

A New Approach to English Education for Technical College Students

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Higher English proficiency is increasingly required for technical college students who aspire to become global engineers. However, it has been a difficult issue about how to keep the motivation of English learning at a constant high level for students with an engineering background in Japan. To effectively and steadily improve students' English skills, it is essential to explore new teaching methods in addition to traditional approaches. In this study, we tried a unique approach to improve the present situation of English education in our department. It was applied to the subject called "Basic Chemistry Experiments" for the 1st-grade students. The idea is to intertwine English learning and professional knowledge together so the students know the reason they should learn English and how to use English in their professional fields. We developed one set of interactive professional English learning contents and applied it to our 1st-grade students. It includes an interactive e-Book describing 20 lab equipment with written description, audio, photo, video and quizzes, a set of e-Book quizzes which tests their understanding on related background knowledge right after every experiment they did, a set of Microsoft Forms quizzes which is assigned to students every week for testing their vocabulary of lab equipment and chemical reagents. Students practice these contents right after finishing the experiment or are given assignments for vocabulary tests (English to Japanese, Japanese to English and English spelling). During the whole year-long learning process, students also have a chance to experience making simple e-books by themselves. The feedback from students is very positive and contributed to the improvements of these contents. We also prepared video instruction contents to let students get hands-on with their mobile phones so they can learn at any time and any place they want.

Keywords: English education, chemistry experiments, e-Book, interactive, motivation

Introduction

For fostering engineers who are able to succeed on world-wide stage, many approaches have been conducted

in Kosen recently to improve the students' English skill. National Institute of Technology (Kosen) have taken many initiatives such as launching 5-year global education projects in many colleges, hiring native English teachers and providing exchange programs of sending Japanese student to abroad and accepting foreign students from different countries to offer opportunities for communication and mutual culture understanding. With all these efforts, the English skill for Kosen students has been improved and the TOEIC-IP average score has kept on improving during the past 5 years. However, comparing to other educational institutes such as high schools and universities, TOEIC score of Kosen students is still at the lowest level. Therefore, it is hard to say that present situation of English education in Kosen is good enough and all the initiatives taken are very effective. Many Kosen students don't have a strong motivation to learn English even they understand that English is very important for their future careers. Therefore, we should rethink the way we teach English in Kosen. Should English teaching be done only by English teachers? Are the teaching styles for high school students or university students good for Kosen students? Is there any better way or method by which Kosen students can learn English positively with a constant high motivation? 5 years ago, we started an unique approach by introducing English learning into an experimental subject (Basic Chemistry Experiments) for 1st grade students in our department. We think this is the better way to let students to be motivated in learning English because the importance of English becomes tangible, and they can see the reason they need to learn English and can learning it in a fun way because KSOEN students love experiments. Intertwining English learning with professional experiments can be a much more effective way to let them keep a constant motivation and get a better result. In this paper, the tailor-made interactive electronic contents we made and the way of practicing these contents in the students' experiments will be presented.

Development of Interactive Electronic Contents

Three types of electronic contents have been developed.

1. Interactive electronic contents for lab equipment

20 kinds of basic lab equipment were selected for this approach (Fig.1). The description for each of them is given in a style of words, photo, video, audio and quiz as shown in Fig.2. First, a photo is shown for the equipment and then there is a brief description of the equipment in written words. The English reading of the description is also available in audio form shown as a speaker icon. Both reading and listening abilities are tested. Under the description there is an online video link for students to experience the explanation by a native speaker. After getting the basic concept of the equipment, a quiz is designed for checking the students' knowledge about the equipment. There is an explanation for every selected answer on why their choice is correct or wrong. The final page for every lab equipment includes questions give in audio form to let students answer them with their own English. As shown in Fig.1, most equipment selected are lab glassware and others are safety tools such as lab coat, goggles, etc.

Index	
1. Beaker.....	04
2. Test tube.....	08
3. Erlenmeyer flask.....	12
4. Graduated cylinder.....	16
5. Funnel.....	20
6. Volumetric flask.....	24
7. Bunsen Burner.....	28
8. Pipette.....	32
9. Watch glass.....	36
10. Thermometer.....	40
11. Burette.....	44
12. Stirring rod.....	48
13. Weighing paper.....	52
14. Dispensing spoon.....	56
15. Litmus paper.....	60
16. Electric balance.....	64
17. Lab coat.....	68
18. Safety (protective) goggles.....	72
19. Wash bottle.....	76
20. Filter paper.....	80

Fig.1 Index of Interactive e-Book for 20 lab equipment.



Fig.2 Example of 4-page contents including words, photo, voice, video and quizzes for every lab equipment.

