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A Blended PBL Semester for Local Ordinary Universities in China

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Abstract

In this paper, the current problems related with teaching and learning in application-oriented local universities in China were firstly analysed. More understanding about PBL model at Aalborg University was constructed from the essence of a learner's learning process (Kolb's learning cycle), based on which four elements that could have strong effects on students' learning motivation and competence in team work were obtained, i.e., problems as trigger of learning, team in a project facilitating peer learning, assessment constructively aligned with intended learning outcomes and teaching method to be the driving source of the learning, teaching method/learning activities as activator for learning. Next, a concept of "blended semester" was proposed according to the real situations of local ordinary universities in China, breaking the invisible walls among different majors and providing a lot of opportunities for students' interdisciplinary learning. Students' lecture load is obviously alleviated and students from different majors or disciplines are encouraged to form studying groups to choose projects and course packages according to different engineering application themes. The external teachers are also encouraged to do supervision in teams for many internal teachers do not have sufficient engineering practice before being teachers in most local universities that hinders the individual supervision; Then, to facilitate the "blended semester" for effectively interdisciplinary PBL, a platform involving students, internal and external supervisors, university administrators, enterprises, governments was needed, in which a CH4 model explaining the student-centred learning was proposed as well. Through survey from students and teachers in universities, graduates, the blended semester with support from the platform with excitation mechanism is of promising practicability for better promotion of students' learning motivation, skills in applying theory into practice and competences of good team.

Keywords

Blended Semester; PBL; Interdisciplinary Learning; Platform for Practice.

1. Introduction

According to the online statistics from Ministry of Education of China, the number of institutions of higher education reached 3074 in 2023, among which 1242 for undergraduate education, and the number of students for higher education was 47.63 million. Different from academic-type universities, many local universities/colleges started to regard themselves as application-oriented, expecting more qualified graduates especially in Engineering with ability to smartly apply theory into practice and do collaborative work to finish a shared project within specific deadline.

Much progress in teaching reform has been made in the past several years. However, there are currently some problems remained in locally provincial universities in China. In this paper, the remained problems in teaching and learning are firstly analyzed. Then some reflections on the

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relationship between PBL and Kolb's learning cycle [1-2] are shared, demonstrating how PBL is in accordance with human's learning natural law and greatly promote learning reflection and motivation. Based on the inspiration by PBL especially in Aalborg University, a concept of blended semester is proposed for helping improve the engineering education under current situations of local universities in China.

2. Learning and Teaching Problems in Local Universities in China

The remained problems with teaching and learning in locally ordinary universities in China are mapped in Fig.1. Many students come to classes often for scores and the requirements from special counselors. The much lower attendance rate showes from semester 6 especially in semester 7. Some students do learning-irrelevant things during classes, like reading novels, napping, playing games on smart phones, etc. Many students are not willing to answer questions and have more difficulties in defining and proposing questions. Before and after class, it's hard for such students to do self-learning with homework often submitted with high similarity. Most students wish teachers to specify the key points of the exam and put almost the whole attention on passing the written exam. Even for those students pursuing high scores, they are found with weak integrating skills during the graduation thesis, even not familiar with common functions of software like Office and CAD which they have already learned in the past, and not aware of time management. From graduates' feedback, it is also hard for them to use the theories and principles when facing real engineering problems in their first job and therefore many graduates think most of what they learned in universities is seldom useful.

Based on the above phenomenon reflecting learning behaviors in many local universities in part of China, some realistic analysis was made as follows. Two key problems were extracted, i.e., low learning motivation and lack of team spirit, which explained why students show negative/passive/strategic learning [3], fragmented-knowledge learning, and why they are not good at presentations, discussion, and team work. Further analysis for the two key problems were then carried out. Firstly, local ordinary universities enroll students many of which do not have good learning habit or method in high schools by the screening of National College Entrance Examination (NCEE) in China. Although it is true that universities and teachers have responsibilities to help them become better after entering universities and the above key problems cannot be easily attributed to what students are. More reflection should be done from the perspectives of teachers, universities, local education environment. Quite a few teachers still care too much on their one-way teaching rather than students' real learning situation. The current curriculum with unaligned assessment, ILOs and teaching method hardly meets the intrinsic demand for engineering education. Students have nearly 60 (even 80) courses in 7 semesters with rarely practical project training. Teachers seldom promote students to reflect the relationship among different courses. Separate course design and graduation thesis seldom allow students to do group work. Besides, deviating from ILOs, written exam remains the predominant way to assess the learning. The current measures regarding the teaching reform can only improve the learning in a superficial level and play no essentially effective role in helping students.

