

# An ESP Project-based Science English Lab for Engineering Students

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**Abstract:** The well-known quotation by Confucius, “Tell me and I will forget. Show me and I will remember. Involve me and I will understand. Step back and I will act”, adequately captures the philosophy behind project-based learning. With the first year English curriculum at Kochi University of Technology, there has been a push to encourage students to participate to a greater extent in the learning process. One particular outcome of this drive has been the development of a science English lab. In this lab, learners work together in teams to foster motivation, engagement, meaningfulness and critical learning skills while completing several smaller projects. While the current curriculum does not adhere to a strict project-based formula, there has been a substantial move from a teacher-centered classroom to a student-centered classroom. This paper looks at learner attitudes toward project-based activities in the language classroom.

## 1. Introduction to Project-based Learning

Project-based learning is a broad teaching approach where learners encounter real-world problems and challenges. A project-based course is typically student-centered. Rather than the instructor lecturing the students and the students memorizing facts and reciting these facts on exams, the students take on the responsibility of discovery and learning, and they take on ownership for their learning. Rather than being a passive listener absorbing information, the learner is active and engaged in the learning process. The teacher becomes more of a mentor, moving around the classroom and coaching learners. In a true project-based curriculum, the students are fully responsible to choose the topics that they will learn about and topics are multidisciplinary. Project-based learning is also typically augmented through the use of technology.

### 1.1 Group work

Perhaps that most important aspect of project-based learning is that students work together in groups to complete the tasks that make up the project. While this is sometimes a new concept for Japanese students in the classroom, they typically adapt quickly to learning in groups.

### 1.2 Tangible product

A project-based course typically has some type of tangible ‘product’ produced by the students that can be exhibited to the entire class or even to the world. The product can be a collection of interviews, a presentation, or even a more concrete creation such as a model or invention.

## 2. PBL History

Project-based learning is not a recent concept. Dewey (1938) expressed the idea that education should not simply prepare us for life but should aim to reproduce ‘real life’. More recent studies

have shown that project-based learning, when implemented properly, can help improve problem solving and higher-order thinking (Gultekin, 2005), analytic thinking (Boaler, 1999), teacher and learner attitudes and motivation (Strobel & Barneveld, 2009), and critical learning, (Savin-Baden, 2003). More recently several institutions in Japan have tried to initiate project-based learning. In 2011, Akita International University established a project-based curriculum and was rewarded a grant from MEXT.

### **3. PBL Challenges**

There are a number of challenges when implementing PBL. One of the most critical challenges is the perceptions from those scrutinizing the course, such as learners, other faculty and administration. Critics of PBL may argue that teachers are escaping their duties as instructors and passing on the work to the students and the students may not easily identify the learning outcomes as they spend time on the process of completing the project. There are also types of courses or learning content where PBL may not be appropriate, for example when learning content that requires repetitive practice, such as reading, spelling or basic mathematics. In addition, with the surge in standardized testing, there is more room for criticizing the subjectivity of the rubrics used to assess the projects. Finally, there is some trepidation that PBL is a more of a western approach to education which may not be as effective in some cultures.

### **4. PBL Criterion and Assessment**

Deciding on the quality of the outcomes of a project and what constitutes an acceptable project are important considerations. To fairly evaluate a project, the entire learning process from start to finish must be considered.

In addition very tangible guidelines and benchmarks must be given to the learners at the onset of the project. Sample projects from past students can also serve as good examples, being careful that students don't simply copy the ideas but rather generate new ideas. Evaluation also involves the creation of a detailed rubrics with specific criterion which can be completed by both the learners and the instructors as the project is being completed.

### **5. Content-based Instruction**

Content-based instruction or CBI involves a narrower approach to language instruction where the 'language' content is derived from authentic sources such as newspapers, journals, websites, radio and television programs. As the title of CBI suggests, the main element of this approach is the subject matter, but not necessarily the method used to introduce the subject matter to the learner. While project-based instruction often entails content-based elements, PBL content is typically derived by the learners and CBI material is supplied by the instructor.

### **6. English for Specific Purposes**

English for specific purposes or ESP is not so much an approach to teaching but rather a methodology that underlies the tasks and activities that make up the curriculum for a given set of courses. ESP is designed to rapidly provide very specific language to a group of learners who will use the language in academic settings or on the job. Typical uses of ESP may involve, for example, airline pilot training or business negotiation language. ESP is typically implemented in intermediate or advanced, but can also be used with lower-level courses.

### **7. Science Lab & Science English Course Outline**

Both project-based learning and content-based instruction models were the driving force behind the development of the innovative science lab for engineering students at Kochi University of Technology in Japan.

