

# Improvement of IT Students' Communication Skills using Project Based Learning

Chikako Morimoto

*Tokyo Institute of Technology, Tokyo, Japan*

**Keywords:** Communication Skills, Project Based Learning, Practical Education.

**Abstract:** It is well known that communication skills are important in business. In recent decades, diversity has been becoming a big trend among Japanese companies. As a result, a high level of communication skills is required of employees. The mainstream information technology (IT) industry is shifting focus from software development to providing software “services.” IT companies need to communicate with their clients to understand the clients’ IT strategies. However, typically, IT engineers are not seen as having good communication skills. There is a similar impression of IT students. In this study, we compared communication skills of IT students and non-IT students. Then, we compared communication skills of the IT students before and after participating in project-based learning (PBL). As a result, we found that PBL is effective in improving the communication skills of IT students.

## 1 INTRODUCTION

The information technology industry in Japan today must pay attention to “communication skills” as many companies in the IT industry are shifting focus from development of software products to providing software services. Japanese IT companies need to communicate with their clients to understand the clients’ IT strategies. Therefore, IT companies require their IT engineers to have both IT skills and human skills, which include high-level communication skills. However, typically, IT engineers are not seen as having good communication skills. There is a similar impression of IT students as well.

It is well known that communication skills are important. In recent decades, as diversity has been becoming a big trend among Japanese companies, high-level communication skills are required of employees. However, the meaning of “communication skills” is different in each business situation. As a result, we identified a need to analyze the structure of communication skills and look for ways to improve it.

In Japanese education, Project-Based Learning (PBL) has attracted great attention. PBL is a comprehensive approach to classroom teaching and learning that is designed to engage students in the

investigation of authentic problems (Ayas and Zeniuk, 2001). In this study, we made two comparisons. One is the difference in communication skills between IT students and non-IT students. The other is the improvement of IT students’ communication skills before and after the application of PBL.

## 2 RELATED STUDY

This section explores the two topics important to our study: PBL and communication skills.

### 2.1 PBL

The education method of PBL is increasingly being used worldwide.

#### 2.1.1 PBL in Engineering Education

In the 1950s, engineering education was “chalk and talk,” in which a teacher lectured and students were mostly passive listeners (Mills, Treagust, 2003). But as the social environment became more complex and diverse, engineering graduates were required to have stronger communication and teamwork skills. To address these types of requirements, new education

methods were proposed as a solution in the U.S., the UK, and Australia.

One curriculum was “problem-based” learning. This method has been used for professional medical training in the U.S. since the 1960s. In problem-based learning, students learn how to cope with real problems through structured presentation of problem situations. This methodology has been extended to engineering programs and has been seen as effective in improving problem-solving and communication skills. However, engineering students needed more teamwork skills than medical students, and “project-based” learning, emerged (Blumenfeld et al. 1991, S. Bell 2010).

Heitmann described the difference between problem-based learning and project-based learning (Heitmann, 1996) as follows. He said that the “project” is the engineer’s workplace. So, project-based learning is a good fit to learning engineering in a practical manner. Project-based learning can include problem-based learning, and it may be defined in various ways by different educational disciplines and levels. Project-based learning has become a major part of the engineering curriculum (Mills, Treagust, 2003).

The “Capstone Education Program” (A J. Dutson et al. 1997) is a famous style of problem-based and project-based learning. It is an experiential learning activity in which the analytical knowledge gained from previous courses is joined with the practice of engineering. It is a popular program in the U.S., and there are many examples of the Capstone Program in many universities. The distinguishing feature of “Capstone education” is that it deals with social issues. Companies and universities design a project together and students learn to solve a problem through a project.

### 2.1.2 PBL in Japanese IT Engineering Education

For over 14 years, in Japan, companies have identified communication skills as the most important skill required of an individual to be hired as a new employee. Engineering students are graduating with good knowledge of fundamental engineering science and computer literacy, but they often do not know how to apply that in practice because they lack experience in teamwork. With this concern, PBL is increasing in Japan. For example, the number of papers about PBL in Engineering Education Magazine doubled to 22 items in 2014 from 10 in 2006.

The IT industry also requires strong communication and teamwork skills. As one solution, in 2006, the Ministry of Education, Culture, Sports, Science and Technology in Japan (MEXT) introduced a new IT training curriculum for graduate schools’ computer science departments (MEXT 2005) to establish a nationwide practical education network for IT human resources development. The curriculum requires using “project-based learning.” By using PBL, the IT industry expects IT students to acquire both software development project experience and communication skills.

## 2.2 Communication Skills

This section introduces communication skills.