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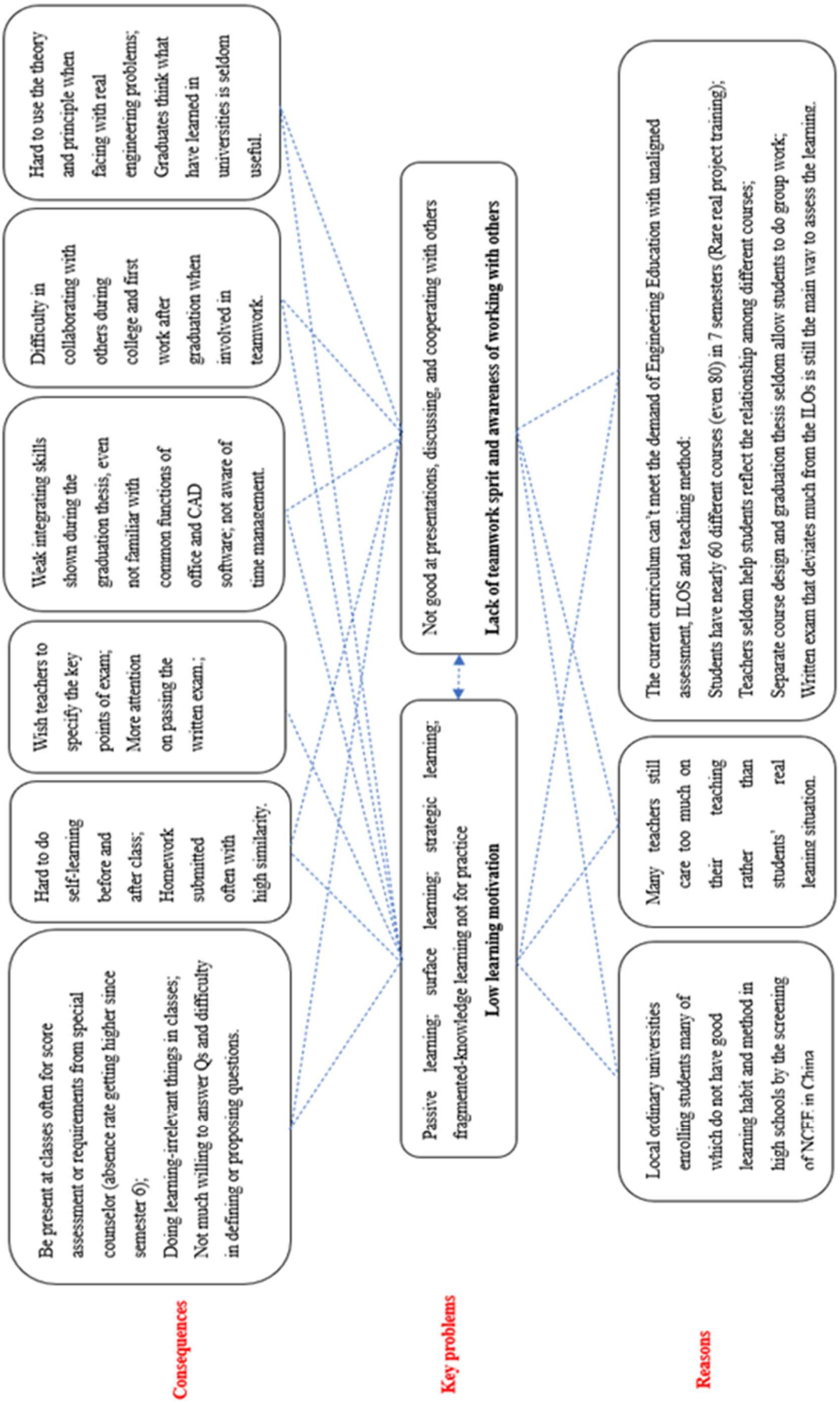

