Ecological Learning Space Teaching Mode based on Investigative Study – Case Study of Computer Image Processing

https://doi.org/10.3991/ijet.v14i04.10109

Ping Zhu(✉), Yinan Xuan, Zhe Xu
Hebei North University, Zhangjiakuo, China
zhuping2019@126.com

Abstract—Computer Image Processing is a foundation course of computer specialty. Due to the problem of teaching method and students' ability problem, the teaching process is boring and students are absent-minded in class, thus leading to low teaching efficiency of Computer Image Processing and low teaching quality. As well, the learning effect and level cannot meet the requirement of market and society. On this basis, Computer Image Processing was chosen as the teaching case to construct ecological learning space mode meeting the course requirements on the basis of investigative study and under the guidance of interactive theory. Besides, the students of computer major were chosen as the objects of study for one-semester teaching practice. Questionnaire survey and interview were combined for empirical research in order to innovate for teaching mode of Computer Image Processing and provide higher-quality computer talents for the society. The investigation found that the teaching mode is well welcomed by students and greatly improves their learning initiative and learning effect.

Keywords—Ecological learning space; Computer Image Processing; investigative study

1 Introduction

With the popularization of internet, all walks of life have larger and larger demand for high-quality computer talents. Meanwhile, the requirements for computer accomplishments, computer knowledge and skills, and practical operation ability also become higher and higher. Computer Image Processing as a required course of computer major is also one of main functions of computer in the internet age. Besides, it is also the important knowledge and skill that each student of computer major must master. However, the teaching method of Computer Image Processing is single. Students' classroom enthusiasm is not high and their autonomous learning ability is poor. Thus, classroom teaching efficiency is not high. Seeing from practical classroom learning and social employment direction of students of computer major, if we still adopt traditional teaching mode, the learning situation of "valuing theory and neglecting practice" will form, and the job requirements of computer post for computer im-

age processing cannot be met. Besides, it goes against subject development. Ecological learning space, also called personal learning space, means students learn independently in the virtual learning space and organically combine theoretical knowledge of computer image processing and practical operation. In the ecological learning space, students can start from their own conditions, conduct self-control, choose independently, complete a series of individualized learning, enhance their theoretical knowledge, improve their operation skills and promote problem-solving ability [1].

At present, in the teaching process of Computer Image Processing, the teaching mode of ecological learning space is still a blank field, and there exist some problems. Firstly, there are many theoretical studies on ecological learning space, but the research directions are very disperse, and the cognition for the value of ecological learning space is not profound. Secondly, the research and design of ecological learning space are still in the thinking and reasoning stage, and there is almost no practical application study about mode construction. There is lack of demonstrative teaching experience for reference [2]. Thirdly, ecological learning space is rarely applied in classroom teaching. There is short of ecological learning space construction for a specific subject, and students cannot start from the course for independent study. Therefore, this study started form teaching practice and constructed the ecological learning space mode meeting the requirements of Computer Image Processing based on Computer Image Processing. This study is an innovative teaching mode study. Meanwhile, the ecological learning space was applied in the practical teaching to improve teaching quality of Computer Image Processing and students' comprehensive abilities of computer image processing, and satisfy the development requirements of market and society. It is very significant for students' learning, subject teaching and social development.

2 State of the Art

The research on personal learning space was first proposed by Sutherland. He indicated that Pebble Pad could play a role between social learning system and teaching system and could be called personal learning system or personal learning space. In the report submitted by ALT (Association for Learning Technology) in 2010, the proposal of constructing learning space with rich techniques and supporting corresponding teaching method or learning method [3]. The government of Queensland holds that learning space construction can effectively promote students' learning efficiency, so it is necessary to increase input and enhance learning space construction [4]. Ken Fisher Boogu [5] carried out the research on connective teaching approach and learning specialization and proposed the research finding that learning activity is motivated and promoted by learning space. Higgs [6] applied personal learning space in ethics course, analyzed the problems in planning and implementation process and discussed the theoretical problem of network learning teaching method. The result showed that personal learning space contributes to students' understanding and mastery of ethic knowledge. In order to comprehend how play can create a unique learning space beneficial to deep learning, Kolb et al [7] put forward an experiential learning framework.