2. Quizzes for Every Experiment

There 18 experiments in the subject of Basic Chemistry Experiments. For each experiment, one set of quizzes has been designed. It includes questions inquiring the background knowledge about the experiment, specific experiment skills and safety cautions. The quizzes are given in different styles such as questions in words, photo selection of lab equipment, and questions given by audio form. With these quizzes (Fig.3), the students can confirm their professional

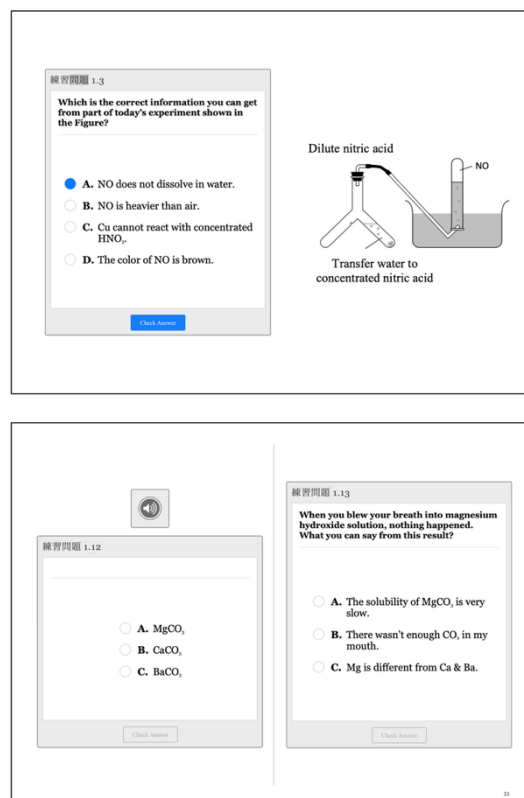


Fig.3 Examples of quizzes for every experiment.

knowledge while learning English to improve their reading, listening and speaking skills. They practice these quizzes right after they finish every experiment.

3. Vocabulary Quizzes for Lab Equipment and Chemical Reagents

A set of quizzes of English words for lab equipment and chemical reagents has been developed as an assignment. It includes three parts, translation of English to Japanese, translation of Japanese to English, and English word spelling check. 10 different lab equipment and 10 frequent-use chemical reagents were selected for the set of quizzes as shown in Table 1. The typical style of the quizzes is shown in Fig.4 and Fig.5, respectively.

Table1 List of vocabulary of lab equipment and chemical reagents

No.	Lab Equipment	Chemical Reagent
1	beaker	sodium chloride
2	test tube	sulfuric acid
3	Erlenmeyer flask	nitric acid
4	graduated cylinder	hydrochloric acid
5	funnel	sodium hydroxide
6	volumetric flask	manganese dioxide
7	Bunsen Burner	ammonia
8	pipette	hydrogen peroxide
9	watch glass	ethanol
10	thermometer	hydrogen sulfide



Fig.4 Mobile phone screenshots of quizzes for chemical lab equipment.



Fig.5 Mobile phone screenshots of quizzes for chemical reagents.

4. Other English Learning Materials

Besides the above contents, we also selected one experiment for total English learning. The description slides, experiment report and the teacher's explanation of the background knowledge about the experiment are all in English. We also prepared some instruction videos for using the developed contents by their own PC, iPhones or iPads. They can download the contents to their mobile devices and practice them after class by themselves.

Ways of Conducting the Electronic Contents

The purpose of developing these contents is to raise the students' motivation of learning English. Therefore, the contents have been applied to the subject of Basic Chemistry Experiments even at the early stage of development. This PDCA cycle led to constant improvement of the contents and students also benefit a lot from practicing them.

The subject of Basic Chemistry Experiments is scheduled once a week for 1st grade students in our department. For every 3-hour experiment, 15-20 minutes are used for practicing the contents. About 40 students are put into 10 groups and each group (4 students) has one iPad. The following practices are conducted.

1. Weekly practices

After each experiment, students start to practice English. First one is the quizzes for testing their background knowledge of the experiment they did that day. In one group, 4 students work together to figure the meanings of the questions and answer the quizzes. Then they can choose one of the contents for lab equipment to do further practice. After finishing

the practices, every group is asked to submit a report about what they did and how they assess the performance of themselves. Another weekly routine work is the assignment. Assignment of vocabulary quizzes shown in Fig.4 and Fig.5 are given every week. To keep the students' motivation, the average score of these assignments counts as one experimental report in the first and second semester, respectively.

2. Making their own electronic contents

We arrange on experiment time (3hours) to let students to make their own e-Books by using the software Page with iPads. They can make questions in words, photos and voices and then ask students from other groups to answer the questions. Students had a fun time to engage, and it is also a good chance of experiencing digital contents making which may benefit them in the future.

