The Research of Integrating Information Technology with Problem-based Learning in Engineering Education: A Case study of English Instruction

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ABSTRACT: *This research aimed at exploring the instructional efficacy of integrating information technology with problem-based learning (PBL) in English instruction. This research adopted self-made multi-media creative teaching materials and designed various teaching activities, including brainstorming skills, creative thinking instruction, movie instruction, group discussion, creative menu design, radio drama, English songs, games and homework sharing time. Learning objectives were set by students through brainstorming. These instruction methods were used on freshmen that studied electronics in the senior vocational high schools. Their study theme was "A Beautiful Date." The instructional contents for this theme were divided into two categories: 1) introducing terminology of western cuisine, menu and food; 2) learning western table etiquette and manners. The learning process was divided into three scenes. Teachers had to start their teaching by using the situations and brainstorming activity designed for that particular scene and gradually guide students to think and learn about the study theme. Creative teaching materials and learning objectives set by the students were mainly taught and presented in the form of multi-media briefings and publications. Information software and hardware, such as Microsoft Power Point、Publisher、Flash、PowerDVD and recorders, were often used as teaching tools to create proper learning situations.*

In the teaching process, formative assessment, summative assessment and instructional questionnaire survey were conducted. According to this research, there was no significant difference between the efficacy achieved through the aforestated teaching activities and through traditional instructional methods, but these teaching activities achieved significantly greater efficacy in affective objectives than traditional methods. Besides, they had significantly better results in creating a pleasant atmosphere in the classroom. This research concluded that if teachers know the process of designing and applying PBL instructional activities and give students guidance at the right time in the teaching process, vocational school students' English proficiency can be greatly enhanced.

1 INTRODUCTION

Research Motivation and Rationale

In the book "Communication Without Obstacle," written by H. Z. Peng, it says that many people like carnivals because they feel happy, have fun and can find many wonders in a carnival. These, of course, include many different people and things (Peng, 2003). It's natural that we would think of a question: why can't an instructional activity be as jolly as a carnival?

In early days, traditional teaching activities were usually implemented in classrooms. There was always a teacher turning textbook pages on the platform and used the blackboard to give lectures. Students usually sat on their chair and listened to every word, phrase and grammar concept that the teacher taught. However, most students felt English was a boring subject of liberal arts. This was resulted from a changeless instructional process. The center of the classroom should be students instead of teachers. Students are the persons that find solutions to their learning problems while teachers only play the role of inducing students' learning motivation. Therefore, we should return the stage of the classroom to students!

When many company owners are worried about how to find suitable employees, we find that Disney never has the problem. That is because there is so much fun and happiness in the Disney world that its employees always feel joyous when at work. Though they have to work all day long, they still feel very happy. Let's pause and think for a while. If we can create an interesting atmosphere in the English classroom, helping students to learn in suitable situations and to explore the foreign language and cultures naturally, and even if there are tons of boring words, phrases and grammar lessons, they can still learn happily. The reason lies in that the fun, imagination and thinking integrated into the learning process have created a lively learning atmosphere and made the classroom a merry place with unlimited joy.

The reasons stated above have aroused our interests in designing an English instructional method with which such a joyous learning environment can be created. With a passion for teaching and an ideal to help students learn English happily, we referred to some publications and magazines related to thematic instruction, problem-based learning and all kinds of situational instruction methods and theories. Based on these, we started to design the instruction activities described in this paper and have made necessary teaching materials and tools. We have also conducted instructional tests on instructional activities we designed.

Research Purpose

Based on the research motivation and rationale stated above, this research has the following purposes:

A. Develop a structural map for a set of self-made teaching media and teaching CDROMs.

Establish a set of English teaching activities that are focused on thematic teaching and problem-based learning.