### 2.2.1 Structure of Communication

The communication process has many sequential steps: getting thoughts, encoding, sending, receiving, decoding, and understanding (see Figure1). Each step uses distinct skills, but generally, the term “communication skills” is used.

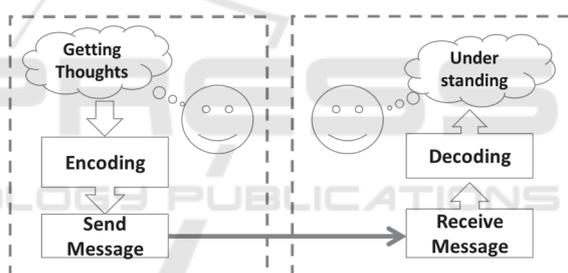


Figure 1: Communication steps.

Katz said communication skills were important for all managers including top executive and foremen (Katz, 1955). His skill model is accepted widely by Japanese business organizations; however, he did not explain in detail what skills are included in communication skills.

### 2.2.2 Index of Communication Skills

Fujimoto and Daibo investigated a factor pattern of ENDCOREs (Fujimoto, Daibo, 2007), defining the scale of communication skills. They examined psychology students and found six categories of factors: expressivity, assertiveness, deciphering ability, other acceptance, self-control, and regulation of interpersonal relationships. According to their survey, Japanese students are better at “reaction skills” than “expression skills.” However, these indices did not test students in other majors.

The Ministry of Economy, Trade and Industry in Japan (METI) has defined basic social skills. In basic social skills, communication skills are not clearly defined; communication skills are separated into “general social skills,” “active speaking skills,” “active listening skills,” and so on.

### 2.2.3 Research Question

Our research question was to determine whether PBL is effective in improving communication skills for IT students. We tried to determine the difference in communication skills between IT students and non-IT students. Then, we compared the effect of PBL and other school activities on the students.

## 3 RESEARCH AND ANALYSIS

We used two questionnaires to gather our research.

### 3.1 Study 1: IT Students and Non-IT Students

First, we compared the communication skills of the IT students with those of the non-IT students using paper questionnaires.

#### 3.1.1 Research Outline

Our research outline was as follows:

We chose three groups to compare their project experience and their communication skills.

Group A comprised our main research target. It was composed of 29 IT students in a graduate computer science course. All of them were male and 22–23 years old.

Group B was composed of 66 undergraduate non-IT students who were learning project management. In Group B, 7 students were female and 59 were male, and they were 18–19 years old. They had project experience.

Group C was also composed of 58 undergraduate non-IT students, of which four students were female and 54 were male. They were 18–19 years old. They were studying finance and did not have project experience.

Our questionnaires consisted of ENDCOREs and the Basic Social Skills indicators. We chose 16 questions (Table 1 and Table 2). The attitude of politeness is included in general skills.

We used anonymous questionnaires. The questions were categorized into “importance” and “execution.” The respondents were to indicate

whether they thought the skill or trait was important and then also whether they thought that they “executed” (personally possessed the skill or portrayed the trait). Each question required ranking the response from 1–5 with 5 being the highest and 1 being the lowest.

Table 1: The question category for research 1.

Question Category	Number of question
General skill (G)	3
Deliver message (D)	3
Active listening (AL)	3
Polite leadership (P)	3
Assertiveness (AS)	4

Table 2: The questions.

**	Question
G	If I am having a trouble, I consult a friend.
G	I gather everyone's opinion during the discussion and then I make a conclusion.
G	I usually behave politely.
D	When I talk with other people, I pay attention to their level of understanding.
D	Before I talk with them, I organize my thoughts first.
D	When I write to other people, I consider their level of understanding.
AL	In the conversation, I look at my partner's face or eyes as much as possible.
AL	In the conversation, I nod and react.
AL	In the conversation, I confirm my understanding by asking suitable questions.
P	When there are different opinions, I listen to them carefully and think how to convince them with my opinion.
P	When there are different opinions, I listen and respect them.
P	In front of many people, I can say my thoughts.
AS	I can take the initiative of conversations.
AS	Without being influenced by other opinions, I can insist mine.
AS	To lead the conversation, I can easily adjust to others' attitude.
AS	I can insist logically and in a concrete way.

\*\* Category

Because of the small sample size, we analysed each group without dividing by gender and age groups.

#### 3.1.2 Result

In the three groups, there were slight differences. There was no significant statistical difference, but there was a difference in mean values. Group A said that “deliver message” was the most important skill

and the next most important skills were “polite leadership” and “assertiveness.” Group B identified “polite leadership” and “assertiveness” as the most important. Group C answered “general skills,” “polite leadership,” and “assertiveness” as the most important. Tables 3–5 show the answers as “important,” “executed,” and “not executed.” An “x” shows the category that they selected the most.

