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# Applying the ADDIE Instructional Design Model to Multimedia Rich Project-based Learning Experiences in the Korean Classroom

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The purpose of this study was to apply the ADDIE instructional design model to develop multimedia rich project-based learning methods for effective instruction in a Korean mechanical engineering high school. This study was conducted as action research based on a high school situation. The study included 40 participants in a class purposively selected from 52 classes at 2080 student high school. Data were collected through observations, surveys and artifacts. Results indicated the multimedia rich project-based learning allowed students to take part in learning activities and there was close cooperation with and among group members to create better products. Also, the flexibility in the project-based learning environment allowed the participants to make decisions about their abilities, resources, and plans. Recommendations and implications for teacher educators as well as in-service and pre-service teachers are also presented.

*Keywords : ADDIE instructional design model, multimedia rich project-based learning, project-based learning*

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# Introduction

In Korea for five years from 2000 to 2004, I taught General Mechanical Engineering at a mechanical high school. At that time, multimedia classrooms were equipped with advanced personal computers. Information communication technology (ICT) and multimedia technology were used in instruction and learning activities to improve the effectiveness of instruction and learners' learning. However, research studies related to how those technologies were used and integrated into instruction or learning activities were needed, because there were not enough related research studies at that time in my country. To develop the methods for effective instruction and learning, it is very important to identify instruction and learning background. The next section of this paper highlights some important situations that I had when I taught in my country.

**School background**

The school at which I taught students was J Mechanical Engineering High school. The school was equipped with advanced personal computers, cutting-edge facilities, and teaching and learning equipment so that better instruction and learning activities could be conducted. Three multimedia classrooms were designed to improve information skills and ability and multimedia technology for students. The school spent $350,000 USD to create the multimedia classrooms. The software for the classrooms included Director Version 6.0, Macromedia Authorware version 4.0, web editor Namo version 5.0, and other need software. Hardware included cutting-edge computers, video on demand systems, digital encoders and decoders, digital camcorders, and digital cameras, Network systems included a new server and Internet equipment. An important issue in the school was how those resources should be used effectively and efficiently for instruction and students learning activities.

**Subject background**

General Mechanical Engineering was a core subject for third year students of the

mechanical engineering high school. This subject consisted of the theoretical contents for mechanical engineering. The school assigned three hours per week to teach this theory subject. In addition, there was another subject, Mechanical Engineering Practice, to develop students' hands-on skills. Six hours a week were assigned to teach this subject. General Mechanical engineering was usually taught in the classroom, however Mechanical Engineering Practice was taught in the shop. Knowing correct and more knowledge for theory for mechanical engineering were essential to obtain skills for mechanical engineering through practice. Therefore, it was very important how teachers enabled students to obtain theoretical knowledge for general mechanical engineering effectively and efficiently.

**Student background**

Life most students, as mechanical high school students graduate high school, they usually get a job and go out into the world. So, they need professional knowledge, skills, and techniques of their task field. Also, in view of their task characteristics they should perform, they need a spirit of cooperation with prospective colleagues and good human relationship skills, because they will have to work together in their workplace

In particular, they need problem-solving skills and creative thinking ability to improve the productivity of corporation in which they will get a job. However, most students rarely had interest in the lecture delivered general theory subjects. Therefore, the students needed programs or learning methods to raise their interest and motivation of theory subjects, enhance their problem solving skills and creative thinking ability, and raise a sprit of cooperation.

**Teacher's background**

As stated earlier, the school spent $350,000 to create three multimedia classrooms to support instruction and learning activities using ICT and multimedia technology. Very often, teachers who delivered instruction in the multimedia classroom gave a

lecture to their students using presentation through the PowerPoint program. Some of students who experience the lecture would take a nap in front of the computer, chat with other students, or navigate the Internet.

With this background, it was very important to develop and implement instruction and learning methods to use advanced multimedia facilities and equipment prepared for instruction and learning, to raise interest and motivation for learning, and to enhance their problem-solving skills and creative thinking ability. Therefore, this project will detail my experience to apply the ADDIE instructional design model in my country, Korea, to develop multimedia rich project-based learning methods for effective instruction and learning results on the basis of this background.