Fig. 1 The current teaching and learning problems in some local ordinary universities in part of China

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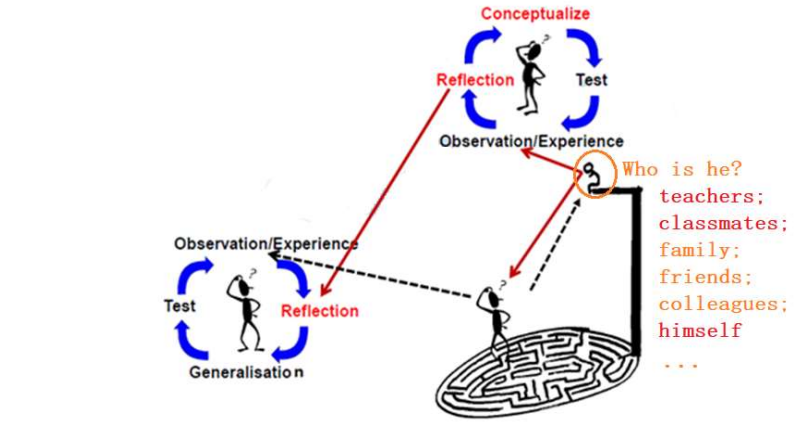
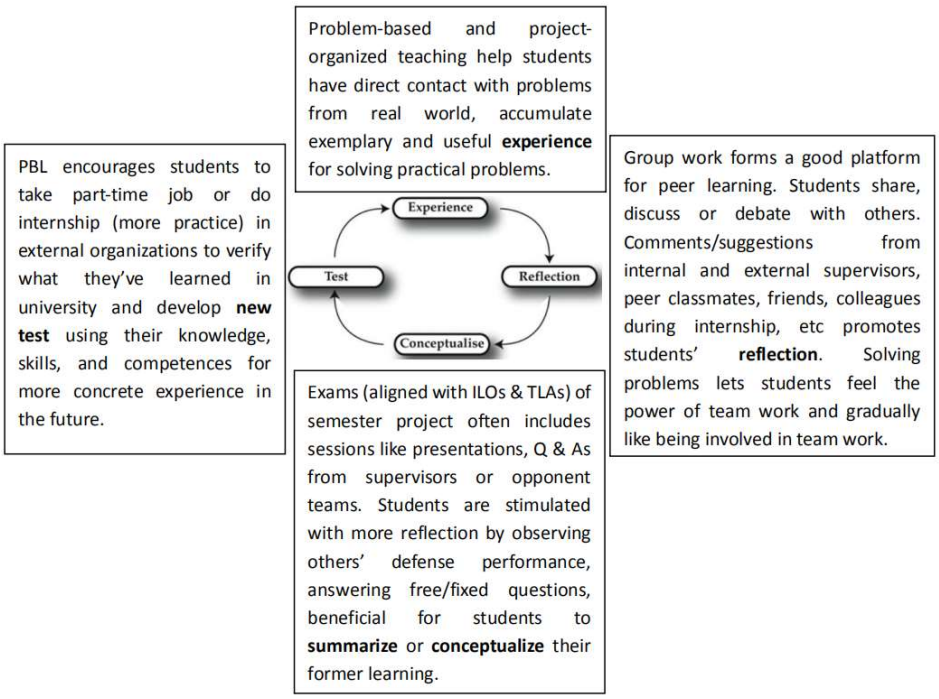
3. Reflection on the Relationship between PBL and Kolb's Learning Cycle

Through literatures reading on problem-based and project-organized learning mode (PBL) [4-7], combined with practical observation and real attendance in PBL at Aalborg University in 2018, PBL has the greatest and promising possibility to solve the above problems of teaching and learning because PBL follows the intrinsic feature of the learning process and respects the learners' natural learning law, consistent with meta learning.



