

# Research on Scene Case Teaching Method for Computer Basic Courses Based on Aerospace Applications

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**Abstract.** At present, computer teaching in the field of aerospace in China mainly focuses on one-way knowledge transmission, which cannot stimulate students' enthusiasm for learning and exploring aerospace. This article proposes a teaching method based on scenario cases of computer basic courses in aerospace applications, which optimizes the teaching quality of computer courses in the field of aerospace engineering from three aspects: selection of aerospace cases, design of case types, and innovation of teaching methods. This method has been proven to achieve good teaching results in practice.

**Keywords:** spacing engineering; computer-based teaching; scenario based cases.

## 1. INTRODUCTION

Spacing engineering is a discipline formed by the intersection and integration of multiple disciplines<sup>[1]</sup>. The computer foundation teaching of aerospace engineering majors is based on the talent cultivation concept of "focusing on aerospace applications", adhering to problem oriented approach, actively promoting the practicality of teaching content, and diversifying teaching modes<sup>[2]</sup>. At present, most of the cases in computer basic courses for aerospace majors in domestic universities are still universal, and there are still few cases for aerospace applications.<sup>[3]</sup> As a result, the course still lacks sufficient support for students to deeply understand the application of computational thinking in the aerospace field, and to analyze specific aerospace equipment and activities based on their knowledge of computer theory. In addition, currently, the use of cases in the course teaching process is mostly through teacher classroom demonstrations. The types of cases are simple, the methods are relatively single, and the participation of students is insufficient, which has not fully utilized the important role of cases in teaching. This article explores the "scenario case" teaching method, which has reformed and reshaped the teaching of computer foundation courses in aerospace engineering majors, and achieved good teaching results.

## 2. SCENARIO CASE TEACHING METHOD

Case teaching method is a teaching method in which teachers fabricate or select appropriate cases as teaching materials based on the requirements of teaching objectives and training objectives, guiding students into teaching situations, and cultivating students' abilities to discover, analyze, and solve problems through interpretation, analysis, and discussion. The definition of case-based teaching method can summarize some basic characteristics of case-based teaching method. The situation is a case, which is the fundamental characteristic that distinguishes case teaching method from other teaching methods. The case teaching method advocates that teachers should master and regulate the teaching process, and students should participate in case practice as the core. Case teaching emphasizes the interaction between teachers and students, as well as the interaction between students. Interaction is about communication and discussion, conversation and sharing in the "internship field" and "practical community". It is about students actively exploring rather than passively accepting, and is a diverse form of interaction that is clearly different from the teaching style of "point-to-point" and "face-to-face". The case teaching method is open, which allows interaction between teachers and students to be beyond the classroom, making it possible to conduct diverse and in-depth discussions on complex problems, and leading the results towards openness. The case teaching method emphasizes the cultivation of students' thinking ability, analytical ability, and expression ability, enabling them to exercise their minds, cultivate their temperament, and increase knowledge through active participation in activities. It focuses more on the process rather than just the result. Table 1 shows a comparison between case-based teaching method and traditional teaching method.

The scenario case teaching method is a teaching form that guides students to engage in teaching and learning interactive

**TABLE 1.** COMPARISON BETWEEN CASE-BASED TEACHING METHOD AND TRADITIONAL TEACHING METHOD

	Case Teaching Method	Traditional Teaching Method
The Main Carrier Of Teaching	Cases	Textbook
Role Of Teachers And Students	Teachers: Organizers, mentors, facilitators. Students: Participants and Explorers.	Teachers: Knowledge lecturer Students: Knowledge receiver
Responsibilities Of Teachers And Students	Teachers: Selecting case studies, guiding students, and regulating the process. Students: Exploration and analysis, communication and expression, sharing and communication.	Teachers: Imparting knowledge, answering questions, and controlling the classroom. Students: Memorizing knowledge, understanding knowledge, practicing and consolidating.
The Status Of Teachers And Students	Teachers: Dominant Students: Subject	Teachers: Control status Students : Subordinate status
Important Points	Pay attention to "why" and focus on the process.	Pay attention to "what" and focus on the result.
Form Of Interaction	"Point-to-point", "face-to-face", multi-directional	"Point across", one-way

discussions on specific problems that are hidden within the specific typical scenarios or events presented by the case<sup>[4]</sup>. This method inspires students' creative thinking in discovering, analyzing, and solving problems, and improves their ability to respond to real-life problems. The implementation methods of case teaching have diverse characteristics<sup>[5]</sup>. It revolves around teaching objectives, focuses on the main teaching line, and combines the advantages of various methods such as research discussion, homework scenario, on-site practice, and scenario simulation for teaching design and classroom implementation<sup>[6]</sup>. This article will explore the scenario based case teaching method from three aspects: case selection principles, case types, and teaching methods.

