

Study on Converged English-Science Teaching Methods Using the PBL Model in Elementary Schools

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PBL 모형을 적용한 초등학교 영어·과학 융합 수업

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Abstract The information and knowledge of modern society in the 21st century is changing rapidly. Based on this social change, the ministry of education introduced STEAM (Science Technology Engineering Art Music) in 2011 to foster creative convergence talents. Therefore, this study is based on the PBL model that learners participate in the class voluntarily to develop appropriate talents in the 21st century. The combined subjects were English, which is the world's official language, and Science, which is found in almost all the fields with the development of the 4th industrial revolution. As a result, learners could define the problems and solutions during the English class and take part in the group activity actively to obtain the problems and solutions of environmental pollution during the Science class. Through this, learners answered that they had a great understanding of learning (86%), high motivation for learning (100%), improved self-confidence (100%), and improved collaboration and creativity (100%). Unfortunately, this study does not progress actively due to the entrance exams, which still require accurate answers rather than the necessity and effectiveness of convergence education. To foster talents suitable for the present age, more active research should be applied to a range of educational sites.

요약 21세기 현대 사회의 정보와 지식은 급속도로 변화하고 있다. 다양한 시각으로 창의적 및 비판적 능력으로 해결해 나갈 능력이 필요로 하다. 이러한 사회적인 변화에 따라 2011년 교육부가 창의 융합형 인재 육성을 위해 STEAM(Science Technology Engineering Art Music)이라는 융합 교육을 제시하였다. 그리하여 본 연구에서는 21세기에 알맞은 인재 양성을 위해 주도적으로 학습자들이 수업에 참여하는 PBL 모형을 기반으로 수업이 진행되었다. 과목은 세계 공용어로 자리매김한 영어 수업과 4차 산업혁명으로 인한 발전으로 거의 모든 분야에서 찾아볼 수 있는 과학 수업을 융합하여 실제 수업에 적용하였다. 학습자들을 대상으로 한 설문 조사 및 교사 관찰을 통해 다음과 같은 결과를 얻을 수 있었다. 학습자들이 영어 교과 주제인 "Problem and Solution"을 정의할 수 있었으며 이를 바탕으로 과학 교과 주제인 "Environment Pollution"의 문제점과 해결책을 얻기 위해 그룹 활동을 활발히 진행할 수 있었다. 이를 통해 학습에 대한 높은 이해력 (86%), 학습에 대한 높은 동기부여(100%), 자신감 향상(100%), 협동력 및 창의력 향상 (100%)이라는 답변을 하였다. 본 연구를 통해 안타까운 점은 융합 교육에 대한 필요성과 효과성보다 여전히 정확한 답을 도출해야 하는 입시 교육으로 인해 활발히 진행되지 않는 점이 있다. 현시대에 알맞은 인재 양성을 위해 더욱 활발히 연구되어 다양한 교육 현장에 적용이 되어야 한다.

Keywords : Creative and Critical Skills, English, Science, PBL Model, STEAM(Science Technology Engineering Art Music)

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1. Introduction

1.1 Necessity and purpose of research

In the past, the ability to acquire fragmentary knowledge focusing on entrance exams was the goal of education and a teacher-centered method was mostly conducted. It brought that knowledge simply built up in learners' head so learners didn't know how to apply it in real situations. These days the information and knowledge of modern society in the 21st century is changing rapidly so it requires the ability to solve the complicated problems and integrated thinking skills. The ability to improve creative and critical skills should be improved on diverse perspectives[1]. Following this change, the word "convergence" has been used in earnest since the 2009 revised curriculum, and we are actively promoting the convergence education that has been supported only by gifted and university education to all elementary and secondary school from 2011 to 2015[2-3]. According to the 2015 revised curriculum Q & A data released by the Ministry of Education in September 2015, the basic direction of the 2015 revised curriculum is to equip all students with a basic understanding of humanities, society, and science and technology. In order to grow as a creative convergence talent, each subject suggests core concepts and principles rather than short knowledge, and optimizes the amount of learning so that students can participate in debate and experimental practice activities, and develop their roles.

Therefore, this study analyzed PBL model based on constructivism, which is foundation of learner-centered education and researched the convergence education of Korea and other countries to foster talented students suitable for the 21st century. Also this study examined the importance of the converged education using English and science that English which is the

world's official language and Science which is found almost all the fields with the development of the 4th industrial revolution[4-6].

In the introduction of this study, the concept of PBL and the concept and necessity of convergence education will be introduced. We will examine the English curriculum goals and the Science curriculum goals used in this study. This course introduces a total of six teaching and learning lesson plans.