The case study showed that the learning in the learning space could facilitate deep learning in the fields of intelligence, body, spirit and morality. The domestic research on personal learning space is still in the starting stage. Zhu [8] collated the concepts and theories of personal learning space and proposed that indicated personal learning space is the bridge between personal learning environment and virtual learning environment. Zhong [9] indicated that personal learning space is learner's individualized service on network based on individual needs and national education cloud platform.

2.1 Research on computer teaching

Foreign computer teaching develops rapidly, and foreign countries pay great attention to computer teaching. American [10] computer education level is all-round, and the educational idea is all-inclusive. The education methods are flexible and open. The popularizing rate of computers is quite high. Most students can surf the internet via computers on campus, and multiple virtual universities have been established. EU formulated various computer education development plans, drove information-based teaching development and proposed multiple measures for educational information reform. Domestic scholars also attach great importance to the research on computer teaching. In recent years, domestic scholars have paid special attention to the application of computer teaching. For example, Fan et al. [11] set forth the construction scheme of computer experiment teaching platform framework based on cloud computing, and applied it in computer experiment teaching. Song [12] proposed networked hierarchical computer teaching mode based on SPOC mode and conducted secondary development of existing network teaching platforms. There are many similar studies on computer course teaching mode, such as task-driven method, project teaching method, "smart class" construction, classification, stratification and modular teaching. However, at present, although Chinese universities have many studies on the application of computer teaching, most of them focus on computer basic courses, such as Introduction to Computers and Fundamentals of Computer Culture. There are just a few studies on the application of Computer Image Processing. For the students of computer major, computer image processing is a very important skill. So, it is very necessary to study the teaching mode. Secondly, there is almost no study on the combination of ecological learning space with computer courses and especially Computer Image Processing in teaching practice. Therefore, this study innovatively starts from the perspective of ecological learning space, takes Computer Image Processing for example and provides the reference for teaching Computer Image Processing.

3 Ecological Learning Space Teaching Mode based on Investigative Study

Theoretical basis of this study is interactive theory [13]. People generate connections and collide ideologically, called interaction. In teaching, interaction refers to an interactive behavior. People generate connections and exchange. Through interactions, learners can gain the feedback of learning results and enhance cultural and so-

cial belief. Moore put forward learning interaction distance theory and indicated three interaction forms in the learning process: student-teaching content, student-teacher, and student-student. Wherein, student-teaching content is essential and the foundation of education. The interaction between students and contents will reconstruct students' cognitive schema. Sabagh indicated that the interaction between students and contents has the greatest influence on students' learning in al interaction modes. The interaction between students and teacher is the root of teaching process and also the key to making students and learning contents form effective interactions. Meanwhile, it is also an important way of improving teaching quality. The interactions between students and teacher are more and deeper, students have higher learning enthusiasm [13]. Interactive learning diagram of Computer Image Processing based on interactive learning theory and the property of Computer Image Processing is shown in Fig.1.