## Review of literature

### Multimedia

There are many definitions of multimedia; however, I will define multimedia as the integration of text, graphics, animation, sound, and/or video (Pinellas County Schools, n.d.). Various research studies have been conducted on whether using multimedia to instruction and learning is effective or not. There are the research results that proper use of multimedia enhances learning methods, learning tools, and the diversity of instructional materials. Bialo & Sivin-Kachala (1996) emphasize facilitating active learning, responding to different learning styles, enhancing collaborative learning, increasing individualized learning and self-paced study, and encouraging greater student independence. Other researchers highlight increased interactivity, exploratory learning, and higher-class retention (Cardenas, 1998; Lyons, Kysilka, & Pawlas, 1999).

Also, according to Mayer and Moreno's (2003) Cognitive Theory of Multimedia Learning (CTML), meaningful learning is active learning in which the learner

possesses and uses a variety of cognitive processes to make sense out of the presented information. The major cognitive processes that lead to meaningful learning include selecting relevant information, organizing that information into coherent representations, and integrating these representations with existing knowledge. Moreno & Valdez (2005) state that multimedia environments have the potential of promoting meaningful learning by varying both the number of representations provided to students and the degree of student interactivity. In fact, having students organize rather than study the preorganized materials will be cognitively engaging, and thus promotes deeper learning. Also, learning will be improved when students are asked to generate their own context for meaning by self-organizing the materials (Bruning, Schraw, & Ronning, 1999).

Therefore, instruction using multimedia should be considered in a creative environment in which learning is facilitated and be designed to facilitate the cognitive organization process during students' meaning making (Schnotz & Rasch, 2005). More recently, Brown, Collins, and Duguid (1989) and Lave (1990) have proposed that learning is contextualized for individuals. Through interactions with the environment, including people and technologies, individuals create meaning. As mechanical high school students I taught, applying and integrating the content of different subject areas at authentic moments in the production process, instead of in isolation or in an artificial setting will help them to generate their own context for meaning and facilitate the cognitive organization process during their meaning making by self-organizing the materials through learning more actively. That is the reason that learning becomes relevant and useful as students establish connections to life outside of school.

Authentic projects or materials also help students make their meaning by addressing real-world concerns and develop real-word skills. In institutions in which learning must be facilitated, instruction is the facilitation of learning (Alessi & Trollip, 2001). It was meaningful to design and develop instruction which allowed the students to facilitate their learning and to enhance their learning transfer using such a

multimedia classroom environment, because the school in which I had taught had an advanced multimedia classroom.

## Project-Based Learning

The school in which I taught had some big problems, such as how to motivate students and how to transfer learning results into real practice. Especially, as 21st century interpersonal skills for people to employ to manufacturing jobs, teamwork and problem solving skills, as well as effective oral and written communications skills, which are highly desirable by business communities are necessary (U.S. Labor Department, 1991). Also, information industrial societies require employees who can communicate and cooperate with people from diverse backgrounds. The question of how the school will raise human resources with the skills and quality stated above will be another problem.

Our educational system is continuing to search for ways to effectively respond to the changing needs of today's global society and an innovative instructional approach that allows them to develop both strong technical skills, as well as the critical value skills related to effective interpersonal and collaborative communication. In an attempt to understand how and under what conditions individuals learn skills and communication stated above best, researchers have attempted to isolate these variables independent from one another, including cognitive styles, learning styles, learning modalities, and various individual cognitive and psychomotor abilities. As suggested by Vygotsky, the most effective learning environments afford learners personal interest and the opportunity to negotiate meaning from others (Brush & Saye, 2000). Thus, pedagogy that fosters personal interests and interactions with peers, experts, resources, and technologies seems to offer promising alternatives to teacher-centered instruction. Some researchers suggest project-based learning as one example of a student-centered learning pedagogy, because it provides the student autonomy over and responsibility for what is learned (Means, 1994; Means & Olson, 1994;

Wilson & Cole, 1991), moving learners to wear expert knowledge. Project based learning encourages individuals to explore and examine a variety of problems and resources to construct personal strategies for handling these problems, as well as negotiate and share solutions (Barrows & Tamblyn, 1980; Bransford et al., 2000; Harel & Papert, 1991).