2. Theoretical Background

2.1 PBL concept

PBL model is not a teacher-centered class but it is based on constructivism that students take part in the class voluntarily with responsibility. In PBL model, ill-structured problems are key-concepts that students try to solve them with their group mates, so they are able to achieve the goal without teacher's assistance[4-5].

2.2 STEAM concept

If we look at the meaning of "fusion" and "convergence" according to the standard Korean dictionary, different kinds of things are melted and merged together or made indistinguishable from each other[4]. Likewise convergence education in the education field can be regarded as education that converges knowledge or skills of various fields in order to cultivate an integrated, creative and thinking talent. The reason why the U.S. implemented the convergence education is learners' performances in Science and Math were very declining and they were not interested in engineering and technology. STEM(Science Technology Engineering Mathematics) education was implemented and the U.K. Finland, Israel carried out it as well. In America, President Barack Obama ignited a movement to teach students 21st-century skills to

become more competitive with other countries in the fields of STEM. It resulted millions in funding were invested in many schools to promote STEM study[7-8].

Like the above, the convergence education has become important in the educational flow around the world. In 2011, the Korean government created a new education policy by adding Arts to STEM (Science Technology Engineering Mathematics) which was emphasized in America[7-8].

Instead of fragmentary knowledge, diversified knowledge should be applied to the real life to solve the problems through the convergence education[9].

3. Body

In this study, the combined subjects are English which is the world's official language and Science which is found almost all the fields with the development of the 4th industrial revolution. In addition, PBL model based on constructivism is applied to the lesson. According to the survey before the class, learners answered English and Science are difficult subjects. Research subject and textbooks were used in this study are introduced below.

3.1 Research Subject

The school A, the research site, is divided into classes for each grade level for English specialized education, and PBL classes were conducted for seven learners in the upper class. They are fourth grade students.

3.2 English Language Learning Objective

The school A, the research site, is using Pearson Longman Cornerstone for specialized English education. The textbook is published by Longman Pearson and it helps learners to

become fully proficient in four skills of English: Listening, Speaking, Reading, and Writing. The topics of reading texts are about Language Arts, Social Studies, Math, and Science.

3.2 Science Learning Objective

The school A, the research site, has two Science classes every week. The textbook is McGraw Hill Education Science A Closer Look. The goal of its education is to help learners more motivated and excited in Science through various dynamic scientific activities.

4. Research Method

4.1 Considering the topic and learning contents

Curriculum of the English textbook and the Science textbook for the 1st semester were reviewed to find the common topics. The common topic that can be learned at similar times is problems and solution. This is a table for the comparison between topics from English textbook and Science textbook.

Table 1. Textbook of English and Science

Subject: English	
Textbook	Pearson Longman Cornerstone 4B
Unit	Unit 4 Problem-Solvers
	Build Unit Vocabulary
	What do you know about problem solvers?
Subject: Science	
Textbook	Science A Closer Look 3B
Unit	Ecosystems
	Living Things in Ecosystems
	Living Things Change Their Environments

The goal of Unit 4 Problem-Solvers in English subject, learners are able to define problems and solutions, describe problems and solutions for a variety of situations. In the Science textbook,

learners are able to think of environmental pollution and describe its problems and solutions. The two lessons are selected as above because they have the same learning objectives for problems and solutions.

4.2 Learning objective setting

The learning goals of the English and Science subjects were set as follows.

First, Learners are able to define problems and solutions, describe problems and solutions for a variety of situations.

Second, Learners' creativity and cooperation can be improved through problem-solving.

Third, Learners are able to think and learn about environment pollution in real life with various perspectives, and learners can be aware of social and scientific problems.

4.3 Developing PBL problems

The core of PBL learning is the problem. Learners should understand their roles and situations and define the problem. The contents of problem should be ill-structured and related to the real life to make learners solve the problem voluntarily. The ways of presenting the problem are verbal description, video clips, handouts, newspaper, and articles. After constructing the problem, it is necessary to examine whether it is appropriate to the level of the learners, that the information is well provided for the inquiry, and that the characteristics of the learners are well reflected.

Through this procedure, the PBL problems of English and Science convergence class were completed. The goal of Chapter 4 Changes in Ecosystems Lesson 1 Living Things Change Their Environments is to think about environmental pollution and identify the solution. The problem is set as follows.

[Problem]

Good afternoon, we're going to start Yujung

student council meeting now. Have you ever seen a trash can in the classroom and a recycling bin on the ground floor at Yujung School? There is a big amount of trash we can see every day. We've heard about pollution from various mass communication. First, we should make a solution. As a director of environment, please prepare for those questions until next student council meeting in Power point for the presentation.