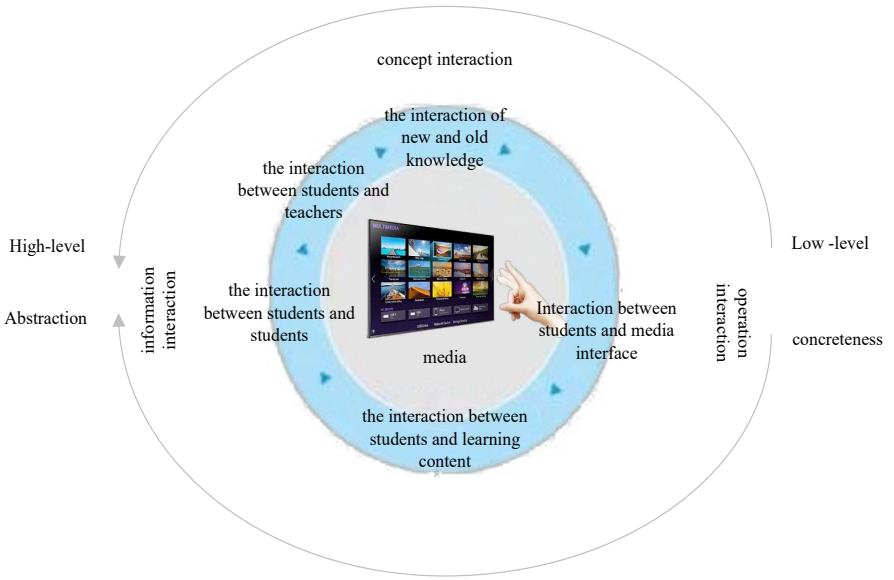

Fig. 1. Interactive learning diagram of Computer Image Processing

3.1 To specify differences between learning space and ecological learning space

Before construction of ecological learning space for Computer Image Processing, the differences between learning space and ecological learning space must be specified. Learning space contains two parts: personal network learning space with individualization which is private for every learner; public learning space which provides public service for all learners. In other words, personal learning space is ecological learning space, and also a form of learning space. The relationship between the two is shown in Fig.2.

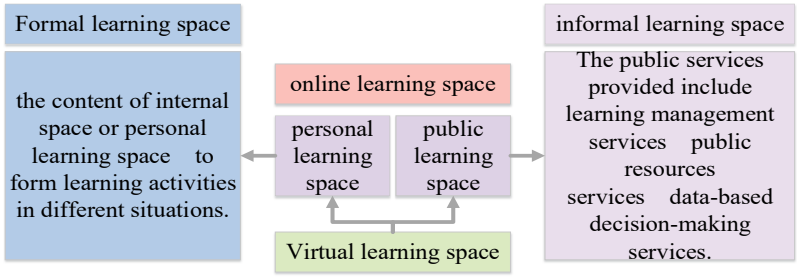

Fig. 2. Relationship between learning space and ecological learning space

3.2 To design ecological learning space

The design of ecological learning space for computer image processing mainly involves 6 steps. The design starting from the principle of ecological learning space design, combines learning activity elements of ecological learning space, specifies subjects and objects of learning activity of ecological learning space, confirms the tools used in ecological learning space, and involves labor division, cooperation and exchange to form learning community. The detailed steps are shown in Table 1.

Table 1. Design steps of ecological learning space for Computer Image Processing

Steps	Design content of ecological learning space
1. Confirm activity purpose	Set problem situation and task and understand the contradiction between subjects and the activity
2. Analyze activity objects	Confirm subjects, objects and the community as well as the relations among the three and the result
3. Analyze activity structure	Set activity content and decompose the activity into behavior and operation to make the activity proceed orderly
4. Analyze tools and rules	Confirm the supporting role of tools in the activity, specify the use roles in the activity and divide the work clearly
5. Analyze activity situation	Specify the activity situation of subjects and activity situation of the community as well as the driving function of objects
6. Analyze activity structure	Focus on interactions of each part in the activity and the interaction between the communities

3.3 System architecture of investigative study process

Investigative study means under the guidance of the teacher, students make the best of ecological learning space for resource sharing and interactive learning, and focus on learning content and theme to carry out learning activities. Teaching design and process of Computer Image Processing based on mobile technology, cloud technology, ecological learning space and interactive theory framework mainly includes 6 parts. Each part contains two aspects: explanation of key and difficult points, and practice. Course design involves three levels: before class, in class and after class. In the aspect of explanation of key and difficult points, before class, students learn the course autonomously through ecological learning space, including knowledge point

