

## Application on Pbl Teaching Model of Aalborg University in Rs Course

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**Abstract:** The AAU PBL teaching model is one of the most characteristic and influential teaching mode in the world. How to introduce this advanced teaching idea into our country and put it into practice? Based on the research and analysis AAU PBL model, the course of remote sensing software development is introduced as the object of teaching reform. In view of the deficiency in the current teaching mode, the paper discusses how to apply the PBL teaching mode to the course, and puts forward the teaching reform plan in each link of the teaching, which aims at enhancing the students' interest in learning and promoting the students' learning initiative. It will cultivate the students' learning ability and improve the teaching effect.

### 1. Introduction

It is a kind of teaching method widely used in western education circles, and its basic core idea is to take the problem as the leading, and to organize the students to learn the relevant knowledge points through solving the problem. This is an active teaching method, because of the complexity of the problem, need to solve the problem through the way of group collaboration, it is possible that the group members need to acquire a lot of interdisciplinary content and knowledge to solve the problem together.

In western education, PBL originated from the reform of medical education at Macmaster University in Canada in the 1960s, intended to organize learning through the analysis and resolution of medical cases. In the 1970s, PBL was widely used in emerging universities such as AAU, Roskilde University and Maastricht University in the Netherlands[1]. The PBL model has been applied in medicine, engineering, society and humanities. Although in different regions, different colleges and universities, different professional applications, the form of expression will be different, but there are still some common, such as looking for scientific problems, group learning, making reports, on-site defense, and so on.

Because PBL teaching mode is a student-centered active learning method, it can greatly promote and stimulate students' interest in learning, and make the teaching effect improve significantly. The most representative of these universities is AAU in Denmark, where almost all subjects are taught using the PBL model, which has formed the AAU PBL model, which has been used and extended to many engineering universities in Europe, Australia, Latin America and South America. The results of various educational studies have proved that this approach has played a positive role in developing and promoting the ability of engineering students, including in-depth independent learning ability, positive and self-directed learning ability, critical and creative thinking ability, interdisciplinary knowledge and skills, management and cooperative communication ability, engineer professional identity and social responsibility, enterprise management spirit, etc[2-3].

Different national and international educational review organizations rated the model as a model of student-centered education, while surveys from companies showed that engineering graduates

from AAU were generally well-received by their employers after work. Compared with the students trained under other teaching models, they were able to adapt quickly to the various working environments and reduce investment in continuing education and training for the enterprise as a whole, bringing a good reputation to AAU [4-5]. This paper will deeply analyze the PBL teaching model of AAU and apply it to the teaching of surveying and mapping majors.

## **2. Pbl Teaching Model at Aau**

### **2.1 The Pbl Curriculum Model**

The AAU implements the “3+2” model, the first three years are undergraduate study, the latter two years are graduate study stage, after graduation they can obtain a master's degree. Each semester, it will arrange 3 courses for students, and do one course project, each course has 5 credits, a total is 15 credits, one project has 15 credits, so, the score of a semester is 30 credits. A semester is divided into two parts, the first half is dominated by theoretical courses, the second half is mainly to do the project, the project and the course is not necessarily related. Course study is the same as normal classes in domestic universities, they need to lessons, homework, examination, etc. The purpose of course study is to promote students to have a certain knowledge system, most of them are theoretical knowledge and professional skills related to the subject of the project, doing the project is the characteristic in AAU, and it is also the biggest difference with the domestic university.

Project teaching is an inquiry learning model with students as the main body, problems as the starting point and project work as the important link to combine knowledge acquisition and knowledge application [6]. Project work is an important part of students' study in this semester. Teachers will provide a number of topics related to this term's project work. Of course, students can also freely choose topics around the subject content, according to their respective professional interests to further discuss the topic of the project.

### **2.2 Pbl Project Teaching Model At Aau**

In AAU PBL model, teaching is presented in two ways: course teaching and project teaching. The process of project work is mainly the responsibility by students themselves, the teachers help them to choose the appropriate theory and research methods, and the final project report will be evaluated in the final exam. The whole project work is usually completed in three steps: problem analysis, problem solving and written report [7].