Table 3: The answer of each group (important).

	Category				
	G	D	AL	P	AS
A	x	xx		x	x
B			x	x	x
C	x			x	x

Table 4: The answer of each group (executed).

	Category				
	G	D	AL	P	AS
A	x	xx			
B	xx	x	xx		
C	x	x	x		

Table 5: The answer of each group (not-executed).

	Category				
	G	D	AL	P	AS
A	*		x	xx	x
B	*			xx	x
C	*			xx	xx

It seemed that Group A focused more on “deliver message” than on “active listening,” while Group B focused on “active listening.” All groups thought that “polite leadership” and “assertiveness” were important, but they did not execute these traits.

Group A answered that they did not feel free to consult their friends, but Group B and Group C answered that they could do it. Group A felt that it was difficult to look into other people's eyes and to understand their reactions. Group B and Group C could look at others and could understand their reactions easily.

### 3.1.3 Analysis

From each answer, it seemed that all groups thought that a polite attitude was important, and they tried to act politely. They said that it was difficult to show assertiveness and take leadership. These are all typical Japanese attitudes.

The biggest difference between the IT-students (Group A) and the project management students (Group B) was listening attitude. IT students seemed

to push their own thoughts and opinions, but project management students listened to others' thoughts carefully. We think that is one reason why IT students seem poor at communication.

## 3.2 Study 2: before and after PBL

In the second study, we compared the communication skills of IT students before and after administering a PBL program. We administered PBL for a full year and the students could take the PBL course voluntarily. It was also possible to retire from PBL in the middle of the year.

### 3.2.1 Research Outline

We surveyed how much the IT students' communication skills improved, using a questionnaire before and after PBL. Our research outline was as follows:

Our questionnaires consisted of the same indicators used in Study 1: the ENDCOREs and the Basic Social Skills indicators. The respondents were 24 graduate students in a computer science course. All of them were male, 22–23 years old and in the first year of the master's program. They were surveyed in April 2014 and January 2015.

In our PBL program, the students developed the Android mobile application software and server application software using AWS and NEXUS7. Each team consisted of 5–7 members. They started PBL on April 2014 and ended in January 2015. The aim of the PBL program was to learn software development and learn project management through trial and error. The PBL class met once a week for 3 hours per class. However, the students also needed to work additional hours and plan their own team schedule. Figure 2 shows their standard annual schedule. Some of the students were good at Java programming, and some of them were not. They needed to take lessons in addition to the PBL class, including an Android development class. It is standard for master's students in Japan to participate in the seminar. They also participate in an internship during summer vacation and do additional study for their research.

We needed to compare before and after PBL, so we used assigned questionnaires. We asked the same questions from the standpoint of “importance” and “execution.” Each question required different levels with 4 being the highest and 1 being the lowest. In addition, we asked for their opinion regarding the effectiveness of PBL on a 5-level scale with 5 being the highest and 1 being the lowest.

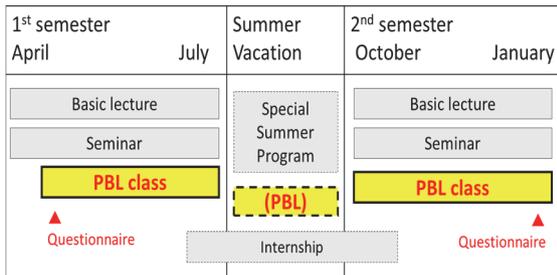


Figure 2: A standard annual schedule of PBL.

### 3.2.2 Result

In this section, we explain the results. There was a change in the skill level of the students' communication skills before and after PBL.

Overall, "importance" received higher scores than "execution." The respondents seemed to understand that communication skills are important, but felt that they did not execute them enough. This trend was the same both before and after PBL. However, their communication skills scores improved after PBL.

Table 6 shows the result of the question: "Do you think that PBL was effective for your communication skill improvement?" We saw that 74.8% students answered that PBL was effective in improving their communication skills.

Table 6: Effectiveness of PBL.

Effectiveness of PBL	Answer
Strongly agree	5
Agree	13
Soso	6
Not agree	0
Strongly not agree	0

In a free answer column, some students wrote that they thought that PBL was very effective in keeping up their motivation for learning and that it was effective in improving their social skills. One student said that he made some friends through PBL.

In the next step, we analyzed each category. According to the category evaluation, the most important skills before PBL was "deliver message" and the least important skill was "active listening." At first, their interest lay in the output of their own thoughts, but after PBL their interest changed.