According to the McGrath (2004), collaborative work is the cornerstone of project-based learning, central to inquiry, research, organization, time and task management, design, reflection, feedback and revision, and public presentation. Some collaboration takes place within a single classroom, some across classrooms in a district, some across the country or the globe. Within a project, collaborations occur between and among students, between teachers and students, and between experts and students. Learning has come to be recognized as fundamentally a social process, and modern views of how to design a learning environment lean heavily on the notion of collaboration with a community of learners. Increasingly, project-based learning is used as an instructional approach to prepare students to succeed in today's dynamic workplaces. In project-based learning, instruction and learning both occur within the context of a challenging project. Just as workers would encounter complicated tasks in the workplace, in a project-based learning environment, student teams are presented with complex problems that focus and act as catalysts for what they need to learn. Typically, projects extend over time to act as interactive vehicles to help students acquire new, necessary knowledge and skill sets.

An individual must be willing or motivated to learn, he or she must be able to learn, the environment must foster learning, and the instruction must be effective for the learner (Jonassen & Grabowski, 1993).

Students learn more when they are creating their own learning opportunities. The "tell me and I'll forget; show me and I may remember; involve me and I'll understand" concept is being acknowledged and implemented in classes nationwide. In light of view above and considering the background of my school, student, subject, and teachers, I thought project-based learning worked well as an instruction and

learning method. Sometimes, multimedia technology offers a a wealth of good tools for collaborative projects and student learning motivation. With the current increased national attention on educational technologies in our schools, I was interested in multimedia rich project-based learning as technology tools for analyzing, presenting, and communicating results, because multimedia technology tools in project-based learning mediate (or can be used to create) digital artifacts (e.g., electronic presentations and Web pages).

## Design Model

Instructional design is a system of procedures for developing education and training program in consistent and reliable fashion. Instruction design is a complex process that is creative, active, and iterative. ADDIE is a type of instructional design model. It is composed of five components: Analysis, Design, Development, Implementation, and Evaluation (ADDIE Instructional Design Model, 2006).

Analysis includes conducting a needs assessment, identifying a performance problem in a business setting or other environment, and stating a goal. Design includes writing objectives in measurable terms, classifying learning as to type, specifying learning activities, and specifying media. Development includes preparing student and instructor materials as specified during design. Implementation includes delivering the instruction in the settings for which it was designed. Evaluation includes both formative and summative evaluation as well as revision. The ADDIE model is not very complex, but it is thorough enough to be quite useful. Therefore, I applied the ADDIE model to develop a multimedia rich project-based learning using student-centered learning methods, not teacher-centered instructional methods.

## Analysis

To develop a multimedia rich project-based learning method, consideration must be given to instructional settings, such as instructional equipment and facilities, students' background and teacher and subject background. I conducted a needs assessment in the form of observation, interview, and survey to identify how to raise students' interest toward learning and a spirit of collaboration, how to increase usage rates of advanced and cutting edged equipments and devices equipped in multimedia classrooms, and how to improve to transfer learning into real world.

While I delivered instruction to my students, I made the following observations: First, many took a nap or were distracted (chatting and surfing the web for content unrelated to instruction) while I delivered a lecture in the multimedia classroom. Second, students lacked interest in learning. Third, students preferred hands-on activities to lectures about theory subjects. Fourth, advanced equipment, devices, software, and hardware outfitted in the school's multimedia classrooms were not used effectively. Finally, as students of a vocational school, the students needed interpersonal skills to work with others. After the students graduate, they will enter into an industrial society.

I also conducted a survey to identify how students felt about a multimedia classroom, their level of comfort with multimedia technology, and whether they were interested in that the method of delivering instruction was changed from lecture to project-based learning. As a result, I could identify that students' operating levels of multimedia technology were varied and they were interested in changing the instructional method. Considering these results that I observed through instruction and I surveyed by questionnaire, I determined to that it would be appropriate to conduct multimedia rich project-based learning.

## Design

For their project, students created multimedia content related to their subject,

General Mechanical Engineering, using applications such as a word processor, MS PowerPoint, a web editor, Macromedia Flash, Macromedia Director, or Macromedia Authorware, Students then presented their creations to others in the course.