(1) Analysis of the problem: after the classroom teaching of three courses per semester, the students have a certain amount of knowledge accumulation, and then put forward the project needs, set up a project group, through many group discussions, put forward the question. The goal is to determine the project topics through group discussion, need to carry out a large number of relevant literature reading and analysis. Teachers, students and relevant enterprise leaders were interviewed to determine the feasible topic.

(2) Problem solving: When the topic is determined, it is necessary to construct the research idea. According to the characteristics of topic, students need to master the knowledge of what subject theory, some knowledge students already have, and some need students to further study, it is possible that students will flash the spark of innovative thinking. Through the division of labor within the group, everyone need solve a part of the problem, and then combined together, furthermore, the group need to discuss and communicate in time, the content of the division would be linked logically. The role of teachers is to guide students and give groups the right direction and methods. In this stage, students mainly carry out course study, research and hands-on practice, and it is also the process for students to obtain professional knowledge and professional skills to the maximum extent.

(3) Project report: When the main R & D process of the project is over, each team needs to submit a project report, mainly including the research ideas, the specific research methods, the detailed problem solving process, and finally the conclusion. This stage is mainly for students to

summarize the acquired knowledge, meanwhile, it can train students to apply office software skillfully.

The problem-centered group project learning determines that this kind of curriculum mode should break the traditional discipline boundary, produce the discipline intersection, combine the subject teaching closely with the interdisciplinary project teaching, train the students' ability of autonomous learning and constructing knowledge through the project work, and form the curriculum mode of mutual cooperation and complementary to each other.

### **2.3 Pbl Evaluation Model At Aau**

The examination of subject course is usually carried out at the end of the semester by the traditional written test. The total score will be determined by the examination of project course and work, but the result is the premise of whether the total score is qualified or not. At the end of semester, there are usually two out-of-school examiners in the group evaluation examination, one is from the professional field of business, and the other is from the related field of other universities. The focus on the examination is to evaluate the project work. The project team needs to submit a project report (50 to 150 pages) within one to two weeks before the exam. During the examination, the project team first makes a statement, each student separately states a part, undertakes the whole project report work together. Each team member then responds to his/her project report. Finally, the teacher would do the overall evaluation of the project.

### **2.4 Characteristics of Pbl in Aau**

(1) Problem-oriented. The definition of a problem is to identify and experience a problem that exists specifically in society. From the analysis of learning process, PBL takes the problem as the starting point of students' learning, and explores, analyzes and solves the problem through the whole process of learning [8].

(2) Project as an organizational form. The definition of project is a series of comprehensive and complex processes, which need to analyze the problems to be solved, and make management plans, etc. The questions that need to be addressed should be new questions that have yet to be answered, requiring resources from different traditional organizations and knowledge systems, taking into account the changing processes of environment, organization, human knowledge categories and attitudes, as well as pre-established time frames.

(3) Interdisciplinary. Solving problems with varying degrees of unknownness means that the required categories of knowledge span traditional discipline boundaries, and their complexity means that project work usually requires collaboration. Interdisciplinary knowledge integration is not acquired by students through direct learning, but is gradually mastered in the process of students analyzing and solving problems. Of course, interdisciplinary learning is not about learning static "interdisciplinary" knowledge, but rather a practical problem-solving process. The AAU deepens interdisciplinary ideas into all aspects of curriculum and teaching design, and students gradually apply multidisciplinary knowledge to analyze and solve specific problems in production or life, thus effectively realizing interdisciplinary integration [1].

(4) Social learning. Students carry out various learning activities around problem-based projects, through presentation, discussion and rebuttal, the students' logical thinking and language expression ability have been effectively improved. In group learning, students should assign tasks, manage groups, build work contracts, and thus coordinate each other's actions around a common goal, which can not only exercise students' participation in learning activities, enhance learning enthusiasm, and also cultivate students' learning team management and team awareness. In addition, the study group simulates the actual work situation, which can more reflect the principle of authenticity of combining theory with practice [9-12].

### 3. Teaching Reform Design of Pbl Teaching Model for Rs Software Development

#### 3.1 Course Introduction

RS software development course is a required course for RS major, mainly opened in the second half of the third year, it is 64 hours, the theory teaching is 32 hours, the computer practice teaching is 32 hours, and theory is the same as practice. In order to cultivate students' ability of hands-on programming, they would be usually arranged some after-class programming assignments, which require more practical classes in their spare time. In addition, every month or so will assign a separate big homework, requiring students to complete independently, in order to enhance interest in learning, the big homework will be more or less added to some personal information, it will promote the enthusiasm of students to learn, at the same time, can avoid the situation of copying homework.