3. Experiment Instruction in English

For every experiment a 50-minute instruction is given by teachers before the start of doing experiment. It includes explanation of background knowledge such as experimental phenomenon and related chemical reactions, details of every experiment step, and specific cautions students need to know. As mentioned above, one experiment, Making Oxygen and Measuring Its Density, is selected and teachers give the instruction in English. For achieving better learning result, it is arranged in the second half of the first semester after they have practiced other English learning contents several times. Students are also asked to submit their report for this experiment in English.

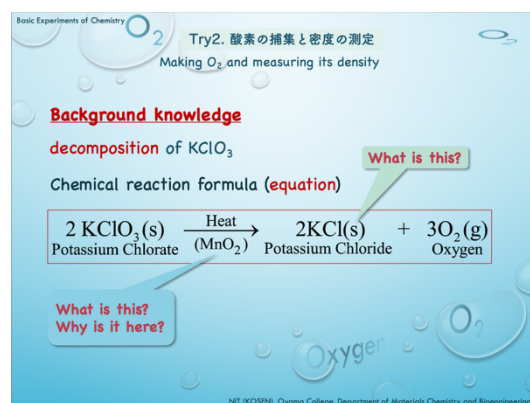


Fig.6 An example of the PPT slides used for the experiment instruction.

Results and Discussion

This project has been conducted since 2020. Students who attended this project gained progress in professional English by knowing technical words and expressions. Fig.7 shows their journey of making progress week by week by doing technical vocabulary quizzes. Fig.8 shows the score comparison for the same students who took part in the project at their 1st year in 2021 and then answered

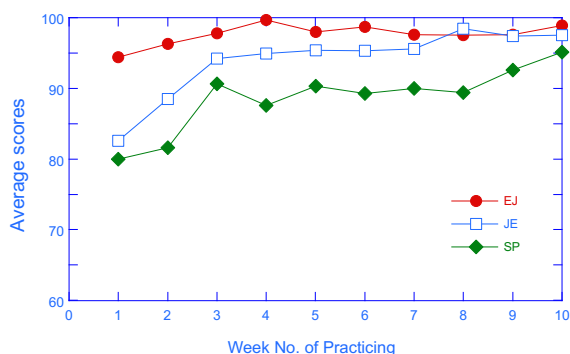


Fig.7 Changes in average scores for 3 types of lab equipment vocabulary quizzes. EJ: English to Japanese, JE: Japanese to English, SP: Spelling.

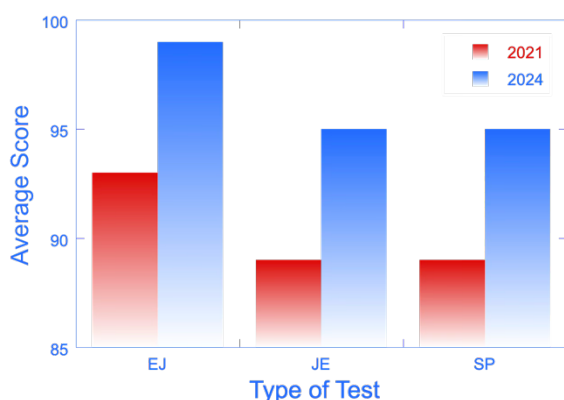


Fig.8 Results of lab experiment vocabulary test from the same students when they were 1st grade students in 2021 and 4th grader students in 2024. EJ: English to Japanese, JE: Japanese to English, SP: Spelling.

the same lab equipment vocabulary quizzes in 2024 when they became 4th grade students. With the experience in 1st year, most of them have kept a strong motivation of learning English and haven't forgotten what they learned.

Another evidence of showing the effectiveness of this approach is the questionnaires taken every year. Most of the answers are very positive. In 2024's questionnaires, when asked "Did you actively engage in professional English learning over this academic year?", 100% of them said "Yes". When asked "Was learning professional English using the developed electronic contents effective?", 92% replied "Yes" and other 8% replied "Basically". When asked "What were the advantages of learning professional English using an iPad?", the top three replies are as following:

1. It was great to be able to learn both technical knowledge and English at the same time.
2. Learning in groups was a great experience.
3. The quizzes related to each experiment were beneficial.

All feedback from the students who took part in this project during the past 5 years confirmed the effectiveness of the interactive electronic contents we developed and the ways we practice them.

Conclusions

The interactive electronic contents we developed are well intertwined with the subject of Basic Chemistry Experiments. With 5-year practicing, students are totally engaged with this approach and accepted it as a routine part of the subject. Students now have higher motivation in learning English because they feel enjoyable by practicing English with the chemistry experiments which they like the most. The progress that students achieved by practicing the contents and the yearly feedback from them proved the effectiveness of the contents we made and the ways we deal with the contents in practicing. Combining English learning with professional studies, especially experimental subjects is an effective approach of levitating students' motivation of English learning.

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