



The Innovative Lesson Plan for Enhancing Students' Ideas in Physics About Application of Newton'S Laws Through STEM Education

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The innovative lesson plan for enhancing students' ideas in Physics about application of Newton's laws through STEM Education

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Abstract. This paper aims to clarify the innovative lesson plan learning activities about making facilities or assistance methods for disabled or elderly. The activities provide the application of Newton's laws concept based on the development through the STEM education. The STEM education learning activities were developed by Sutaphan and Yuenyong (2019) "The context-based STEM education learning approach". This activity is started from the social issue identification of the uncomfortable in disabled or elderly from the urban area. This issue engages students to develop the projects and find the solutions. The context-based STEM education learning approach can be used to facilitate the developing ideas related to making simple tools for designing the facilities or assistance methods for disabled or elderly. Teachers may motivate the students to apply their knowledge from physics (e.g., application of Newton's laws or friction) to design the prototypes or products through engineering design process. This paper may have implications for designing the STEM education learning activities.

1. Introduction

The science curriculum framework for basic education in the Thailand set indicators and core content. That the learners need to study as a foundation in order to be able to apply this knowledge to life or further studies in a profession that requires science by arranging the order of the difficulty of each content in each level so that knowledge is linked to the process learning and organizing learning activities that encourage learners to develop ideas both creative thinking and critical thinking. There are important skills, both scientific process skills and 21st century skills in researching and creating knowledge through the process of searching for knowledge and able to solve problems systematically. Students can make decisions using a variety of information and testimonials. [1]

Studies have noted that science process skills are effective on teaching and learning about Science [2]. Teaching strategies such as inquiry teaching, problem solving, problem based learning and project based learning relies heavily on the effective use of the science process skills by students to complete in an investigation [3]. Problem solving is considered as the most important constructivist learning method [4]. Constructivist course goals should provide realistic problems that elicit social cognition, facilitate student application of external knowledge sources, and encourage students to utilize scientific reasoning. Students are more likely to persist in pursuit of problem solutions if they feel efficacious, that is, if they judge themselves as capable of solving the problem [5]. Self-efficacy can be promoted by

encouragement, but is best promoted by actual problem solving success. Students, as well, can apply their scientific knowledge when trying to find a solution about the problem found in the society.

Education gradually increases adjustable at the moment that focusing on the integration of knowledge, especially the STEM education that allows students to be a multitasking citizen with various interests, abilities, and experiences to enhance critical skills in the 21st century workforce (e.g., problem-solving, creative thinking, collaborative teamwork, and technology literacy). Thailand is one of the countries that has begun introducing the STEM education as a spearhead education. Moreover, the concept of STEM in Thailand becomes popular in recent years, particularly in higher education. It can be said that the concept is gradually developing in Thailand. The purpose of learning according to the full educational approach is to encourage learners to recognize and value learning in science, technology, engineering, and mathematics. Students see that subjects in STEM can be utilized in daily life [3]. This paper focuses on the application of STEM education about facilities or assistance methods for disabled or elderly to be alternative product ways to solve the basic problem that involved with every single life of people in their country such as comfortable in transportation, safety in life, and enjoy living in the city.

This paper aims to integrate the knowledge of science, technology, engineering, and mathematics (STEM) to the science classroom and reflect the ideas from the classroom activities and applied those to the complex tasks in their lives. Moreover, students are more persistent in the pursuit of problem-solving based on scientific knowledge.

2. Developing STEM education learning activities: design facilities or assistance methods for disabled or elderly

The developed lesson plan of the designing of facilities or assistance methods for disabled or elderly through the STEM education. The STEM education learning activities were developed by Sutaphan and Yueyong [6]. The context of Thailand is entering an aging society from 2005 to 2014. 10 years ago, Thailand had elderly than 10 percent of the total population and increases to 15 percent due to the urban expansion. As a result, the elderly or the disabled move to the city, thus becoming a full-fledged elderly society. The urban environment causes many problems for the elderly such as the buses have steep stairs, steep pedestrian overpasses, these make difficulty for the elderly or disabled to use wheelchairs, footpaths for disabilities are level uneven and obstructions, and the most important problem is not having enough parks.

Sutaphan and Yuenyong [6] the context-based STEM education learning approach consists of 7 stages. These included (1) Identification of social issues, (2) Identification of potential solution, (3) Need for knowledge, (4) Decision-making, (5) Development of prototype or product, (6) Test and evaluation of the solution, and (7) Socialization and completion decision stage. The 7 stages of context based STEM education teaching approach, the activities may motivate students to practice knowledge for designing something related to produce facilities or assistance methods for disabled or elderly (e.g. process of making facilities for disabled, city plan).

The lesson study is collaborative planning of a research lesson because teachers have to build a small groups (3-5 teachers) of teachers who teach students in same level and/or content. Then, they begins to design the design the lesson together. After the lesson is designed, a teacher from group will teach the lesson. And, the rest of group members will observe and collect data about the lesson process. The data collection may focus on the

student's learning in content being studied, and diversity of students' issues of learning. Then, each member of group will reflect his or her interpretation of classroom data collection to the group as individual reflections. Based on these reflection, the group have to review and revise the lesson for the next teaching. And then, another group member will teach the revised version of lesson plan to another class of students. And, the group may keep doing classroom observation and interpreting data for giving reflection for further customization [6]. To suggest teachers going on culture of lesson study, many educators provided the cycle of lesson study. One of those is about the cycle of plan, do, and see. Inprasitha [7] suggested that lesson study in Thai school could be implemented for 3 simple steps. These included collaboratively designing research lesson (Plan), collaboratively observing their a group member teaching the research lesson (Do) and collaboratively doing post-discussion or reflection on teaching practice (See).