(a)



(b)

Fig. 2 PBL model in association with Kolb's learning cycle

Some reflections on the relationship between PBL and Kolb's typical learning cycle are demonstrated in Fig.2. In Fig.2(a), there is a man down in the maze and another man up on the pole. Two Kolb's learning cycles are shown for each man, implying that the two men could meanwhile be learners. The second man sitting on top can easily observe how the first man behaves like a learner struggling in many difficulties and confusion in the learning maze. Who could the second man then be? He could be the learner's teachers, classmates, peers, family members, colleagues, friends and even himself from whose observations, suggestions,

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supervisions the leaner can do more reflection and generalization and finally go out of the maze and complete the ILOs. Here, the second man could be the learner himself for sometimes the leaner may obtain improvements when he jumps out of his old thinking way. By observing the first man and providing suggestions, the second man also obtains more experience and more reflection in his own learning. So, a man could be a learner and a teacher as well, which makes sense for "The best learning is teaching". That's why teachers should not regard themselves as the dominator in students' learning and make one-way teaching. In the Kolb's learning cycle, the reflection is the most important step for its significant fluence on the conceptualization/generalization and then the behaviours in the new test for forming new experience.

Since the second man who is so important for the learners' reflection in the learning cycle could be teachers, classmates, peers, family members, colleagues, friends and even himself, the reason why PBL can efficiently improve the learning situation in universities especially aiming for engineering applications is explained in Fig.2(b). Problem-based and project-organized learning help students have direct contact with problems from real world, accumulate exemplary and useful experience for solving practical problems. Group work forms a good platform for peer learning. Students share, discuss or debate with others while keeping frequent touch with supervisors from whom they timely get comments or suggestions. Peer learning in collaboration and supervisor's comments/suggestions promotes students' reflection. Solving problems together lets students feel the power of group work and gradually like being involved in teams. Examinations for both courses and projects require teachers to make alignments among assessments, ILOs and TLAs[8-9].

For the project, the assessment often includes sessions like presentations, Q & As from supervisors or opponent student teams. Students are encouraged to answer free or certain questions, and observe others' defence performance, beneficial for them to reflect, summarize or conceptualize more and deeper about their former learning. Students take part-time jobs or do internship in external organizations to verify and utilize what they've learned in universities, and develop new tests by using their knowledge, skills, and competences for more concrete experience in the future. Besides, teaching portfolios also help teachers reflect more for better teaching activities. According to the above analysis, the PBL mode is promoting the learning reflection to the greatest extent from classmates (peers), teachers, colleagues and friends in the internship and social activity, and himself as well. The assessment is for the learning not of the existed learning. The projects for the whole semester and courses with active teaching has close relevance with real world, which is of great help to provide students with many opportunities to put theory into practice and internally enhance their confidence in learning and future career while accumulating more and more practical experience.

4. Blended Semester" for Local Universities in China

The local ordinary universities in China are usually financially supported by provincial government without highly competitive faculty and students due to the academical level, city locations, low popularity, etc. The university administrators currently welcome theoretical teaching reform investigation but too conservative for large changes in the university level. So, at present, applying PBL in the university level involving the whole 8 semesters is of small chance in short time due to too much challenges for the administrators and teachers. According to this specific situation in local universities in China, a blended semester applying PBL in engineering education maybe a breakthrough way for universities. Once the effect of the blended semester is encouraged, it will be beneficial for greater and wider promotion of PBL in the future.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202408_7(8).0046

Table 1. An example of course arrangement for a semester in local universities in China