## **2.1 Case Design Principles**

### *1) Targeted principle*

The selection of cases should be targeted, taking into account not only professional issues, but also teaching content and methods. Allowing students to learn in targeted cases can stimulate their interest in learning, facilitate their entry into "role experience" and "situational experience", and improve their ability to solve problems in case situations.

### *2) Practical principles*

The principle of case design is that the purpose of computer application is to cultivate students' ability to apply computers to solve practical application problems. Therefore, the selected cases cannot be imagined out of thin air and detached from the aerospace field. They should conform to the cognitive laws of students, conform to the professional laws of students, extract from practice, have theoretical support, and achieve full integration of theory and practice.

### *3) Inspirational principles*

The scenario created by professional cases is to allow students to think, analyze, and solve problems step by step in a real environment as parties involved. The scenario case method emphasizes students' initiative in learning, so the selection of cases should be inspiring in order to broaden students' thinking horizons, form various innovative and effective problem-solving methods, and achieve the expected teaching objectives.

### *4) Participatory principle*

Only by helping students actively participate in case situations can teachers use cases to complete teaching tasks. Therefore, the selected case must be able to motivate students to actively participate, and cannot be created through imagination.

## **2.2 Case type**

The computer foundation courses of the Aerospace Engineering major cover the knowledge system of computer science. Aerospace engineering has application requirements for each of the above course knowledge, and large-scale aerospace missions have comprehensive application requirements for certain course knowledge. Therefore, the types of cases we design are divided into independent cases and penetrating cases.

### 1) *Independent case*

Independent case studies are designed for the application of each computer foundation course in aerospace engineering. The computer education of aerospace engineering majors includes courses such as computational thinking, programming, information coding and data representation, computer architecture, computer networks, databases, etc. Specifically, computer programming courses can combine cases such as radar detection of aerospace vehicles, flight level classification of aircraft, and data processing of spaceborne laser altimeters to carry out program structure teaching, such as sequential structure, selection structure, and cyclic structure. The data structure course can combine cases such as orbit period calculation and rocket flight position. The object-oriented programming course can be combined with the design and implementation of spacecraft classes for teaching. The teaching of wireless network transmission content can be combined with cases where the aerospace system server reads request files and response files. The storage, query, and analysis of aerospace data can be used in the teaching of database courses. The independent case is shown in Table 2.

### 2) *Penetrating Case*

In response to the comprehensive application of computer knowledge in aerospace engineering, we are guided by the overall training objectives of the discipline, integrating the knowledge of various computer courses into the same integrated teaching case, emphasizing the central position of students, strengthening their knowledge utilization, and effectively improving their ability to analyze and solve complex engineering problems. Based on teaching requirements, the design of penetrating teaching cases has the following principles. Centered around students, guided by course objectives, focused on continuous improvement, and fundamental in cultivating the ability to solve complex problems.

## 2.3 Teaching Method

The basic requirement of case teaching is that students must participate in discussions and achieve the teaching purpose and

TABLE 2. INDEPENDENT CASES IN COMPUTER COURSES

Teaching module	Independent Case
Computer programming	Radar detection, spacecraft flight level judgment, satellite orbit period calculation
Computational thinking	Calculation and Sorting of Space Communication Delay
Information Coding and Data representation	Space communication delay calculation and sorting Space data file encryption, compression, and decompression
Computer system	Feng Neumann Simulator Reading, Writing, and Backing up Aerospace Files
Networks	The aerospace system server reads the content of the request file
Database	Storage, Query, and Analysis of Aerospace Data for Reading Request File Content on the Aerospace System Server

learning effect of "drawing inferences from one example" and "analogy" through mutual discussions with teachers and classmates. In student discussions and interactions, classroom discussion forms such as "case group discussion - extended examples - classroom small experiments", "case group discussion - image explanation/analysis - each student thinks independently - students ask and answer each other", "case group discussion - extended examples - group common principle analysis - students comment on each other" can be designed, enabling each student to fully participate in case learning. In addition, forms such as student classroom presentations and flipped classrooms are also conducive to the implementation of case teaching, allowing students to switch roles and actively think, explain, and analyze cases, which can achieve twice the result with half the effort.