I designed the project process so that students could conduct their project efficiently. The project process I designed is illustrated in figure 1, below:

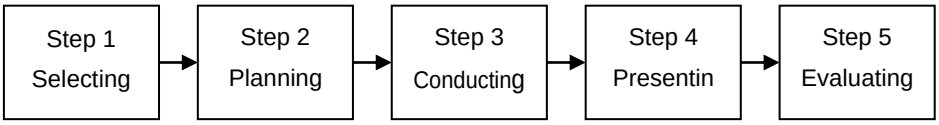


Figure 1. Project Process

In the selecting step, students formed a group and selected a topic for their project. In the planning step, students assigned their members' tasks, listed equipment or devices, hardware, and software needed to conduct their project, calculated their costs needed to conduct their project, and planned where, when, and how they were to collect materials related to their project. In the conducting step, to create multimedia content about their topic, students collected primary materials related to their project topic using a digital camera, digital video camera and through interviews with experts related to their topic. They collected secondary materials related to their topic, using the Internet, books, magazines, and journal articles. They created multimedia content using materials and sources collected. To create their multimedia content for the project, they used a word processor, MS PowerPoint, a web editor, Macromedia Flash, Macromedia Director, or Macromedia Authorware. In the presenting step, students presented their multimedia projects to other students and teachers. In the final step, evaluating, students were evaluated with rubrics that were constructed by the teacher. Group members and the teacher served as evaluators for the project.

## Development

I developed guidelines to lead students in keeping track of their project while conducting the project. Guidelines for the project-based learning included activities that students should engage in each week to conduct their project successfully and how teachers should help them on each activity to conduct their projects effectively and efficiently and to facilitate their learning. Specifically stated, the guideline provided an overall plan for the project showing when, how, and what students should do to conduct their project, and when, how, and what the teacher should do to facilitate their students' projects from the first week to the last week, ending with the 19th week.

Also, I developed a specific weekly guidance plan, guiding students through their project-based learning activity, to help them conduct their projects effectively and efficiently. The guidance plan included the name of learning topic, learning objective, the content related to curriculum, materials, sources, and needed supplies. Also included were, facilities, equipment, and tools needed for the project, the object of evaluation, and teachers' guide to help students conduct their project effectively every week.

I developed rubrics to objectively evaluate students' activities during creation of their projects, as well. To structure evaluation of students' activities during their projects, I divided evaluation areas into nine categories: 1) group activities, 2) selection of topic, 3) planning, 4) collection of materials, 5)conduction of project, 6) products, 7) presentation, 8) portfolio, and 9) students' evaluation area. The evaluation areas for group activities were participation in group activities, collaboration, and discussion between group members. The evaluation areas for selection of topic area were relevance to between subject and project topic, creativity of topic, and pertinence to real world of topic. The evaluation areas for planning for the project were relevance of time schedule, whether students planned required facilities, tools, and devices for doing project, and whether students planned an allotment of roles. The rubrics for the project are presented in Appendix E. In

addition to the rubric, I developed a checklist to evaluate the learning result of students at every step of projects.

## Implementation

To facilitate the students' projects, and to motivate students when they felt difficulty with conducts their project, I help students with their project and encouraged them in various ways. First, I conducted an orientation for students about the basics of project-based learning, how to conduct projects, and how they would be evaluated. When students selected a topic for their project, I presented examples of previous projects. When students made a plan for their project, I would demonstrate the planning process to them. When they intended to collect materials related to their project, I let students know of some sources for the materials and demonstrated to them how to create primary materials using digital camera, digital video camera, and scanner. As students created their products for project, I circulated around the class, going group to group observing how their projects were going, giving advice related to their project, and encouraging students to improve their projects.

To help the students present better final projects to others, I instructed them in ways to present to others, having a proper presentation attitude, and gave opportunities to practice their presentations. After the completion of their project, each group submitted its portfolio of work accumulated during the creation of their project. Students were instructed on how to organize their portfolios, as well. Their accomplishments and achievement at each step of the process were evaluated with a rubric.