Work day	Mon.	Tues.	Wed.	Thur.	Fri.	EXAM WEEK	Mon.	Tues.	Wed.	Thur.	Fri.	EXAM WEEK
Classes 1-2	Course 1	Course 2	Course 3	Course 4	Course 1		Course 5	/	Course 6	/	Course 7	
Classes 3-4	Course 3	/	Course 1	/	Course 2		Course 6	Course 8	Course 7	Course 5	Course 6	
Classes 5-6	Course 2	Course 4	/	/	Course 3		Course 7	Course 5	/	/	Course 8	
Classes 7-8	Course 4	/	Course 2	/	Course 4		/	/	Course 8	/	/	
Semester	First half semester						Second half semester					

Table 2. An example of course arrangement in a blended semester applying PBL

Work day	Mon.	Tues.	Wed.	Thur.	Fri.	Mon.	Tues.	Wed.	Thur.	Fri.	No Courses or course exam
Classes 1-2	Course 1	Course 2	Course 3	Course 2	Course 3	Course 4	/	Course 4	/	Course 4	
Classes 3-4											
Classes 5-6	Joint-project for semester				Status seminar	Joint-project for semester					Exam for joint-project
Classes 7-8											
Semester	First half semester					Second half semester					

There are normally 8 semesters for undergraduate education. Taking the school of mechanical and energy engineering in our university for example, in semester 1 and 2, students are provided with public courses like all kinds of levels of math and English. In semester 3 and 4, students begin to have some basic courses like mechanical theory, engineering mechanics, CAD, etc. From semester 5 to 7, professional courses will be provided. No courses are arranged for semester 8 but individual graduation thesis. Different from universities in Europe and other countries, universities in China have much focus on the employment rate before graduation. Therefore, students have their attention diverted from semester 6 because the students are busy and anxious to either prepare the Unified National Graduate Entrance Examination or start to directly hunt for jobs. Under this circumstance, semester 5 could be selected as the pilot blended semester.

Students currently must finish nearly 60 courses in 7 semesters, and the heavy lecture load takes most of their learning time in university. There are no courses teaching students methodology in science and engineering or how to do group work. In this blended semester shown in Fig.3, students from different majors or disciplines are mixed in the learning process where the invisible walls among the disciplines are broken to form in an interdisciplinary way. The number of courses will be decreased to 4 optimized courses, of which course 1 is designed to help students with methodology in science and technology, and team work training. Table 1 shows the typical course arrangement in a current semester and Table 2 demonstrates the new course agenda in a blended semester. In table 1, students have 8 courses in a semester within 19-20 weeks. Usually, 2 courses are successively arranged in the morning or afternoon (sometimes evening) with each course of only 1.5h. In table 2, students have only 4 courses with each course for a whole morning (3-4h) including the break. In this way, more active teaching activities can be designed like group discussion, debate, practice, mini learning tasks

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like mind-mapping and small experiments. What's more, in the afternoon, students in a group have freedom to choose a place they prefer or in the companies in the second half semester after courses all close to carry on with the semester project.