After PBL, the score in all categories improved. The most executed skill was "deliver message," and the most unexecuted skill was "polite leadership." Particularly, the improvement of "active listening" was statistically significant. The other scores were not statistically significant. Table 7 shows the

difference in the execution score before and after PBL, and also shows the result of the T-test.

Table 7: The difference of execution.

Skill	Before	After	T-test(p)
General skill	2.60	2.83	0.033795034
Deliver message	2.76	3.04	0.018403696
Active listening	2.65	3.03	0.00098705 *
Politely leadership	2.51	2.74	0.065603211
Assertiveness	2.53	2.72	0.051826543

\* > 0.01

We considered each question. Before PBL, the respondents said that the following two statements were the most important skills: "When I talk with other people, I pay attention to their level of understanding" and "I gather everyone's opinion during the discussion, and then I make a conclusion." However, each respondent said that they did not think they executed them enough. After PBL, all skills improved. The improvements in these skills were statistically significant in the T-test as follows:

"If I am having a problem, I consult a friend."(p=0.035)

"I gather everyone's opinion during the discussion, and then I make a conclusion."(p=0.009)

"When I talk with other people, I pay attention to their level of understanding."(p=0.004)

"In the conversation, I confirm my understanding by asking suitable questions."(p=0.005)

"When there are different opinions, I listen to them carefully and think how to convince them with my opinion."(p=0.000)

### 3.2.3 Analysis

PBL appeared to be effective in improving the communication skills of IT students.

Their interest seemed to change from a focus on the output of their thoughts to listening to others' thoughts. These results were similar to the trend among project management students in Study 1.

Earlier, they placed themselves in the center of their communication. However, after PBL, they placed others in the center of their communication. We think this is a significant change.

## 4 CONCLUSIONS

In this study, we surveyed the communication skills

of graduate IT students. In the first study, we compared the communication skills of IT students and non-IT students. As a result, we found that the project management students paid attention to others in their communication. In addition, we found that IT students were not good at listening to others. They seemed to focus on output during communication.

In the second study, we compared the communication skills of IT students before and after they participated in a PBL program. As a result, we found that PBL was effective in improving their communication skills. Particularly, “active listening” was improved.

We used self-questionnaires, and acknowledge that it can be difficult for respondents to subjectively judge their own communication skills. Also, besides the PBL program, other factors could influence the respondents, such as their seminars, internships, and other school activities. However, we still think that PBL is an effective training method to improve communication skills.

IT students like to communicate using online tools such as Twitter and Slack. But to improve their communication skills, it is necessary for them to communicate with other people directly. We think that IT students can learn teamwork and interactive communication with other people through PBL.

Our future plans for study are as follows: 1) analyse the data in detail and 2) find exactly what skills are improved most effectively using PBL.

## ACKNOWLEDGEMENTS

This research study received a grant from the Nomura School of Advanced Management.

## REFERENCES

- Ayas, K. and Zeniuk, N., 2001, Project-Based Learning: Building Communities of Reflective Practitioners, *Management Learning* March 2001 (32), pp.61–76.
- Bell S., 2010, Project-Based Learning for the 21st Century: Skills for the Future, *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 83(2), pp.39–43.
- Blumenfeld, P., Soloway E., Marx R., Krajcik J., Guzdial, M. and Palincsar A., 1991, Motivating Project-Based Learning: Sustaining the Doing, *Supporting the Learning*, *Educational Psychologist*, 26(3–4), pp.369–398.
- Dutson, A., Todd, R., Magleby, S. and Sorensen C., 1997, A Review of Literature on Teaching Engineering Design Through Project-Oriented Capstone Courses, *Journal of Engineering Education*, 86(1), pp. 17–28.
- Fujimoto M. and Daibo I., 2007, ENDCORE: A Hierarchical Structure Theory of Communication Skills, *The Japanese Journal of Personality*, Vol.15, No.3, pp.347–361.
- Heitmann, G., 1996, Project-oriented study and project-organized curricula: A brief review of intentions and solutions. *European Journal of Engineering Education* 21(2), pp.121–131.
- Katz, R., 1955, Skills of an effective administrator. *Harvard Business Review*, 33(1), pp.33–42.
- MEXT, 2005, *The basic strategy of education for high-level IT human resources*, (written in Japanese), [http://www.mext.go.jp/component/b\\_menu/shingi/giji/\\_icsFiles/afieldfile/2015/02/10/1355034\\_016.pdf](http://www.mext.go.jp/component/b_menu/shingi/giji/_icsFiles/afieldfile/2015/02/10/1355034_016.pdf), 2015-12-30 referenced.
- Mills, J. and Treagust, D., 2003, Engineering Education– Is Problem Based or Project Based Learning the Answer? *Australasian J. of Engng. Educ.*, online publication (2003–04).