The 1st year English curriculum composed of 4 quarters. First year students typically complete 2 quarters (30 contact hours) of Science English and Science Lab and 2 quarters of Listening and reading. This next section provides an overview of the first-year Science English & Science lab (SLSE) courses. Science Lab and Science English are split into 2 quarters but essentially a single course with a single textbook. The 1st quarter covers units 1-3 of the textbook with 2 projects while the 2nd quarter includes units 4-6 of the textbook with 2 more projects. SL and SE are not bona fide project-based courses in that the students do not choose the con-

tent for the projects entirely themselves. There are extensive samples and guidance provided. SL and SE are comprised of PBL, CBI and ESP elements. Because of the challenges discussed earlier of employing a 100% PBL approach in Japan, a hybrid approach was incorporated. The students alternate between a typical classroom and a language lab setting. In the classroom, learning is naturally more teacher-centered. Language from the textbook is introduced using traditional PowerPoint slides and students work through activities in the textbook in a self-paced, self-study setting. In the alternating lab environment, student typically work together in groups to complete their guided projects. In this more student-centered setting, the teacher's role is move from group to group coaching the students. Students are encouraged to collaborate with other group members and with the teacher to complete the given tasks.

The role of the textbook, *Science English*, is to provide the necessary language required to complete the projects. The textbook is divided into 6 units focusing on description, numbers, appearance, materials, functions, and time, frequency & amounts. The textbook focuses on all 4 skills— reading, listening, writing and speaking. Each unit has an authentic content-based reading passage, a cloze listening activity, pair work speaking activities and sentence-level writing activities.

The textbook is purposely designed to support the 4 required projects— a hometown data project, a measurement project, a science model building project and a survey project. The textbook includes recurrent language structures which are also recycled in the project work. The topics for both the textbook and the projects are related to learners' own life experiences, for example, in the Hometown data project, students collect data and images about their individual hometowns in order to give a presentation. Lastly, both the activities in the textbook and the project work are extensively supported through the use of technology. Details of the technology support are outlined in the next section.

## 8. Technology Assisted Language Learning

Technology often plays an important cognitive role in PBL, from authentic information retrieval, to interactive language practice, and to capturing and archiving language production. Learners use the Internet to discover knowledge on their own via websites, video or even communication with others around the world. The completion of the projects also requires the use of technology, whether it be capturing images or video for a slideshow or using scientific measurement devices to gather data. When designing the activities for both the Science English textbook and Science Lab projects, a number of resources were exploited including an academic word list, engineering journal articles related to the student majors, and the input from the engineering faculty at the university.

## 9. Course Design and Structure

The Science Lab and Science English courses developed at Kochi University of Technology include a slice of PBL, CBI and ESP. The 4-skills (reading, writing, listening and speaking) courses are designed integrate a more traditional-based textbook with several smaller-projects that students complete in small groups. Students alternate between textbook activities and project work, and between individual study and group work. There are recurrent language structures that students are exposed to in both the textbook and the projects. The textbook and project topics are related to student experiences, such as the hometown data project and the survey project. Finally the courses rely heavily on the aid of technology. A custom mobile learning content system was developed so that students can complete reading, listening and comprehension activities at their own pace using an iPod in conjunction with the paper textbook. A course management system, is also used to distribute, collect and display content derived from the instructor and students.

## 10. The Study

This research investigated students' perceptions of both project-based and non-project-based activities encountered in the Science Lab and Science English courses. Students were surveyed both before they

embarked on the project-based English courses and again at the end of the courses after they tackled a range of learning activities within the course. The activities included both student-centered activities and teacher-centered activities.

### 11. Participants

95 first year students participated in the study. All students in the study were enrolled in both the Science Lab and Science English courses for a total of 2 quarters. Approximately 80% of the learners were male and 20% were female. The majority of the learners had little or no experience with project-based learning before entering this course.

### 12. Methodology

Students were asked to complete a survey, shown in List. 1, at the beginning of the course and then again at the end of the course. In the survey students were asked to rate ten activities on a scale of four as either being helpful or not helpful for language learning. The activities that the students were asked to rate were either conducive or non- conducive for a project-based learning approach. The survey was given twice to the same students, once at the beginning of the semester before students embarked on the projects and again at the end of the semester after students participated in several project-based learning activities.

### 13. Results and Discussion

As seen from the results of the survey, students in Japan often view the teacher as being the central knowledge point of course. Before taking the course, students rated item 1, ‘listening to the teacher’ as the most important aspect of the course. Even after completing the project-based course, students still ranked item 1, ‘teacher talk’ as the second most important item within the list. This seems to confirm the eastern view of education, where the role of the teacher emphasizes discipline and authority (Smith & Hu, 2013). Interestingly though, students rated item 8, ‘giving a presentation in a group’ highest in the list after completing the course. Initially students gave this item a much lower score. In addition, the scores for items 5, 6 and 9, all PBL type activities, increased at the completion of the course.