The development of initiative the innovative lesson study learning activities on Physics was processed based on Lesson Study through STEM Education. Based on lesson study, teachers discussed how to enhance students' about the application of Newton's laws through STEM Education. Teachers began to raise the real world problems that related to students' context of facilities for disabled or elderly in Thailand. Teachers selected some real world problems which could align to Thailand science curriculum. One of the teachers agreed to present the lesson based upon the lesson plan made cooperatively with his or her colleagues. The rest of the group's teachers take on the role of active observers in taking notes on what is happening in the classroom. All of the teachers then met again as a group for analysis, criticism and evaluation of the lesson plan in order to examine the appropriateness of teacher's performance, materials used and problems involved in enhancing students' learning about physics ideas on the application of Newton's laws. Finally, teachers discussed necessary revisions to the lesson plan based on their observations and reflections. Through the lesson study, the innovative learning activities, then, will be categorized.

The making facilities or assistance methods for disabled or elderly in STS education was developed through teaching as provided in the table 1.

Table 1. Lesson Plan on making facilities or assistance methods for disabled or elderly in STEM education

Stage	Activity
1. Identification of Social Issue	1. To starting social issues, teacher may engage their students by present the pictures and VDO clip-showed about the daily difficulty and uncomfortable of the disabled and the elderly in the urban cities. 2. Teachers may provide some questions to probe students to perceive the key ideas of problems. Teachers raise the issues, "From the video, Do you have any questions ?", and "What are the problems that they are facing?". 3. Teachers raise the social issue about transport problems for people with disabilities and the elderly and asks students, "What are the causes of the problems?" and teachers allow students to formulate as many issues as possible and cover all areas. Determine the scope of the problem and select the most appropriate issue with explanatory reasons.
2. Identification of Potential Solution	1. Teachers divide students into groups of 5-6 people each. Students and teachers discuss about the designing of facilities or assistance methods for disabled or elderly using materials that are easy to find, not costly & functionality. 2. Assign students brainstorming ideas about how to design a device.

3. Need for Knowledge	<p>PHYSICS (2 hours)</p> <p>1. The related knowledge that will be raised includes the application of Newton's laws.</p> <p>1.1 Students may do some activities about Newton's law to explain that one of the ways</p> <p>Teachers assign students to write freebody diagram and find the force acting on a stick 2.0 kilograms mass by</p> <ul style="list-style-type: none"> - Case 1: The stick is placed still on a slippery floor. - Case 2: The stick glides over a rough surface at a constant speed of 2 metres per second for a distance of 5 metres. - Case 3: The stick tied with a soft rope vertically. - Case 4: The stick is on an inclined floor at an angle of 45 degrees to the level. With a kinetic friction coefficient of 0.3. <p>This is some background information for students. Allow students to explore the materials, using worksheets for guidance, and then have a classroom discussion to highlight the main learning points.</p> <p>1.2 What results do you get? Students will write down their answer on a worksheet.</p> <p>You can see more activities at http://proj14.ipst.ac.th</p>
4. Decision-making	<p>PHYSICS (1 hour)</p> <p>1. The students design and easy tools facilities or assistance methods for disabled or elderly. They should apply scientific principle, friction, Newton's laws and other knowledge for presentation to the class.</p> <p>2. Let them draw the draft of their design on a paper and indicate the materials that they are going to use and the reason behind using those.</p>
5. Development and prototype or product	<p>PHYSICS (1 hour)</p> <p>1. The students will create a facilities or assistance methods for disabled or elderly using the materials that they have proposed.</p> <p>2. The students will create a facilities or assistance methods for disabled or elderly using Solidworks.</p> <p>Teachers can use whatever modeling software you are comfortable with, but teachers can use, for instance, Google Sketchup instead of Solidworks.</p> <p>3. When the design is finished able to build facilities or assistance methods for disabled or elderly by ordering a factory.</p>
6. Test & Evaluation of the solution.	<p>PHYSICS (1 hour)</p> <p>Let the students develop ideas of how their facilities or assistance methods for disabled or elderly will work.</p> <p>Each group provides a conceptual framework for testing and evaluation what criteria of your group draft must to be considered successful.</p>
7. Socialization and completion decision stage	<p>1. The class will exhibit their final prototype – the facilities and poster</p> <p>2. Present how to test and evaluate the solution.</p> <p>3. Present how the prototype can be explained as the real one.</p> <p>4. Share what they learn from the comment and what they will revise for the completion solutions.</p>

3. Conclusion

This paper showed how to provide STEM education through teaching based on Sutaphan and Yuenyong [8] context based STEM education learning approach. The identification of social issue provided of facilities or assistance methods for disabled or elderly to be alternative product ways to engage students to develop projects for solutions. In physics class will support students to find the possible designing solutions regarding on the physics may allow students to design about a simple tool for producing facilities or assistance methods for disabled or elderly which requires knowledge of Newton's laws.

In test and evaluation of the solution stage, it allows students to apply knowledge about the Newton's laws needed for force to do the facilities. In the socialization and completion decision stage, students need to make a report in the form of a poster-infographic for presenting their prototypes or products. Then, the human need will be considered for validating and improving the better facilities and assistance methods for disabled or elderly. This may share some ideas of how to develop the STEM education learning activities and suggest some ideas how to develop learning activity from grounded or teacher practicing in profession learning community (PLC) of lesson study.

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