2 RESEARCH METHODOLOGY

This research adopted the action research method, conducted literature review, and held expert meetings and instruction research meetings, purposing to design an English curriculum for senior vocational high school students. It used self-made instructional media and various kinds of video and audio equipment to create proper situations. This research first used instructional methods, such as lecture giving, cooperative learning and creative thinking, in agreement with the problem-based learning method to design instructional activities, and then it implemented diversified assessments to evaluate students' creativity, professional competency and learning experience. The research subjects were two first-year classes of students studying in the department of electronics in senior vocational high schools. One class was the experiment group and the other was the control group. Both groups had the study theme of " A Beautiful Date."

Research Design and Implementation

PBL and Creative Instructional Structure

Figure 1 shows the relations between teachers' instruction and students' learning and uses "study time" as its vertical axis. With the time goes upward, the study starting point is at the bottom of the figure while the stopping point is at its uppermost place. There are two triangles on the right, which represent how much the learner studies and how much the teacher constructs.

This instructional activity comprises three acts, each of which lasts for two hours. All acts have the same structure: in the instructional activity, the teacher first constructs basic knowledge and then gives lectures and uses situations to guide students into the instructional theme. After the teacher has guided students' thinking into the instructional theme, he or she starts to use various creative instructional activities to transform a teaching that is centered on the teacher to a teaching that is focused on students' self-study. At this stage, the teacher has changed to an auxiliary instructional role.

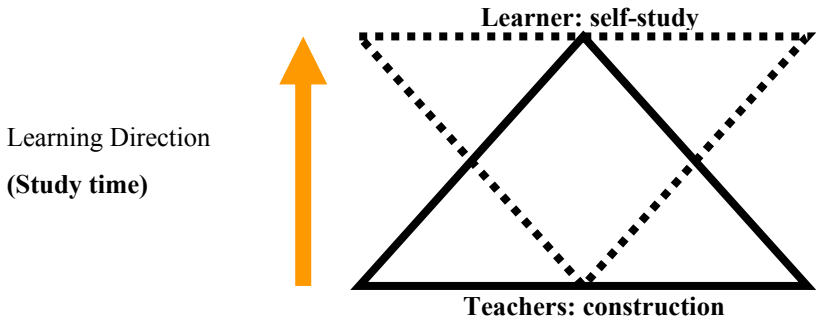

Figure 1 - Relationship Between Teachers' Teaching and Students' Study (Y. W. Chu, 2003)

Classroom Layout for the Instructional Activities Designed in This Research

Figure 2 shows the classroom layout for the instructional activities designed in this research. From this layout, it is clear that the desks and chairs are not arranged in the traditional square-like way. Instead, they are arranged in small groups so that it is more convenient for group members to hold discussions. In addition, the teacher positions himself or herself in the center of the classroom to enhance his or her interaction and communication with students instead of giving lectures on the platform.

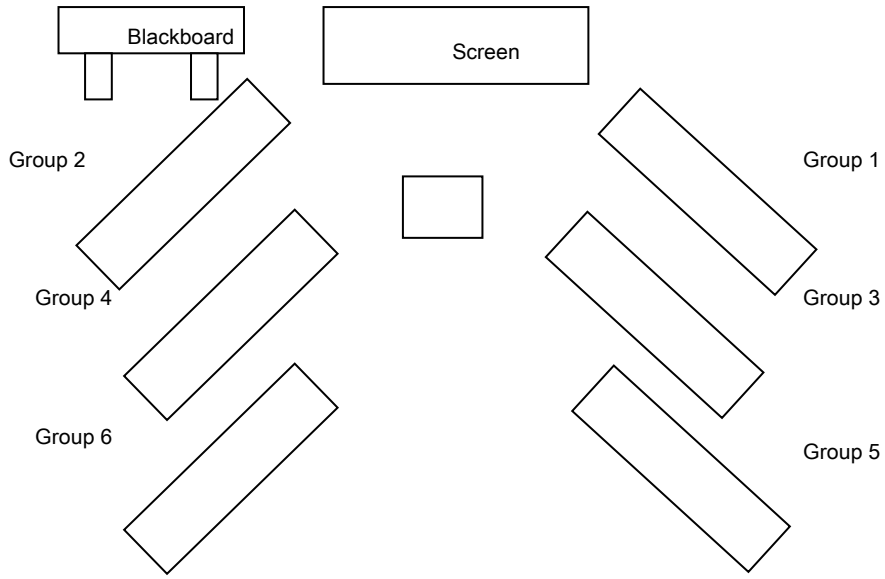

Figure 2 - Classroom Layout for the Instructional Activities Designed in This Research

Instructional Activities Design

Use self-made instructional media and various kinds of video and audio equipment to create situations.

