Active Learning Experiences by Learning with “Buildings Around" Program

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ABSTRACT

For Civil engineering students, during the general learning in school, they can seldom meet opportunities to participate in the construction of whole projects in the real process. To make a situation for design ability according to Standards 5、6 and 8 in CDIO, the traditional engineering laboratory was moved to the campus in a program named "Learning with Buildings Around" in a course "Architectural Design and Construction" for Civil Engineering in Shantou University. The buildings in campus such as Library, teaching buildings, dormitory have been the Learning objects. Students explored these existing buildings on their space, function, composition, materials and constructing. The exploration practices constitute the students understanding of the buildings and stimulate students desire to create new buildings. This paper focuses on introducing the implementation of the program. Also a discussion on teachers' guide work and the learning outcomes are included as well as some improvement suggestions to active and experiential learning for the course.

KEYWORDS
Civil Engineering, Active Learning Experiences, Buildings Around, Learning-Outcomes, Standards: 5, 6, 8

1. Origin and Motivation for Changes

CDIO Approach proposes to take students as the center, and let them study independently and practice actively, from the beginning of conceptual design in the conceptual phase, through product design and implementation, thus acquiring the knowledge of science and technology of application engineering and the ability to design and make products and systems. It makes requests on the environment in engineering learning. According to Standard 6 in CDIO, the learning environment should also include practice spaces apart from traditional classroom, seminar room and laboratory.

All the time, because of the strong economic and technological limitations on real construction activities in school, practice spaces for civil engineering majors are generally enterprises out of school. For those students majoring in civil engineering, in their learning process of only four years, even if they take one year to practice in design and construction units in the society, it is still difficult for them to participate in a relatively complete process of an actual project. It is not ideal for the cultivation of students' abilities.

Architectural design and building technology are relatively special disciplines for civil engineering majors, which focus on the knowledge and experience of human constructing sites all the time. What is interesting is that the process of imparting knowledge and experience also needs to be performed in a site that has been built. If the real construction experience of this site can be included in the learning process, does it serve as the practice to some extent? If the knowledge can be directly applied to the design of this site, does this kind of practice also have the significance of learning?

In the course Architectural Construction in the Department of Civil Engineering in Shantou University, a plan called "Exploration on Campus Buildings Around" is set, which, in essence, is to move the traditional laboratory to the campus according to Standard 5 and Standard 6 in CDIO. The existing buildings in the campus such as library, teaching building, and dormitory are all objects for students to learn. Students can learn knowledge and improve their abilities through completing the explorations on the space, function, composition, materials and constructing of these buildings.

2. The Space for learning and the learning in space

2.1 Pay attention to the experience of students for buildings and sites

Today, the working mode of architects has been highly stylized, such as designing with drawing software, completing a large-scale construction project in a short time, using concrete or steel structure, combined with complete sets of techniques such as surface building techniques including building blocks, external thermal insulation, coating, clevis and curtain walls and so on. These gradually place architects in the virtual reality while they are absent from building entities and sites in reality.

The learning process of students in school also has this tendency. Through Internet and mobile devices, students can easily acquire knowledge and information; therefore they do not need to contact real sites. When students are learning at school, they tend to be blind to

the architectural phenomena around them, hence losing opportunities to think by themselves. However, it is hard to acquire the experience in building sites and constructions by simply drawing or reading after all and they themselves need to be on the spot.

Thus, the "Exploration on Campus Buildings Around" program set in the course Architectural Construction provides students with an opportunity to personally know sites, learn selection and use of materials, construction ways, and node connection and analyze the logic and implementation process behind the form.

2.2 The "Exploration on Campus Buildings Around" program

Campus buildings can be described as good and inexpensive practice spaces. The "Exploration on Campus Buildings Around" program is that students should choose a campus building in Shantou University; they should aim at specific components detailed methods and so on as required by the assignment book, then carry out observing, recording, plotting, calculating and other work and then summarize the construction principles behind the construction methods by themselves.

Eight exploration points are set in this plan and they are the layout of the campus building, the planar graph of ground floor of the building, the wall structure of the building, the ground layer structure of the building, the design and structure of the stairs, the form and structure of the roof, the location and structure of the deformation joint, doors and windows and shading of the building. Students should observe, analyze and summarize each exploration point according to the "Exploration Points Guidance". Table 1 below is the task arrangement for the first exploration point. Figure 1 for students completing exploration tasks in the campus.