Question #1 What are different types of pollution?

Question #2 What are the causes of a big amount of trash?

Question #3 How does pollution affect living things (people, animals, plants)?

Question #4 How can people protect the environment?

4.4 Teaching and learning play by class

The lesson plan conducted in this study consists of 6 lessons and the subjects and contents of each lesson are as follows.

1st Period (English class)

- Organize ideas by problem and solution.
- Define Problem and Solution.
- Choose a problem to write about.
- Think about how you solve the problem.

2nd Period (English class)

- List the information in a problem and solution chart.
- Present

3rd Period (Science class)

- Watch the video clip of pollution and pictures of trash can and trash of A school
- Present PBL problem
- After reading PBL problem, students share ideas to complete the project plan: ideas, facts, learning issues, action plan.

4th Period (Science class)

- Share the project plan.
- Discuss on types of pollution, causes of a big

amount of trash, how pollution affects living things, how to protect the environment.

- Talk about solution.
- 5th Period (Science class)
 - Make the PowerPoint slides to draw up the solution.
 - Present by groups.
- 6th Period (Science class)
 - Evaluation Time: journal, self-evaluation, peer-evaluation.
 - Survey
 - Wrap-up the discussion.

4.5 Implementation

In the PBL implementation phase, a teacher should be a guide and facilitator to make the exploratory, problem presentation, project plan writing, project planning presentation, individual research, team research report writing, team research report presentation, problem solving presentation, evaluation steps smooth.

Project planning writing needs creative thinking and critical thinking while cooperating with peers. In this step, 'What I already know', 'What I want to know', 'What I should know' should be included. After this step, the presentation is required. Revision may occur after presentation. Individual research and team research are required for problem solving. This is a process of making solutions based on expertise and information. After creating the report, learners present their works. Through the presentation, learners' confidence can be increased. Based on the train model road of Cho Yeon-soon (2006) based on the entire problem-based learning model, the execution steps were designed as follows.

4.5 Evaluation and survey

After 6th lessons of English-Science convergence class, journal, self-evaluation, and peer-evaluation were conducted. The goal of convergence education and PBL is not to extract the right

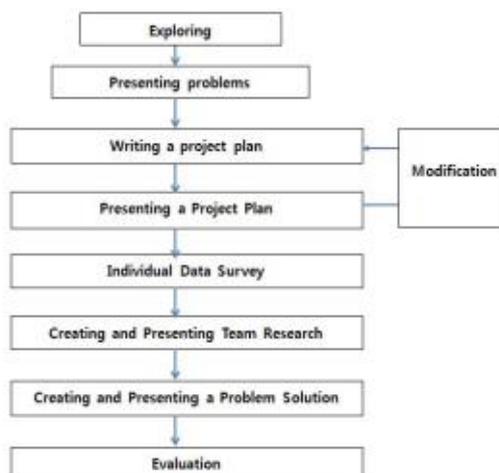


Fig. 1. Implementation

answer, but it should be process-based evaluation rather than result-oriented evaluation

After all classes, the survey was conducted. The result is learners had a high understanding of learning (86%), high motivation for learning (100%), improved self confidence (100%), and improved collaboration and creativity (100%). What we learned from the interviews is the learners think it was good that after the lessons of problems and solutions in the English class, speaking and writing activities were conducted in English so that students could freely communicate in English about the problems and solutions of environmental pollution in Science class.

5. Conclusion

Creative thinking, convergence thinking, problem-solving skills are required in the 21st century of modern society rather than memorizing knowledge. For this purpose, STEM(Science Technology Engineering Mathematics) was implemented in the U.S. and In 2011, the Korean government created a new education policy by adding Arts; it is STEAM(Science Technology Engineering Arts Mathematics). However, PBL

based on constructivism and convergence education are not generalized at the school site or may be conducted at a one time level in order to enter prestigious universities and employment only.

To build the capacity and potential to adapt and lead to global change, this study focuses on convergence education based on PBL model. The combined subjects are English which is the world's official language and Science which is found almost all the fields with the development of the 4th industrial revolution. What we know from this class is a high understanding of learning (86%), high motivation for learning (100%), improved self confidence (100%), and improved collaboration and creativity (100%). From the learners' point of view, it was helpful that after the lessons of problems and solutions in the English class, speaking and writing activities were conducted in English so that students could freely communicate in English about the problems and solutions of environmental pollution in Science class.

Since the importance and effectiveness of convergence education based on PBL model has been improved, teachers should feel responsible in the education field and research more active and foster future talents.

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<관심분야>

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