### 3. EXAMPLES OF SCENARIO CASE TEACHING METHOD

This section takes the university computer foundation course as an example to demonstrate the practical process, teaching effectiveness, and existing problems of scenario based case teaching method based on aerospace applications.

#### 3.1 Independent Case

##### 1) *Aerospace Case Study of Bubble Sorting Algorithm*

During the in orbit flight of an aircraft, continuous energy supply is the foundation for the aircraft to carry out various tasks. Under the constraints of light weight and small volume of aircraft, there is a problem of difficulty in balancing energy supply and consumption throughout the entire mission cycle. To efficiently manage energy consumption in orbit, it is necessary to establish energy consumption algorithms, establish on/off adjustment mechanisms, and reasonably schedule single machine work modes and execution sequences. It is necessary to use energy sorting algorithms to identify the minimum energy consuming devices. Here we use the commonly used sorting algorithm - bubble sorting.

##### 2) *Teaching method*

Based on the bubble sorting algorithm, we have designed an immersive teaching method that includes three steps, which is shown in Figure 1. Firstly, the teacher demonstrates the execution process of bubble sorting through animation, enabling students to have an intuitive understanding of the algorithm execution process. Secondly, conduct group discussions. Each group will discuss and draw an algorithm flowchart, write pseudo code, and provide the results of each round of sorting. The group representative came on stage to explain. Finally, the teacher selected students of different heights and randomly queued up on the podium to simulate a disordered sequence of numbers. The students simulated the bubble sorting process according to the algorithm logic, and the whole class supervised the discussion. Through this approach, students are immersed in understanding and mastering bubble sorting in aerospace cases.

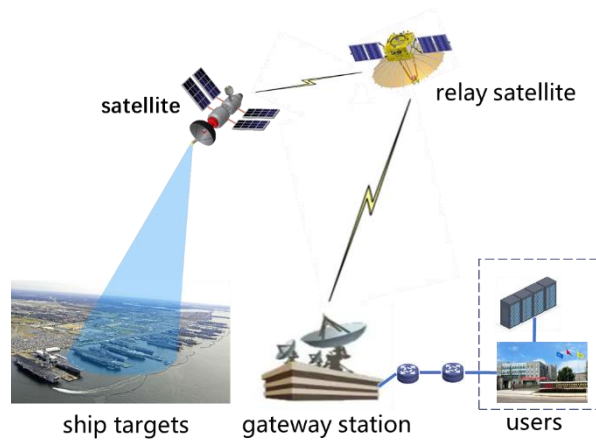


**Figure 1.** Immersive Teaching Method of Bubble Sorting

## 3.2 Penetrating Case

### 1) Case of Aerospace Remote Sensing Target Recognition

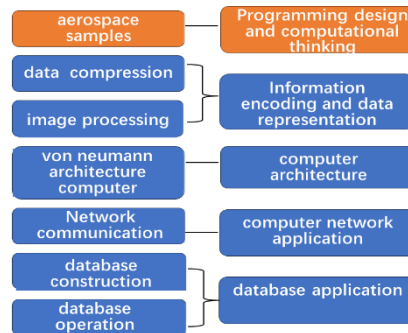
The penetrating case is shown in Figure 2. During the transit period of the satellite, the ship targets are photographed, and the images are compressed and transmitted back to the ground gateway station through the relay satellite. The gateway station preprocesses the data using a von Neumann system computer, and then transmits it to the user database for storage through a wired network for target recognition. This comprehensive case corresponds to the content of multiple modules such as computational thinking, information coding, computer systems, computer networks, and database technology. The Distribution of computer course techniques in satellite remote sensing target recognition tasks are shown in Figure 3.