Table 1 Guidance for the first exploration point

Exploration point guidance 1—layout of the campus building		
Observation	**Analysis**	**Summary**
1. the position and site area of the building in the campus	1. What decides the scale of the campus building?	What characteristics should an excellent campus building have?
2. Campus geographical	2. What decides the functions of the campus building?	

information system of the building		
3. Building type of the campus building	3. How many exits and entrances at least are there in one building usually? And what is the suitable distance between one and another?	
4. Connection between the building and roads	4. What are the differences in the colours of buildings of Shantou University compared with other colleges in Guangdong? And do you like them? Why?	
5.The relationship between the building and the environment	5. Basic information of the environment around the set of campus buildings you choose to explore	
Outcomes specification Aiming at this exploration point, submit a learning report and the content should include observation, analysis and summary. And the observation part should include at least 5 real scene photos and 2 freehand schematic diagrams; in the analysis part, texts and diagrams should be used to answer the corresponding questions; and the summary part should be verbal expression of the understanding of the construction principles.		

Figure 1 Students completing exploration tasks on campus

2.3 Implementation strategies

2.3.1 Promote students to think actively

According to the traditional teaching methods, students mainly learn through receiving the knowledge about building construction explained by the teacher in class. Although the teacher utilizes multimedia, network resources and so on to increase the vitality of classroom teaching, the result isn't very ideal. The most typical outcome is that although students can understand teaching content more easily by "listening", they still can't connect the knowledge with the reality very well and apply it flexibly. If students' habit of being satisfied with just "accepting the knowledge without question" is not changed, the practice will also descend to the superficiality like a visit and can't take effect. The expected goal can be realized only when students are in the activity of "using their brains to think". In this activity, students must get encouragement and help to develop their ability to deeply understand concepts and their skills in solving problems and thinking deeply. Therefore, several questions are raised for each exploration task. Being unable to directly obtain the answers from the Internet, students will be promoted to think actively by themselves and get the answers according to the building.

2.3.2 The teacher should provide timely feedback.

It is inevitable that the students' own thinking is incomplete or wrong, the teacher must give timely feedback and correction. Upon completion of each task, the teacher must read over and give marks on the report submitted by the students, and point out the problems and timely feedback it to the students.

2.3.3 Assessment based on the leaning-outcomes

This course defines the *leaning-outcomes* in accordance with CDIO syllabus, the main knowledge that the students should master and the main capabilities that the students should have are:

- Mastering and using the basic principles of building construction;
- Mastering the specifications related to architectural design;
- Correctly understanding sustainable development and forming their own view of environment;
- The basic capability of doing architectural design;
- Capability of critical thinking
- Capability of teamwork and cooperation;

The "Exploration on Campus Buildings Around" program mainly undertakes "mastering basic principles of building construction, and the cultivation of students' capability of critical thinking and teamwork and cooperation", especially the cultivation of "the capability of critical thinking". According to CDIO syllabus, the teacher clearly states and assesses the observation points, basis and standard of various capabilities so that quantitative rating can be carried out. Of course, considering the difference of talent and growing environment of the students, it is impossible for us to determine the uniform height of various capabilities and we only use "achievement scale" to judge whether the students have achieved our expected goal. Table 2 is the evaluation form aiming at "Capability of Critical Thinking".

Table 2 Evaluation Form of "Capability of Critical Thinking"

Expected Learning Outcomes		Task, Process and Observation of Learning		Evaluation of Actual Learning Outcomes
Expected Learning Outcomes (Level)	Characteristics of Detailed Expected Learning Outcomes	Learning Task	Observation Points	Achievement Scale
Have the Capability of Critical Thinking (L2)	➢ Analyzing the problems concerning construction in existing buildings; ➢ Choosing logical argument and solution; ➢ Assessing the supporting evidences; ➢ Verifying the hypothesis and conclusion;	Exploration on Campus Buildings Around	➢ Completing the exploration task and submitting the report; ➢ Putting forward their own points of view aiming at the existing building phenomenon; ➢ Finding out the theory and examples to expound and prove; ➢ Concluding construction principles;	

3. Thoughts and Advices

Having implemented the "Exploration on Campus Buildings Around" program, the students generally respond that they have gained a lot from it; and they have a more profound

understanding of buildings and they yearn for participating in the design and construction of new buildings instead of being diffident like they were before.

The key factor to this successful change is the utilization of university resources and developing the practice site that complies with the teaching demands according to the course features-campus building. Of course, with the continuously accumulated teaching experiences, the campus buildings integrating the outstanding construction engineering experiences of predecessors can also be conferred upon more teaching meanings, and more students can comprehend the quintessence of engineering in the course of experiencing "pursuing what the predecessors were pursuing".

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