Use information technology, particularly the briefing software of Microsoft Power Point, as the major tools for developing instructional media. The words, lessens, dialogues and instructional situations in the instructional content are all presented in a briefing way, and appropriate sound effect is also included. Several multimedia design and development software, such as Movie Maker, Flash, Media Player, Visual Basic 6.0 and Media Show, are used to generate multimedia video teaching materials. Carefully selected movies, songs and pictures are edited and inserted into the multimedia briefings. The selection of multimedia teaching materials is purposed to create instructional situations. All these media resources are used to guide students to enter the instructional situations that the teacher creates.

Use lecture, cooperative learning and creative thinking to implement instruction

In addition to the traditional lecture giving method, in order to increase learners' learning interest and participation, cooperative learning and creative thinking are also integrated into the instructional activities. The purpose for doing this is to diversify sources of knowledge. In other words, students acquire knowledge not only from the teacher but also from their classmates and through self-thinking and creativity.

Design instructional activities in agreement with PBL.

PBL is a teaching process that focuses on practical problems and cultivates students' active learning, creative thinking and problem-solving abilities through group discussions (Wu, 2002). Therefore, PBL can develop students' critical and creative thinking abilities and increase their innovation ability through problem solving process (Hong, 2001). In light of the abovestated, this research designed instructional activities based on PBL..

3 IMPLEMENTATION STEPS

Figure 3 is the implementation structure map for the instructional activities designed in the research. The instructional theme is predetermined. The teacher collects teaching materials and teaching resources for the predetermined theme, and then uses school resources to design instructional situations that students can easily relate to their daily experience. Then the situations are used to arouse students' motivation. Such a design is focused on the creation of instructional situations, within which students can be guided to learn English naturally.

Then the teacher needs to divide the theme into several sub-themes and identifies a question for each sub-theme. Based on these questions, the teacher uses the PBL teaching plans he/she has made to guide students into study theme through brainstorming.

The PBL instructional activity is divided into three acts, each of which has a set of guiding questions. For example, in the experiment done in this research, the whole instructional activity was designed around two major characters, George and Mary. They were designed as a couple of lovers and the background was Valentine's Day. The teaching content included the terminology of western cuisine, menus and food and the western table etiquette and manners.