learning and video watching. The teacher tests key and difficult points, gains feedback and decides the arrangement of teaching content according to the feedback. In class, the teacher arranges the task tasks and students learn and exchange through ecological learning space. Later, the teacher answers questions. After class, students expand and extent the knowledge in ecological learning space, and the teacher discusses and summarizes the questions. In terms of work criticism and practice, before class, the teacher formulates teaching objectives according to the teaching content, and provides several works of computer image processing for students to learn and operate in ecological learning space. Students learn and practice. In class, the teacher designs teaching questions and teaching situations according to teaching objectives, organizes students to discuss and practice in ecological learning space and overall evaluates the discussion result. After class, the teacher helps students deepen and consolidate the knowledge points they cannot master in time. The framework of ecological learning space mode based on investigative study is shown in Fig.3. The application of computer image teaching software based on ecological learning space is shown in figure 4 and figure 5.

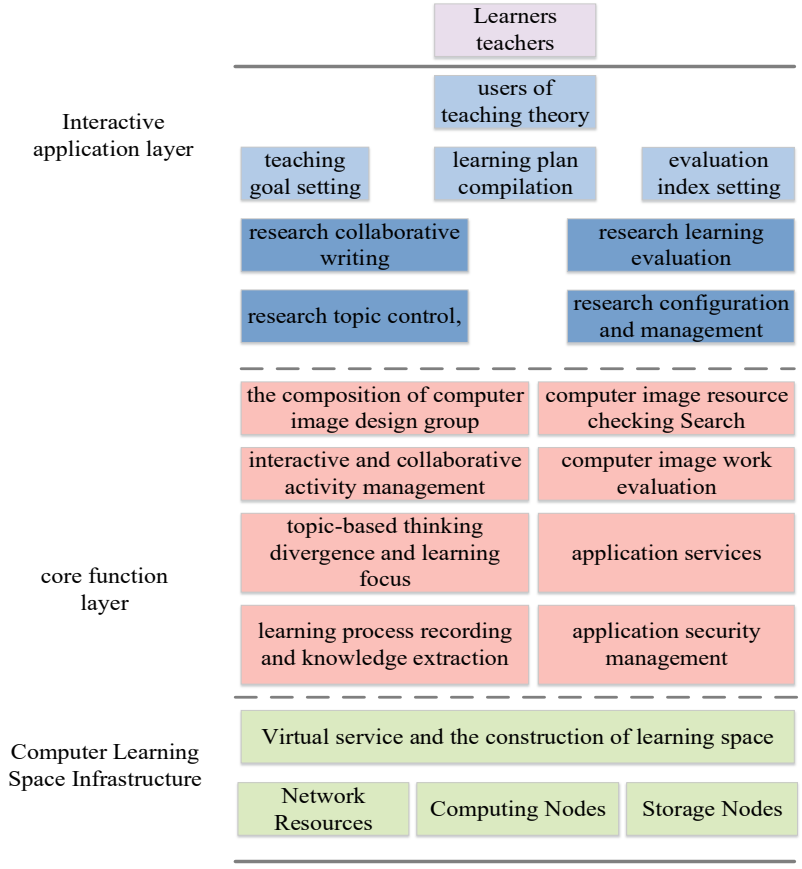

Fig. 3. Framework of ecological learning space mode based on investigative study

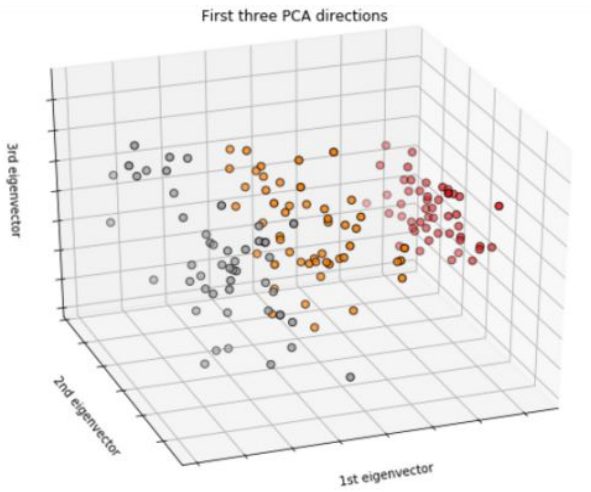

Fig. 4. Software application diagram of computer image teaching based on ecological learning space I

Fig. 5. Software application diagram of computer image teaching based on ecological learning space II

4 Teaching Example and Teaching Effect

4.1 Teaching example

The objects of this study are 40 junior students of computer major from a university, including 28 male students and 12 female students. The experimental course is Computer Image Processing. The research period is from March 2018 to July 2018. The course was taught once per week, and 2 class hours each time.