Items	Before <sup>1</sup>	After <sup>2</sup>
1. Listen to the teacher explain topics or give information about class activities. (Teacher-talk in English)	3.28	3.31
2. Read about topics in the textbook and answer questions (Self-study at own pace)	3.12	3.19
3. Do listening activities from the textbook. (Self-study at own pace)	3.19	3.20
4. Do vocabulary and grammar activities from the textbook. (Self-study at own pace)	3.11	3.11
5. Do question & answer speaking activities from the textbook with a classmate. (Pair work)	3.02	3.21
6. Work in a small group to listen to questions to solve problems and write answers to the problems. (Project work & group work)	3.02	3.19
7. Collect data about a topic and make an English slideshow presentation on your own. (Project work)	3.13	3.28
8. Give a presentation on your own to a small group, not to the entire class. (Group work)	3.10	3.34

*N* = 95 (Average score out of 4 points)

1. Class average before the completion of the course
2. Class average after completing the course

This indicates that students had a more positive perception the benefits of group work after completing PBL activities. Students’ attitudes toward self-study, item 3 and item 4, remained almost the same before and after their PBL experience. Overall, students’ perceptions of the activities that constitute a PBL activity improved after actually completing the PBL activities.

## 14. Conclusion

Although this was a small scale survey, results indicated that students were genuinely interested in being more actively involved in the learning process. While many students felt trepidation with active involvement in activities, such as small group discussion and presentations, they recognized the benefits of project-based activities. While it remains to be seen whether classrooms in Japan will become more student-centered and curriculums will be modified to include more project-based activities, students will continue to naturally become more involved in their own learning processes due to the influx of available information through mobile technologies. For many teachers in Japan implementing project-based learning is an enormous challenge due to the required standardized achievement assessments in place. While an entire overhaul of the curriculum is most likely not possible, initiating smaller project-based tasks and activities, such as those designed for the Science English Lab at KUT, students can become more engaged in the classroom and take greater ownership of their learning.

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### List 1, Student survey

1. 教員が英語でトピックや授業アクティビティについて説明するのを聞く。(教員は英語を使う)  
Listen to the teacher explain topics or give information about class activities. (Teacher-talk in English)
2. 教科書のトピックを読んだり、質問に答える。(各自のペースで自己学習)  
Read about topics in the textbook and answer questions (Self-study at own pace).
3. 教科書を使ったりリスニング学習。(各自のペースで自己学習)  
Do listening activities from the textbook. (Self-study at own pace).
4. 教科書を使った語彙やグラマーの学習(各自のペースで自己学習)  
Do vocabulary and grammar activities from the textbook. (Self-study at own pace).
5. 教科書を使いクラスメイトと質問や回答をやりとりをするスピーキング学習。(ペアワーク)  
Do question & answer speaking activities from the textbook with a classmate. (Pair work)
6. 少人数のグループで質問を聞いてから問題を解き、その回答を記述して答える。(プロジェクトワーク、グループワーク)  
Work in a small group to listen to questions to solve problems and write answers to the problems. (Project work & group work)
7. 各自でトピックに関するデータを収集して、英語のスライドショープレゼンテーションを作成する。(プロジェクトワーク)  
Collect data about a topic and make an English slideshow presentation on your own (project work)
8. 小人数のグループのメンバーに対して、各自プレゼンテーションをおこなう。(クラス全体へのプレゼンテーションではない)(グループワーク)  
Give a presentation on your own to a small group, not to the entire class. (Group work)

9. 少人数のグループでトピックに関するデータを収集し、クラス全体へのプレゼンテーションをおこなう。(グループプレゼンテーション)  
Work together as a small group to collect data about a topic and give a presentation. (Present to the entire class)
10. 少人数のグループで教員と英語で(あまり形式ばらない)ディスカッションをおこなう。(グループディスカッション)  
Informal English discussion in small group with teacher (group discussion)

# 工学系の学生のためのESPプロジェクト型英語学習 Science English Lab

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要約：「言われたただけでは、忘れるだろう。見せてくれたら、覚えているかもしれない。自分でやったことは忘れないだろう。任せてくれれば、私がやります。」この孔子のものと言われる著名な言葉は、プロジェクト型学習の本質をよく表している。高知工科大学の1年生の英語カリキュラムにより、学習過程において学生はより積極的に学習に参加するようになった。これを実現するために、Science English Labの開発が進められてきた。このLabでは、学習者は、グループで協力して、いくつかプロジェクトに取り組むことで、学習意欲、積極性、学習の意義の理解、クリティカル・シンキング・スキルなどを養う。現在のカリキュラムは、厳密な意味でのプロジェクト型学習ではないが、教員中心の授業から学生中心の授業へと大きく変化してきた。本論文では、語学学習におけるプロジェクト型の活動に対する学習者の意識調査の結果を報告する。