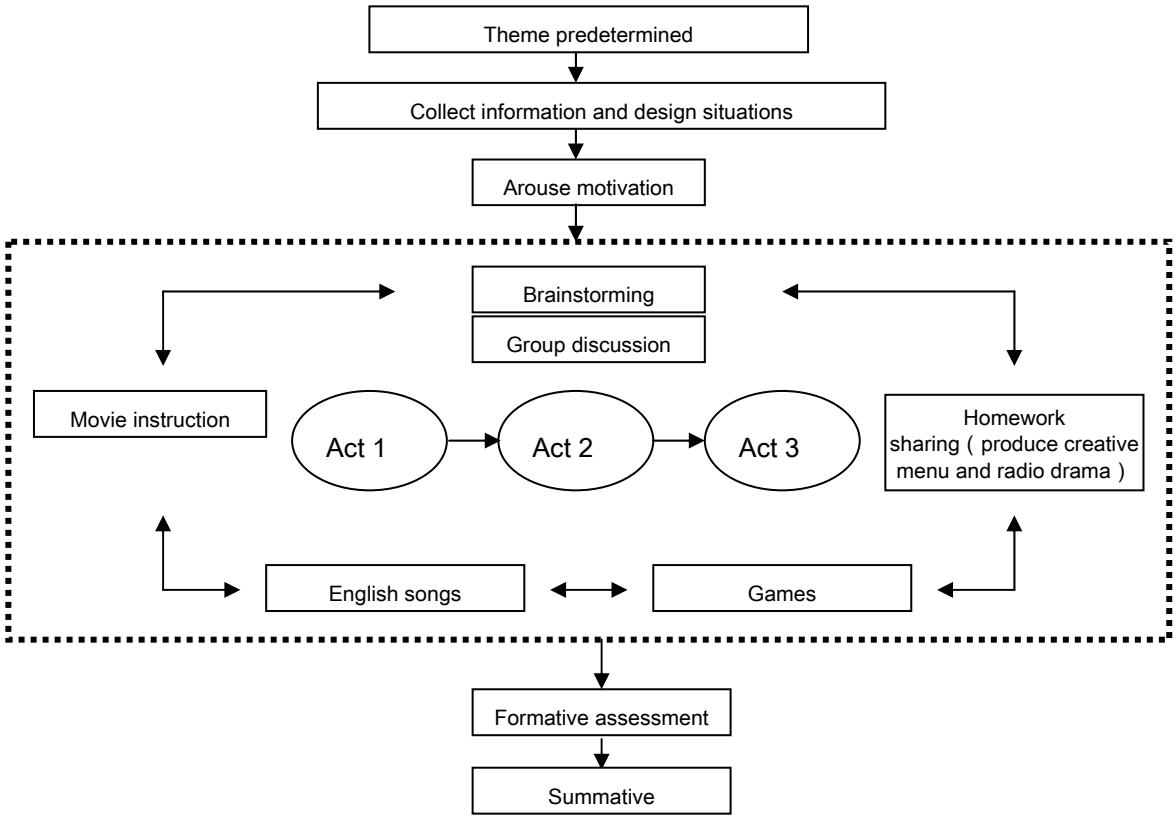

Fig. 3 Implementation Structure for the Instructional Activities

In Act 1, the guiding question was "If you were George's best friend, what kind of advice would you give him?" The teacher introduced the predetermined situational story and played the movie along with the music, helping students enter the study theme naturally. When students became interested in the instructional content, the teacher started to guide them to think and role-play, teach them terminology and tell them the story. Then students were guided to design a creative menu through brainstorming and each group of students should design a creative menu as their homework.

The guiding question in Act 2 was "Are you ready to order?" Based on the situations in Act 1, the teacher introduced the situational story in Act 2 and guided students into the study theme. When arousing students' interest in the instructional content, the teacher implemented a series of instructional activities, including terminology teaching, role play, movie instruction and Flash animation instruction. Then the teacher and students selected the best works from the creative menus that students generated as their homework. Then the students were guided to create a radio drama through brainstorming and each group of students should design a radio drama as their homework.

The guiding question in Act 3 was "Would you help George to fill in the blanks of the paper?" Based on the situational story in Act 2, the teacher introduced the situational story of Act 3, guided students into the study theme and taught them theme-related English songs. Then the teacher guided students to select the best works from the radio dramas that students made as their homework, play word games and share their learning experience. The final step was to fill out the assessment sheet and questionnaire.

4 INSTRUCTIONAL ASSESSMENT

The instructional activities in this research are mostly assessed through diversified performance assessments, which are composed of mid-term formative assessment, final-term summative assessment, learners' questionnaire and a checklist for teachers' teaching plans. These four parts are described as follows.

Formative Assessment

Formative assessment is implemented at the end of both Act 2 and Act 3. The assessment tools used at this stage are mainly student self-grading sheets, including that for creative menu and radio drama. Each group of students has to present their works and fill out the self-grading sheet. A diversified assessment method assesses both the acquisition of knowledge and satisfaction. Learners share their experience with their group members and present and explain their work in front of the whole class and the teacher. In the aspect of knowledge, presentation can help each group to have a clearer picture of the conclusions they reach in discussions. In the aspect of satisfaction, the method that each group has to present a work and make their presentation gives every group member a sense of participation. Besides, they can develop teamwork spirit in the thinking and discussion process.