In general, classroom teaching is mainly taught, and the students are in the passive acceptance position in this situation. By telling the syntax of IDL language, the use of arrays, the input and output of basic graphics, direct graphics and object graphics, and so on, the corresponding programming exercises are assigned at the end of each chapter. After teaching the IDL visualization components, it will arrange the programming about the component visualization, it requests completes independently, then, gradually adds to the image input and output, the image processing function module etc. After the course teaching is finished, the final exam is carried out. In this process, students' learning is in a passive position, the purpose is to pass the examination, which has little effect on improving their own programming ability, and lack of specific application.

#### 3.2 Reform of Teaching Methods

At present, the shortcomings of the traditional curriculum teaching: students in passive learning, lack of enthusiasm and enthusiasm; out of touch with practical teaching, poor application ability; curriculum assessment is more cumbersome and unreasonable. In view of these deficiencies, under the mode of PBL teaching at the AAU, the teaching method of this course is reformed, and the teaching will revolve around the basic problem, that is, "why to learn, how to learn, what to learn, how to use ". The textbook, "IDL program design-data visualization and ENVI secondary development ", was compiled by Dong yanqing, will be selected. The contents and teaching methods of 64 hours are shown in Table 1.

Table 1 Course Reform Of Rs Software Development

Hours	Question	Content	Methods	Instructions
4	why to learn	The relationship between curriculum and specialty; the concrete application of curriculum. Guiding students to ask questions	PPTlecture+discuss,Video Display	Student participation
4	how to learn	Characteristics of RS Software Development Courses AAU PBL mode Organize PBL group	PPTlecture+discuss,Video Display	Organize PBL group by students volunteer group, 3-4 persons/group
24	what to learn	(1)Basic grammar (2)Graphic image input and output (3) IDL components (4) Graphic Image Processing (5).....	PPTlecture+discuss,Video Display(Student participation in the teaching process)	Students switch from passive learning to active learning
16	How to do it	Computer Practice	Gourp discuss, Live presentation,Answering	Students focus on active learning
16	how to use	Research and Development of RS Graphics and Image Processing Experiment System (Project Teaching), Computer Practice.	Focus on question, Group learning	Take the RS image processing in any format as the topic, broaden the field of vision.

Around the above curriculum learning settings, the specific discussion are following.

Why to learn, this question is mainly to guide students to understand the importance of course,

and the status of the course in the whole professional course. After learning the course, what kind of work students can do to help their own growth by mastering the theory and methods? Through slices presentation, examples are given to develop professional image processing system software by using IDL language, such as software processing system for meteorological satellite images, 3D geological data visualization software system for SpaDis™ software package, chip defect detection visualization software system, Galileo navigation system analysis software (GSSF), medical image processing software, etc. From the above examples, we can find the importance of IDL in the development of RS image processing software, which is very helpful to stimulate students' interest in learning, according to their own characteristics and the issues of interest in daily life, such as how to extract numbers, letters or Chinese characters from license plate pictures, how to identify and extract someone's fingerprint data from fingerprint images, etc., those are related to the students' professional study and daily life. It is not only to lay the foundation for the study of the course, but also to provide reference for the following group project topics.

Based on the detailed explanation of the PBL model in AAU, combining the characteristics of the course, let the students know how to learn. First of all, introduce to the students the main features of the RS software development course, such as, IDL integrated rich data input and output, good at processing array and vector data (graphic image data), with advanced image processing ability, rapid mapping and 2D&3D visualization, etc. In addition, the AAU PBL model is briefly introduced, the main contents are: characteristics, operation mechanism and advantages of PBL. At the same time, it is possible to broadcast publicly released PBL instructional videos from the AAU, giving students an intuitive sense about the essence of PBL. Then, I will tentatively interact with students to guide them to form a 4-5-person PBL learning group based on their own questions and research interests. For example, when several students are interested in interpreting radar data, they are able to form a small group in which men and women can match each other as much as possible, according to their own characteristics, work together to solve problems and complete the post-project production.