Ecological learning space design for Computer Image Processing was conducted based on investigative study and interactive learning theory. The detailed teaching process is shown in Fig.6-8.

To create the course of Computer Image Processing: The teacher needed to create the course of Computer Image Processing first in ecological learning space, select the class and students, and edit the course information such as course nature, features, objective and cultivation scheme.

To design the course content: Before each class, the teacher uploaded the learning content in the ecological learning space, such as relevant learning materials, PPT, outline and exercise, marked the key and difficult points, provided quizzes for students and received feedback.

To design course teaching process: Course teaching process includes course introduction design, course content explanation and independent study process. Course introduction should pay attention to practice to train students' operation skills and ability, combine theoretical knowledge with specific cases and apply cases to explain knowledge points. Course content explanation should mobilize students' enthusiasm, apply multimedia teaching and operate while teaching. In independent study process, the teaching content should be uploaded to the ecological learning space so that students can operate personally so as to consolidate the knowledge. Meanwhile, other similar cases should be provided so that students could draw inferences about other cases from one instance and practically improve operating skills.

To test and feedback the course: Except pre-judgment and test of students before class, the teacher should assign homework after class, specify the completion time, correct and evaluate the works of students as well as provide feedback and advice for students through ecological learning space.

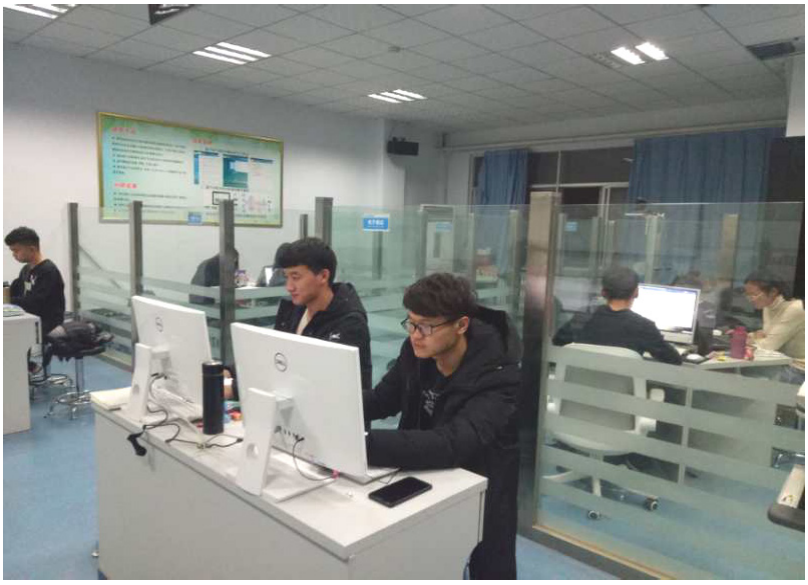

Fig. 6. Teaching process of Computer Image Processing based on ecological learning space I

Fig. 7. Teaching process of Computer Image Processing based on ecological learning space II

Fig. 8. Teaching process of Computer Image Processing based on ecological learning space III

Questionnaire survey and interview were combined to survey practical feelings of 40 students for which ecological learning space teaching mode based on investigative study was applied. The questionnaire included 10 questions and scored with 5-point scoring method of Likert scale. The students' attitudes to the teaching mode were investigated. The interview contained 3 questions to survey students' overall feelings for the course, classroom exchange feeling and the reason why they chose ecological learning space.

