and Applications" is a core course for undergraduates majoring in navigation engineering. However, the traditional "teaching-centered" teaching method shows many disadvantages in teaching practice.

This course is taught to junior undergraduates. The main task of this course is to learn the basic concepts and applications of integrated navigation systems, basic working principles, models and algorithms, and performance analysis methods. To enable students to engage in the military or civil areas of integrated navigation system analysis, integrated navigation equipment, integrated navigation equipment, such as the use of preliminary ability.

This course focuses on knowledge points include: mathematical foundation of integrated navigation - least squares with Kalman filtering, SINS/GNSS integrated navigation, in view of the stationary vehicle SINS/Odometer integrated navigation and for which, the SINS/Doppler underwater integrated navigation and SINS/Vision integrated navigation, a new type of integrated navigation technology introduction. Specific chapters include seven chapters, as shown in Figure 1:

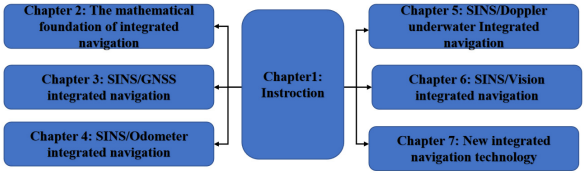

Figure 1 The teaching content of integrated Navigation Systems and Applications

It can be seen from the main content of this course that the characteristic of this course is the close combination of theory and practice, which leads to the disadvantages of the traditional "teaching-centered" curriculum design:

Disadvantages 1. The theory teaching uses "infuse type" to cause the student to grasp the theory knowledge not to be firm, produces the fear of difficulty emotion. In terms of theory, students have already completed some necessary courses of basic knowledge required by this course, such as "Inertial Navigation", "Inertial Sensors", "Satellite Navigation", "Numerical Calculation Methods" and other courses. However, from the performance of the students in the class, they do not have a firm grasp of the basic knowledge of these prior courses, so they have a fear of difficulty in the theoretical teaching of this course. At the same time, the traditional teacher-centered "infuse type" theory teaching makes students' fear of difficulty "worse than before".

Disadvantages 2. The use of "perfect data" in practice teaching leads to the lack of intuitive knowledge and interest of students in the experimental process. In terms of practice, the practical part of the course accounts for 60% of the course grade. The previous teaching of this course is that students directly conduct programming experiments with the experimental data collected by the teachers in advance. However, these experimental data are usually obtained by teachers through debugging a series of complex high-precision experimental equipment. Students lack intuitive feelings and cognition of the data acquisition process, so they have limited interest in the course learning.

Disadvantages 3. Teacher-led "passive" teaching leads to students' lack of independent thinking and practical ability and serious plagiarism. In terms of the comprehensive application of theory and practice, the theoretical knowledge part of this course will ultimately serve the practical part. However, due to the student training mission and task is very heavy, there is a widespread study time fragmentation, they often love assault, opportunistic, even lead to a lot of students in terms of programming practice there are a large number of plagiarism, the programming practice ability of students not only can not get a good exercise, theory of knowledge was also not very good.

3. CURRICULUM REFORM PLAN

Aimed at the disadvantages of "teaching-centered" curriculum design, the course reform of adhering to the "learning-centered" teaching idea, adopting "consistent-construction" as the basic principles of curriculum design, in a meaningful learning taxonomy for learning classification framework of goal setting, at the same time, combining with the characteristics of learning and research papers, research projects, the ideological elements, such as a smart phone APP is introduced into the classroom, innovating teaching mode, breakthrough the limitations of the traditional theory teaching and practice teaching, improve class teaching quality. The structural block diagram of course design is shown in Figure 2:

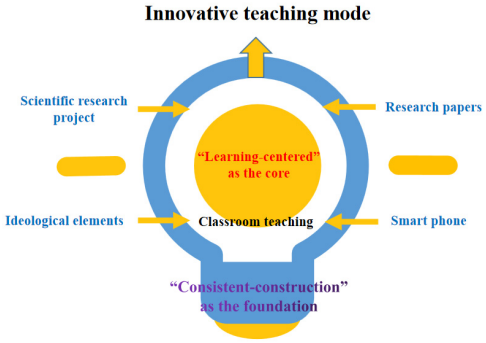

Figure 2 The course design structure block diagram

The main contents of the reform are reflected in the following four aspects:

3.1. The Organization Design of Curriculum is Reconstructed Under The Guidance of Advanced Teaching Concept

Adopt the concept of "learning-centered, consistent-construction" to reconstruct the curriculum organization design. Through the reconstruction of the curriculum objectives and learning activities, learning assessment and other elements of the consistency, so that students understand what they should learn, how to learn, and how to achieve the standards.

3.1.1. Teaching design based on the principle of consistency construction

The complete teaching design should include three links: setting the expected learning goal, designing the learning activity and completing the learning evaluation.
Setting the expected learning goal: Describe the learning objectives with an action verb representing the learning activity and define the criteria to be achieved by the learning activity, so that students can identify what they can learn from the course or unit/module.
Designing the learning activity and completing: Design the learning activity corresponding to the action verb so that the learning goal can be realized.
Completing the learning evaluation: That is to design the learning evaluation that also contains the action verb, so that the teacher can judge whether the student's academic performance meets the standard, and convert these judgments into the evaluation standard of learning results.
An example of a consistency construction is shown in Table 1.