**Figure 2.** The Case of Aerospace Remote Sensing Target Recognition

### 2) Teaching Methods

Through case studies, students can integrate the content of each module over a longer period of time, making it easier to understand the connections between the contents of each module and grasp the overall learning progress. Through case studies can also be used as course designs or large assignments assigned to students at the end of the semester, playing a consolidating and improving role, effectively enhancing students' comprehensive ability to solve complex aerospace engineering problems with computer knowledge.



**Figure 3.** The Distribution of Computer Course Techniques in Satellite Remote Sensing Target Recognition Tasks

#### 4 EVALUATION

We applied the scenario based case teaching method to assess the learning process and effectiveness of 54 students majoring in Aerospace Surveying and Mapping at the Spacing Engineering University. The final score statistics are as follows: 31 outstanding individuals, accounting for 57.4%; 18 good people, accounting for 33.3%; Moderate 4 people, accounting for 7.4%; Two people passed the exam, accounting for 3.7%, with a total of 90.7% being good and excellent, achieving good expected results.

##### 1) Unit Test

The full score of unit test is 100 points, and the score statistics are shown in Table 3. As can be seen from the table, due to the different teaching objectives and evaluation methods adopted in sence case teaching, students have greatly improved on their original level, and almost all of them have achieved excellent or good grades.

**TABLE 3.** THE STATISTICS OF UNIT TEST SCORES

Score	90 point or more	80 to 89 points	60 to 79 points	60 points or less
Number of Students	21	27	8	1

##### 2) Computer Operation

The score statistics of computer operation are shown in Table 4. As can be seen from the table, based on the differences among students and the teaching objectives at all levels, the students' homework is objectively evaluated differently, and it is found that each student has made great progress and development on the basis of his own original.

**TABLE 4.** THE STATISTICS OF COMPUTER OPERATION'S SCORES

Score	90 point or more	80 to 89 points	60 to 79 points	60 points or less
Number of Students	17	28	6	1

3) *Team Work*

We evaluate the team from four aspects of team division of labor, members' active participation, team cooperation, and learning outcomes. The total score is 100 points, and the score distribution is shown in Table 5.

**TABLE 5.** THE STATISTICS OF COLLABORATION PERFORMANCE

Score	90 point or more	80 to 89 points	60 to 79 points	60 points or less
Number of Students	32	15	2	2

4) *Comprehensive Scoring Results*

The overall score of students is calculated according to the allocation method of unit test 50%, computer work 30% and team work 20%, as shown in Table 6.

**TABLE 6.** THE STATISTICS OF COMPREHENSIVE SCORING RESULTS

Score	90 point or more	80 to 89 points	60 to 79 points	60 points or less
Number of Students	23	24	4	1

5) *Remaining Shortcomings*

At present, scenario based case teaching is still in the initial stage, and the connection between case studies and aerospace engineering needs to be strengthened. At the same time, the teaching methods are relatively single, lacking teaching resources and techniques such as virtual laboratories, and the high-level nature of course teaching needs to be further strengthened.

## 5 CONCLUSIONS

This article studies the scenario based case teaching method for computer courses based on aerospace applications. Design case teaching methods from three aspects: principle of case selection, determination of case types, and teaching methods. Taking the basic computer courses in universities as an example, teaching practice was carried out. The course results indicate that the scenario based case teaching method has achieved good teaching results.



## REFERENCES

- [1] Kolb D A. Experiential Learning: Experience as the Source of Learning and Development[M]. Person Education, 2019, pp.25-56.
- [2] Sharples M. The Design of Personal Mobile Technologies for Lifelong Learning[J]. Computers & Education, 2018, 34(3), pp.177–193.
- [3] Dan Li, Study on Learning Situation Analysis in Middle School Mathematics Instructional Design[J]. ShanXi Normal University. 2015. pp:31-43
- [4] Cong Wei, The application of stratified teaching in common basic courses in ordinary universities[J]. Educational Information In China : Education In Middle School, 2014(17), 52-55.
- [5] Williams J B, Jacobs J. Exploring the Use of Blogs as Learning Spaces in the Higher Education Sector[J]. Australasian Journal of educational technology, 2014, 20(2), pp:232-247
- [6] Tsai I H, Young S S C, Liang C H. Exploring the Course Development Model for the Mobile Learning Context: a Preliminary Study[C] IEEE, 2020, pp:437-439