Concerning the other arrangements of curriculum design for the blended semester, several issues are very important, like different disciplines involved, themes of engineering application, course package aligned with themes, project proposals, student group and teacher group, connection with companies and other external institutions. Firstly, unite 4 or more schools or departments with different disciplines that are willing to get involved in this blended semester. Several themes of engineering application will be decided for the blended semester. As illustrated in Fig. 4, there will be several themes discussed in advance with the presence of internal teachers and external engineering experts. For each theme there will be a course package with 4 courses and several project proposals as well. Fig.5 shows the schematic relationship of the student group and teacher group. There will be 4-6 students in a group under the condition that at least 4 students are from different majors or disciplines. Teachers should also make groups with at least 4 internal ones from different majors and at least one from external institutions. One teacher group is allowed to supervise 1 to 3 student groups due to high student-faculty ratio in local universities. Project proposals should be discussed and set with both internal and external supervisors to make sure they have close relevance with real engineering world and imply problems that could trigger students' learning motivation. For the afternoons of workday, students in a group work together, starting from defining engineering problems in their chosen project proposals. For example, for a theme like architecture design and construction, a project proposal could be a demand of a green architecture design and construction for a charity institution of health recovery centre for about 100 teenagers. This architecture needs to be with good earthquake proof capability, simple but multifunctional, energy saving with solar as priority. Students are expected to submit a set of construction drawings of architecture design, interior space design and decoration, feedwater and drainage, HVAC, power and lighting, landscape, etc. All the materials should be environment-friendly. This project can attract students and teachers from more than 6 different majors. Teachers can take turns to supervise the according groups, but when students encounter complex interdisciplinary puzzles, teachers will show up in groups to help students. Normally all student members and teacher members in a project will have a plenary meeting each two weeks on which students give their presentation on the progress and new questions while teachers give timely feedback and helpful suggestions. At the end of each month, a joint-seminar involving all the students participating in the blended semester will be organized to give students opportunities to present their monthly progress and receive more suggestions from more teachers and other peer students. In this way, there will be at least 2 seminars in the semester and one last project assessment. Students are strongly advised to take part in other group's presentation and express their opinions. Project assessment will be made by the presence of both internal and external teachers. Besides, grit will be added to the ILOs of both courses and projects in this blended semester. In most universities including good academic ones in china, the final exam for a term is a real relief for students and teachers. Teachers give marks to the written exam and students are only told about the scores without feedbacks nor explanations about the final written exam. Students do not know why their answers were wrong. There is a crossline between semesters. When a new semester comes, students and teachers just jump into new courses and exams. In this blended semester, teachers will give feedbacks after final exams and allow students to figure out the reasons of the wrong answers or improve their reports, drawings, models, prototypes, etc. For those students who have active attitude and make good use of the feedbacks within the specified time to do improvement again will get a small extra score encouraging students not to easily give up and always work hard for better themselves.

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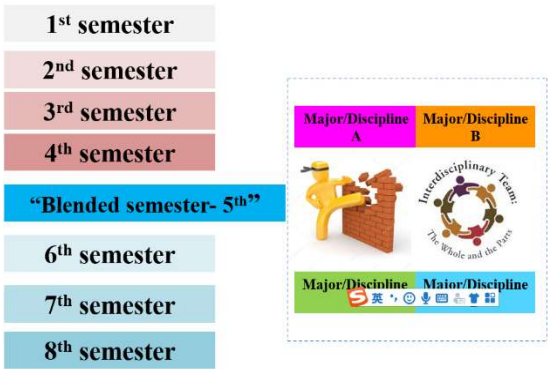

Fig. 3 Schematic of the concept of the blended semester

To do such a pilot blended semester in local universities in China, the following difficulties have to be considered. Firstly, many teachers start their teaching career directly after graduation and do not have engineering practice experience themselves, which make them unconfident with the project supervision. Universities must take measures to encourage teachers to go to companies or factories related with their teaching for deep practice. Secondly, it's not easy to employ or invite many external supervisors from real engineering and hope them to devote much time on students' supervision if little support from their own companies is given. It is true companies do not wish their engineers to be distracted much from their own jobs. So, governments are expected to do something to promote more connections between universities and companies. Then, to facilitate the "blended semester" for effectively interdisciplinary PBL, a platform involving students, internal and external supervisors, university administrators, enterprises, governments is needed with excitation mechanism for different roles. Fig. 6 shows the CH4 molecular model symbolizing the relationship among students, teachers, university, companies, and government, embedded with the notion of student-centred learning. Teachers (supervisors), university administrators, companies are the facilitators for students' learning and governments intermediate and make sure the excitation mechanism smoothly goes on. Regarding the excitation mechanism, for students, they will be assessed with engineering application capability by external engineering experts before taking part in this blended semester. After students start their learning in the blended semester, they will have online learning portfolios on the platform recording their performance in regular meetings, seminars, final assessment and will get an updated extra engineering capability assessment useful for following scholarship and position recommendation before graduation. When they come back to university as external teachers some day after graduation, they will be rewarded again. For internal teachers and supervisors, there will be assessments in two aspects, ability in engineering practice and performance of supervising students that will help teachers with evaluations in professional titles. For external teachers, they will be assessed from the supervision performance and qualified ones will receive extra talent subsidy from government and greater opportunity for promotion in their own company. For companies that actively provide advices for project proposals or support engineers to join the supervision in universities will receive a benefit in the form of tax reduction and priority in applying engineering projects and products promotion. Students (including graduates), internal and external teachers, companies have rights to give estimations of the support from university administrators. Universities that really regard students as the teaching and learning centre and do their best to support this PBL teaching in the blended semester will receive more financial support for talent introduction, teaching facilities, etc. from the government.