3.1.2. The learning objectives of the learning classification framework are set by means of meaningful learning classification

Meaningful learning can have a profound impact on students. This project builds curriculum objectives based on the classification of meaningful learning. The setting of learning objectives is the core of the whole curriculum design. Teachers should clearly and clearly specify what knowledge and ability they want students to learn, and then design corresponding learning activities and learning assessment, which should be directly related to and consistent with this goal.

Table 1 An example of curriculum consistency construction

Learning goals	Learning activities	Learning evaluation
Analyze and compare the difference between inertial navigation and satellite navigation.	Smart phone APP is used to collect real-time data of inertial devices and satellites, and afterwards **analyze** the characteristics of inertial navigation and satellite navigation in different environments.	Write the experimental report and form the experimental report based on the results of the post-**analysis** of the collected experimental data.
Explain why the state transformation Kalman filter is better than the traditional Kalman filter.	Assignments in class are given to **deduce** the velocity error formula of state transformation Kalman filter, and **explain** the reason of the robustness of state transformation Kalman filter according to the system matrix.	In class group discussion, **explain** to the instructor the reason of the robustness of state transformation Kalman filter.
Be able to **explain** what is the nonholonomic constraint of the car body	In class, it was **explained** that when the car body does not skid or jump, the lateral and celestial constraints of the car body can be regarded as nonholonomic constraints.	A quiz with multiple choice questions in the rain classroom, and ask students to **explain** why the side and sky constraints of a car body can be considered as nonholonomic constraints.

Meaningful Learning classification is a learning classification framework proposed by Dee Fink, a representative of teacher development in the United States, in the 1970s [3]. The classification of meaningful learning emphasizes the profound impact of the course on students. For example, whether students can continue to learn after each class or even after the whole course, and whether they can generate value-added learning. Meaningful learning taxonomies are characterized by interactivity and integration. Like Bloom's taxonomy[4], there are six types of meaningful learning taxonomies. However, unlike Bloom's taxonomy, these categories are not independent of each other and have no hierarchy, but interact with each other [5]. This means that giving students access to any kind of learning helps them to acquire the other five types of learning. The learning classification framework for this course is shown in Figure 3.

Figure 3 Meaningful learning classification framework

The six types of meaningful learning taxonomies of this course can be concretely expressed as follows:
Core knowledge. At the end of the course, I can briefly explain the basic principles of inertial navigation, satellite navigation, odometer navigation and visual navigation.
Apply their knowledge. It can collect and analyze data of inertial navigation, satellite, geomagnetic sensor and other sensors through smart phone APP.
Learning to learn. Learn how to become a better student, such as independently complete the collection of experimental data, experimental data processing, experimental results analysis.
Comprehend by analogy. Analyze and compare the advantages and disadvantages of inertial navigation and visual navigation.
Interest feelings. Give play to their combined naviga- tion expertise and continue to contribute to the count- ry's aerospace or maritime fields in the future.
Human dimension. Know yourself - be able to discern the hidden reality. The essence of the result, rather than following the crowd. Know others - be able to inform other non-navigation professionals around you about the specific roles combined navigation plays in military and civilian applications.

3.2. Adopt Heuristic Teaching Method to Cultivate The Ability of Independent Thinking

In the teaching process, heuristic questions are set to guide students to think independently, deepen students' understanding of theories step by step, and combine questions with reality to guide students to think about the philosophy behind natural science, so as to improve students' accomplishment of scientific and technological nature dialectics.

3.3. The Teaching Method

The latest scientific research achievements are introduced into the classroom to deeply integrate theory and practice. The latest research papers and research projects of the scientific research team are introduced into the classroom, and the scientific research practice is taken as the verification result of the theory to attract students' attention, arouse students' thirst for knowledge, and cultivate students' ability to find and solve problems.

3.4. Use Intelligent Products as Teaching AIDS to Train Students' Practical Ability

It is the first time for smartphone APP to be applied to multi-sensor integrated navigation experiment in class, which overcomes many disadvantages of using only the off-line experimental data collected by teachers in traditional class. In the information age, students can directly use smart phones to collect real-time experimental data, which can not only improve students' enthusiasm for learning, deepen their understanding of theories, but also train their ability of self-practice and teamwork.

4. CONCLUSION

In view of the disadvantages of "teaching-centered" in traditional teaching, a method of "learning-centered and consistent-construction" is adopted to re-optimize the curriculum design of "Integrated Navigation Systems and Applications". Di Fink's taxonomy of meaningful learning is used in the coherent-constructed learning goal setting. In order to achieve "learning-centered and consistent-construction", innovative teaching modes are adopted by means of scientific research papers and research projects into the classroom, ideology and politics into the classroom, smart phone APP into the classroom, etc., to stimulate students' interest in learning and improve the quality of classroom teaching.

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