Students to take the initiative to learn are the goal, it mainly reflects in what to learn. In the above context, students carry out their study in a group learning manner with established questions. Give full play to the enthusiasm and initiative of students, guide students to change their roles, teachers are responsible for guiding and answering questions, reasonably split tasks and division of labor. For example, after getting the Landsat8 images data, use IDL to write the image file reading function, write the band operation function, calculate the band in the image file, obtain the NDVI and so on, then visualize the calculation result into the graph display. This process not only reviews the abstract content of the previous RS principles, but also enables students to deepen their understanding and mastery of existing knowledge through programming practice. The results of different band operations are different, which can easily enhance students' interest in learning. In this teaching process, the teacher can let each group prepare the PPT for the report. Of course, the reporter needs the teacher to randomly select at least 2 people on the spot, the main purpose is to let all the students understand the flow of the whole group project to prevent making a profit in troubled situation, and the lazy students do not work hard. After the report PPT is finished, expand the questions and interaction between groups. Teachers mainly act as judges, responsible for asking questions about the student's project, courseware, report, and feedback and evaluation, will also ask questions or answer some difficult questions.

When the theoretical study reached a certain hours, the students basically mastered the grammar of IDL, the input and output of graphics and image files and the display. However, the content is not linked together, how to integrate the application of these knowledge, that is, how to use, when the interpretation is on a certain aspect of RS image, it can form a group project, which requires the students themselves to ask questions, group analysis problems, solve problems, develop the experimental system, write the group project report and PPT, and conduct the final report demonstration. This process needs to follow the principle of easy first and then difficult, and advance steadily.

### 3.3 Reform of Assessment Methods

The course examination mainly includes the process and the report defense examination, the process examination is composed of the theory teaching and the practice teaching examination, the theory teaching examination method is the close-book examination, which will carry on the examination to the grammar, the condition sentence, the program reading and writing as well as the algorithm writing. Practice teaching assessment includes project report and defense, each accounting for 20% of the total score. The purpose of the investigation is students' performance in the whole process of project making, and pay more attention to their logical thinking and oral expression ability.

General evaluation (100%) = attendance & homework (20%) +project report (20%)+ defense (20%) +exam ( 40%).

### 4. Educational Reform Analysis

It is not difficult to find that there are many advantages in this kind of teaching method:

(1) The group project has its own choice of topics, it cannot be repeated, the teacher is responsible for checking whether the appropriate or not, once the choice of topics is determined, the students' learning goals are clear, driven by interest, learning is more active;(2) the group task division is clear, the lack of a certain link will lead to the whole project cannot be carried out, so everyone has a sense of responsibility to drive them to communicate with the other members of the group in time to ensure that the whole project goes smoothly. (3) The whole process of the project can exercise students' ability of self-study and speech expression, and also drive them to apply professional software and office software better. (4) During the group cooperation, students need to communicate with each other many times, so it is easy to accept and master a lot of theoretical knowledge. (5) The system of group questioning and evaluation can broaden students' horizons on the one hand and promote students' mutual support and common progress on the other, thus lay the foundation for moving to society.

At the beginning, in order to cultivate their enthusiasm and self-confidence, we can select some relatively simple experiments to do, such as building a framework for the whole experimental system, beautifying the whole page structure, trying to read the common graphic files, reading a picture or personal image of their favorite, and showing in the experimental system to enhance their interest. If a group chooses a satellite image as a data source to extract and interpret, when the problem is clear, they need to consult and collect the relevant literature, understand what kind of information the image contains, what information is useful to them and what is not needed, then write the function to read&write image file and store the results in their own defined array, structure or linked list for further study. Of course, it can also be compared with the common professional software, on the related functions of simulation experiments, until a certain image interpretation function of the experimental system finished. Then, make the report PPT, report the presentation and make a live demonstration of the system.