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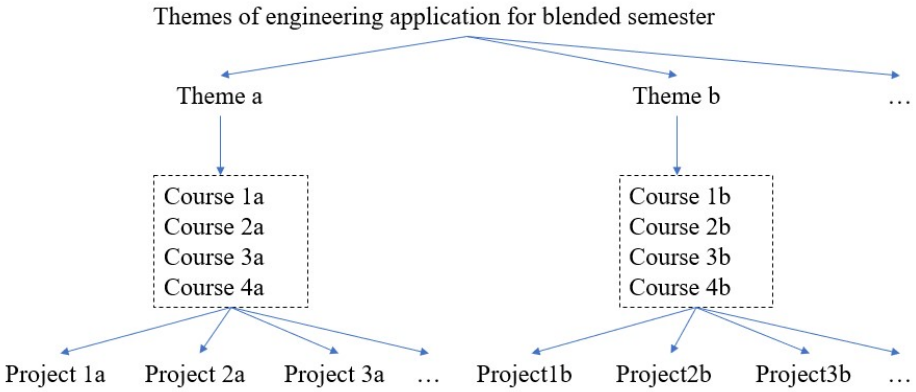

Fig. 4 Framework of the curriculum design of the blended semester

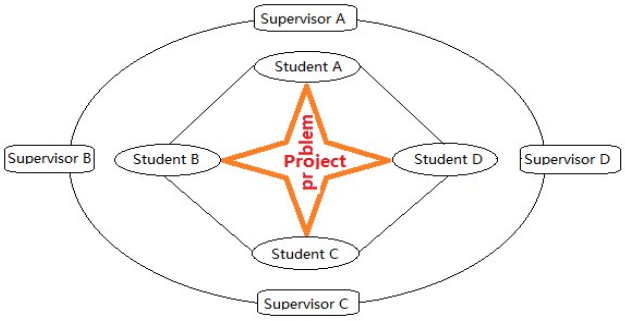

Fig. 5 Relationship between students and teachers

Fig. 6 CH4 model representing different roles in a blended semester for PBL

A basic online survey was carried out oriented to students, graduates and teachers. More than 95% students show interest in this blended semester and 87% students including graduates wish to have this blended semester experience with PBL to help them with more practical ability in engineering problems solving, better presentation skills, internship opportunities in companies, more chances to make friends. Maybe students tend to accept this blended semester easier than teachers. So far over 10% teachers would rather stay put, not willing to devote extra time to work in companies to increase their engineering experience. It's really a huge challenge for a local university to change in a university level. However, it's pleased to know famous universities like Shanghai Jiaotong University have already started to build a similar platform encouraging interdisciplinary learning. Although there are definitely many obstacles for a local ordinary university to walk out of its comfort zone and make essential changes in short time, small improvements are being achieved step by step with wider national teaching reform across China.

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5. Conclusion

A blended semester applying PBL is proposed according to the current real situation in China. In this blended semester, not only the students from different disciplines will form a group, but also the teachers with different academic backgrounds will collaborate as teams. Students will be mixed and choose course packages and interdisciplinary projects according to different themes of engineering applications. What's more, to facilitate the blended semester, a platform involving students, internal and external teachers, companies or other external institutions, and governments was discussed with excitation mechanism for different roles. Through this pilot blended semester, course and project assessment aligned with ILOs and teaching method becomes the outer driving force for students' learning while putting what has been learned in university into practice and solving real engineering problems with others becomes the inner powerful motivation for initiative and active learning. Wider and deeper forms of PBL could be realized later after the pilot blended semester has its encouraging effects.

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