## Evaluation

When I evaluated students' achievement on project-based learning, the biggest problem encountered was how to improve the objective of evaluation. To improve

the objective of evaluation, I created an evaluation rubric, and then made a specific check list to evaluate students' learning on the basis of the rubric. Also, to eliminate possible teacher preconception of student grades, and to provide more objectivity, peer group evaluations were used in the total grade. An example based upon the evaluation checklist for students is presented in Appendix H. This example shows how student group 3 evaluated the rest of groups.

# Results

A framework for the development of effective project-based instruction was developed by following the instructional design process of analysis of needs, design, development, implementation, and evaluation based on the ADDIE model. Using the ADDIE model as instructional design model for this instructional unit worked very well. Based upon evaluations, the ADDIE framework facilitated the creation of successful student projects.

## Evaluation of Cognitive Constructs

I observed that during the project-based learning activity, students' planning ability was improved by discussing matters with their own group members, setting up the plan, and editing their plan. I observed that their level to analyze the content related the subject, synthesize the content, and organize the content increased, as well. Also, students seemed more motivated to actively participate in learning activities, resulting in less distraction (and no naps).

## Evaluation of Social Constructs

Students were required to visit industries or institutions related to their project

topic to collect primary materials or information required to complete their project. Frequently, they visited a public city library to collect secondary materials and information. During the visits, they would contact individuals in charge of work related to their project topic to set up the schedule of when they should go there, what they should have with them, and who they should visit with. When contacting the person in charge of the work (who usually they did not know), they would obtain visitation permission via telephone or through visiting the person in advance. To obtain this permission, they attempted to contact different places and individuals until they were successful. While they conducted these activities, I observed that they learned how they should have relationship with others who they did not know and how they should keep their attitude and courtesy when they had contact a person with whom they did not know. Also, when set up the groups for this project-based learning activity, students selected their own group members. As the result, I observed that they took part in the learning activities very actively and that there was close cooperation with and among group members to create a better product.

## Evaluation of Facility Use

While they conducting their learning activity, collecting materials, making their projects, and moderating their products, students often used computers, various software, such as MS Word, MS Excel, MS PowerPoint, web editor, Macromedia Director, digital still and video cameras, scanners to scan images, and a server to save materials. Students became accustomed with using such tools, facilities, and software. With this familiarity, I observed a higher rate of use for daily task than before conducting multimedia rich project-based learning activity.

## Evaluation of Student Learning

Using the rubrics enabled me to evaluate student projects more objectively. Also,

evaluation was improved by giving students the opportunities to evaluate other groups' learning activities.

### Other Considerations

Having students conduct projects for themselves and give the teacher the role as a facilitator and advisor during instruction allowed students and the teacher better opportunities to communicate between each other. By using the projects of previous students for instruction about the projects, I could reduce the time needed to develop instructional materials for future project-based learning activities. In addition, during the activity, students appeared to learn from one another by exchanging information and knowledge about how to use the computer, hardware, and software.

## Conclusion

### Implications

As identified through the review of literature, researchers could rarely find practical research related to multimedia rich project-based learning based in a mechanical engineering high school. However, this action research was conducted, as practical research in such a school situation. Therefore, this research may give teachers in a similar teaching environment (mechanical engineering high school) and opportunity to find ways to employ multimedia rich, project-based learning into their classroom.

### Obstacles

Even though rubrics were developed in advance of instruction, it was still difficult to evaluate students' knowledge of the content. For students to conduct and

complete their projects effectively and efficiently, the teacher must endure lengthy development of materials for instruction and learning, and address how to keep students motivated during their learning, and how provided them with needed materials and instruction.

## Recommendations

The final products are completed by students after they conduct several steps for their multimedia rich project-based learning activity. To help students conduct their projects effectively and efficiently and to keep their projects on track, the teacher should establish a plan of objectives and specific activities for students. A list of applications, facilities, and tools needed for the project, and evaluation rubrics and methods must be thoroughly developed. In addition, a yearly plan and performance guidelines for project-based learning activity should be developed.

The teacher should give students the opportunity to complete their projects as independently as possible. Also, the teacher should encourage students to be actively engaged with their learning.

At the beginning the project-based learning activity, the teacher should show the students the evaluation rubrics and show them how they will be evaluated on their projects. In addition, an evaluation of their project during each step should be completed, utilizing rubrics, to give immediate feedback and motivate learning and engagement.

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