While each group has to present their work, they also have to assess other groups' work. In order to have an objective result, the final grade of the assessment is composed of three grades: the grade they give to themselves, the grade they give to other groups and the teacher's grade. The final grade is the average of the three grades.

Summative Assessment

This assessment is composed of four parts: student self-evaluation sheet, group discussion self-evaluation sheet, written test and learning process portfolios.

The student self-evaluation sheet comprises individual performance and group performance parts. The individual performance part focuses on a learner's learning attitude and participation in the instructional process, including class participation and homework participation. The group performance part mainly focuses on the homework performance, teamwork, innovation and group sportsmanship. The assessment grades are excellent, good, average and poor. To avoid that learners give grade carelessly, if a learner give grades of "excellent" or "poor," he or she has to provide remarks to let the teacher understand why the grade is given.

The group discussion self-evaluation sheet is filled out by group members together. There are ten questions on this sheet and each question can be graded as "excellent", "average" and "poor." The purpose of this sheet is to help group members to communicate and share thoughts through discussions. They can also learn from the process of reviewing their own performance and use the results as a reference when they have the same types of assignment next time.

The written test is made by the teacher according to the instructional content. There are menu-style combination questions, dialogue-style combination questions, and listening test based on dialogues of ordering meals. Students are also asked to make a script describing the dialogue between a waiter and a customer ordering meals. When taking the test, students are allowed to refer to handouts the teacher gives them in class. The written test is used to evaluate how familiar a learner is with the words and phrases they learn in class and to what degree or she can apply them. Students' listening comprehension ability is also evaluated.

The learning process portfolio contains all the results students achieve during the whole learning process and in all learning activities. Each group has a portfolio, which collects their creative menu, recording of radio drama (or audio file), script of radio drama, and all assessment and evaluation sheets. All the contents can be bounded together in order of learning to form a complete learning process file.

Learners' Questionnaire

The learners' questionnaire is mainly used to evaluate what learners think about this instructional activity, their learning attitude, and how an individual learner or a group is doing in their learning. In other words, this questionnaire evaluates learners' satisfaction. There are twelve questions in the questionnaire and learners can select from three answers, i.e., agree, no comment and disagree.

Checklist For Teachers' Teaching Plans

This checklist is mainly used to evaluate if the teaching plan the teacher makes for this instructional activity is appropriate and if there are some elements that the teacher omits when making the teaching plan. There are eleven questions in the checklist. They are designed to evaluate if the instruction design is appropriate, if the teaching plan can create expected situations, class atmosphere and assessment design. These questions are answered with "yes" or ""no."

5 V. RESEARCH RESULTS AND FINDINGS

This research used PBL methods to implement instruction and had the following findings:

1. Students clear understood the thinking process and how to solve a problem.
2. Students were able to design a creative menu, make a radio drama and present them in front of the whole class.
3. Students were able to conduct self-learning, increase their own interest in English and improve their English proficiency.

In the instructional process, teamwork spirit, sportsmanship and a thankful altitude were observed in class. The class atmosphere was harmonious.

6 CONCLUSIONS AND FUTURE DEVELOPMENT

This research mainly used thematic teaching methods and PBL theories to construct its major structure along with a series of English instructional activities, including situational teaching, brainstorming, creative thinking instruction, group discussion, movie instruction and English songs instruction. The design process is composed of six steps; that is, literature review prior to class, instructional theory analyses, design of teaching plans and activities, teaching experiments, teaching assessments and Instructional efficacy analyses. In the end, the research reaches five conclusions.

1. This design can increase learners' interest in learning English.
2. The instructional activities designed in this research can create a more harmonious atmosphere in class and improve learners' attitude in cooperation with other learners.
3. Fro the assessment results, it is found that the instructional activities are able to help learners order meals with English and use correct restaurant terminology.
4. If the school's administrative units can participate in the design of this instructional activity, related experiment can be implemented in a more efficient way.

This instructional activity was designed only for English instruction. In the future, it can be designed as a cross-discipline activity, integrating with, for example, computer-related departments or electronics-related departments. It can also be used by teachers from different subjects.

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