After having certain programming practice ability, on the basis of the initial completion of the experimental system, gradually add some more complex functions, let the students to explore the practice. For example, you can binarize graphics or images, extract histograms, interpolation operations, open operations, closed operations, image watershed detection, edge detection and other functions. In any case, students should complete the construction and development of the whole experimental system in the form of groups, so that every student can be familiar with the process of making this project, and divide the work to do and write the experimental report. During the reporting period, each group must be on stage to report, the reporting person on the spot would be random selected, and other groups can ask questions at any time. Teachers ask questions about each group project, and finally make overall evaluation, summary, feedback. The specific summary analysis is shown in Fig 2, and the outer large circle is the main role that guides the teacher in the whole PBL model.

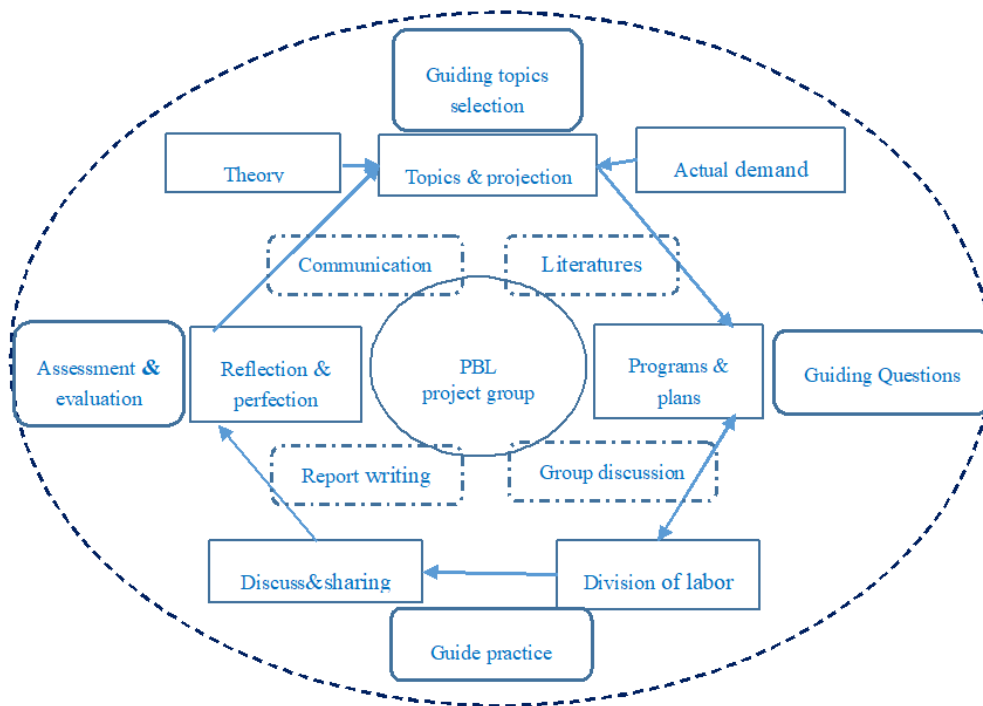


Fig.1 Pbl Model

## 5. Conclusion

Introducing the AAU PBL model in the RS software development course teaching, emphasizing the practical ability of the students. At the same time, problem-oriented is beneficial to stimulate their interest in learning. The model of group learning can promote them to enhance their personal programming ability and teamwork ability. In the process of project report writing, they can exercise their skilled procedures of using common office software and strengthen their communication skills. In the process of project defense, they can improve their language expression ability in public, as well as the logical thinking reflection and judgment ability when answering questions. To some extent, this teaching mode can achieve good teaching results. However, the following key points are needed for concrete implementation:

(1) Teachers should change their role many times in the whole teaching process, especially in the process of group project practice, the initiative of learning should be handed over to the students, let the students discuss independently, play their imagination freely, and give encouragement as long as they are reasonable. (2) During the implementation of the group project, it is necessary to step by step, not to suppress students' enthusiasm for learning, and teacher should give full guidance. (3) Throughout the teaching process, students should pay more attention to enjoying the learning process of the group, not to make excessive demands, or to focus only on the final experimental results, so that students will not have too much ideological pressure, and give encouragement and support to some novel ideas. (4) AAU PBL should be introduced in combination with the actual teaching situation in China, which can add some links or cancel some links, or may be more suitable for some courses, especially in engineering, which is used in almost all engineering courses at the AAU, while further exploration of other subjects, such as liberal arts, is under way. (5) The assessment of the course may also be changed flexibly, and the content of the assessment may be revised according to the actual situation.

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