4.2 Teaching effect

It was found through statistical analysis of questionnaire survey results that, students accept the ecological learning space teaching mode based on investigative study, and the average score of each question is above 4.01. The average score of most questions is between 4.2 and 4.6. Students' satisfaction for "the mode can enhance class communication and cooperation" is the highest, with the average score of 4.7. The degree of recognition for "the mode can help me manage learning independently" is the lowest, with the average score of 4.01, as shown in Table 2.

Table 2. Students' attitudes to ecological learning space teaching mode based on investigative study

Question	Average sore
1.The mode is a useful tool for my study	4.41
2.The mode can enhance class communication and cooperation	4.7
3.The mode can help me seek out relevant learning resources	4.55
4.The mode can bring more learning opportunities	4.37
5.The mode can make me access course resources anytime and anywhere	4.32
6.The mode can make me receive teacher's feedback easily	4.53
7.The mode can help me exchange learning materials with classmates	4.22
8.The mode can help me manage learning independently	4.01
9.The mode can help me complete course assignments	4.44
10.The mode can help me develop learning skills	4.40

According to the interview results, when students answered the question "describe your overall feeling about Computer Image Processing under the ecological learning space teaching mode based on investigative study", it was found that students considered the mode is great, which could not just provide more before-class and after-class learning opportunities, but also help them exchange with classmates and teachers and expand their thoughts. When answering the question "whether does the ecological learning space teaching mode based on investigative study promote exchange between you and the teacher and between you and classmates?", students gave the affirmative answer and considered this mode is better than face-to-face and oral communication and discussion, because it could save opinions, provide the time for thinking, promote exchange depth and enhance exchange chance. When answering the question "what's the reason for choosing the ecological learning space teaching mode based on investigative study?" some students indicated that teacher's uploading of before-class learning materials and after-class assignment feedback could clearly provide them with the learning objectives and solve learning problems. Some indicated that the supply of exchange platform made them have more opportunities to exchange with teachers and classmates. Besides, they could learn independently and avoid awkwardness during face-to-face exchange. They are more willing to express their views and can learn the knowledge again they could not digest in time.

5 Conclusion

In this study, Computer Image Processing was chosen as the teaching case. The junior students of computer major in a university were selected as the objects of study to construct one-semester teaching practice with ecological learning space teaching mode on the basis of investigative study and under the guidance of interactive theory. Questionnaire survey and interview were combined for empirical research. The following conclusions were drawn:

- The teaching mode of ecological learning space based on investigative study should specify the differences between learning space and ecological learning space and pay attention to the design of ecological learning space and system architecture of investigative study process. On this basis, the specific course should be combined for teaching design to ensure promotion of teaching effect.
- Under the teaching mode of ecological learning space based on investigative study, Computer Image Processing teaching should focus on the interactions between students and contents, between students and teachers and between students, and pay more attention to promoting interaction effect. Interaction effectiveness is the key to improving teaching effect of Computer Image Processing.
- The teaching mode of ecological learning space based on investigative study should stress teacher's guiding role. Students' independent learning ability is still poor. In particular, the mode entirely depends on students' consciousness in before-class and after-class learning. Thus, teachers should not let them go completely, but should organize, manage and supervise them properly to maximize the role of this mode.

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7 Authors

Ping Zhu is a Lecturer in the College of Information Science and Engineering, Hebei North University, Zhangjiakuo, China. She is interested in Distance Teaching and Image Processing. (zhuping2019@126.com).

Yinan Xuan is a Lecturer in the College of Information Science and Engineering, Hebei North University, Zhangjiakuo, China. She is interested in Distance Teaching and Ideological and Political Education. (zhuping2019@126.com).

Zhe Xu is a Lecturer in the College of Information Science and Engineering, Hebei North University, Zhangjiakuo, China. She is interested in Distance Teaching and Image Processing. (zhuping2019@126.com).

Article submitted 1 November 2018. Resubmitted 3 January 2019. Final acceptance 15 January 2019. Final version published as submitted by the author.