Research Article

Investigation of the Effectiveness of Video Tutorials in Improving Students' Scientific Thinking Skills

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Abstract

Subjects in General Education program at Valaya Alongkorn Rajabhat University under the Royal Patronage, Pathum Thani has been focused on Project-based learning to promote self-development of learners. However, using scientific skills has been difficult, especially for the learners who were not in Faculty of Science. This research aimed to investigate the effectiveness of video tutorials on students' scientific thinking skills. The Sample in this research was 150 students who had enrolled in Innovation and Scientific Thinking Subject of semester 2/2022. A purposive sampling method was used. The tools used were 5 lesson plans by using video tutorials before each lesson, the pre-test and post-test in each lesson plan; 20 items in total, and questionnaires of students' satisfaction with using video tutorials. The questionnaire consisted of 20 items that were divided into 3 aspects: learning activities, video tutorials, and the benefit of learning with video tutorials. The collected data were analyzed by using SPSS for descriptive analysis and t-test independence. The results showed that 1) There was a statistical difference in students' scientific thinking skills test scores, 2) The students' test scores on project lesson after using audio-visual showed that there were 93.89% reaching the 80% criteria, 3) The students developed their group behavior at a good level, and 4) The overall score of satisfaction of students was at a high level. In the aspect of learning activities, the students' satisfaction was also at a high level, as in the video tutorials aspect.

Keyword: Video Tutorials; Scientific Skills; Thinking Skills; Project Lesson; General Education

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บทความวิจัย

การตรวจสอบประสิทธิผลของบทเรียนวิดีโอต่อการพัฒนาทักษะการคิดทางวิทยาศาสตร์ของนักศึกษา

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บทคัดย่อ

รายวิชาศึกษาทั่วไป มหาวิทยาลัยราชภัฏวไลยอลงกรณ์ ในพระบรมราชูปถัมภ์ เน้นการจัดการเรียนรู้โดยการใช้โครงงานเพื่อส่งเสริมการพัฒนาตนเองของผู้เรียน อย่างไรก็ตาม การใช้ทักษะทางวิทยาศาสตร์ยังถือเป็นเรื่องยาก โดยเฉพาะในผู้เรียนที่ไม่ได้เรียนคณะวิทยาศาสตร์ การวิจัยนี้มีวัตถุประสงค์เพื่อตรวจสอบประสิทธิผลของบทเรียนวิดีโอต่อการพัฒนาทักษะการคิดทางวิทยาศาสตร์ของนักศึกษา กลุ่มตัวอย่าง คือ นักศึกษาจำนวน 150 คน ที่ลงทะเบียนเรียนรายวิชานวัตกรรมและการคิดทางวิทยาศาสตร์ ภาคการศึกษาที่ 2/2565 โดยใช้การสุ่มแบบเจาะจง เครื่องมือวิจัย ได้แก่ แผนการสอนที่ใช้บทเรียนวิดีโอก่อนเรียนในแต่ละบท แบบทดสอบก่อนเรียนและหลังเรียนในแต่ละบท และแบบสอบถามความพึงพอใจของนักศึกษาที่มีต่อการใช้บทเรียนวิดีโอ แบบสอบถามแบ่งเป็น 3 ด้าน ได้แก่ กิจกรรมการเรียนรู้ บทเรียนวิดีโอ และประโยชน์ของการเรียนรู้ด้วยบทเรียนวิดีโอ จากนั้นนำข้อมูลไปวิเคราะห์โดยโปรแกรม SPSS และ t-test independence ผลการวิจัยพบว่า 1) คะแนนทักษะการคิดทางวิทยาศาสตร์ของนักศึกษา แตกต่างกันอย่างมีนัยสำคัญทางสถิติ 2) คะแนนวิชาโครงงานของนักศึกษาหลังการใช้บทเรียนวิดีโอ คิดเป็นร้อยละ 93.89 ซึ่งผ่านเกณฑ์ร้อยละ 80 3) นักศึกษามีพฤติกรรมการเข้ากลุ่มอยู่ในระดับดี และ 4) ความพึงพอใจของนักศึกษาโดยรวมอยู่ในระดับมาก และในด้านกิจกรรมการเรียนรู้ พบว่านักศึกษามีความพึงพอใจอยู่ในระดับมากเช่นเดียวกับด้านบทเรียนวิดีโอ

คำสำคัญ: บทเรียนวิดีโอ; ทักษะทางวิทยาศาสตร์; ทักษะการคิด; บทเรียนโครงการ; วิชาศึกษาทั่วไป

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Introduction

Today, science plays a very important role because scientific knowledge is relevant to everyone in daily life, occupation, as well as the use of various technologies to facilitate. These are all the results of the knowledge of science combined with other sciences. Science can also help humans to develop rational thinking, creativity, analytical thinking, and critical thinking and have the skills to research knowledge which can be used to solve problems in a systematic way (Soodsane, 2018; A-morncheewin, 2013). It could be suggested that science is a culture of learning society. Nowadays, much useful information was widely spread as the video tutorial to develop many skills as shown in the quote "E-learning driven world is experiencing a new set of skills." (Pachuri, 2011 as cited in Iftikhar, Riaz, & Yousaf, 2019). Therefore, everyone needs to be developed to know science for knowledge and understanding of nature and man-made technology as well as apply knowledge in a rational, creative, and ethical manner (Ministry of Education, 2010). These situations would bring to lay the foundation for children and youth to enter the competition in the 21st century. Thailand would be driven by innovation to develop people to be competent and to support science and social science technologies that facilitate the civilization of the country (Chareonwongsak, 2007).

The National Education Act stated that the Core Curriculum of Basic Education establishes a minimum time structure for learning subject groups and learner development activities. However, educational institutions could add the other courses according to readiness and focus which can be adapted to suit the context of the school and the student's condition. University education focuses on increasing knowledge and specialized skills. There is a response to the abilities, aptitudes and interests of each learner in both academically and professionally (Wong-aree, 2015). In addition,the Ministry of Education of Thailand has set General Education subjects as part of courses in undergraduate or higher education level; every student has to enroll in these courses. The subjects were categorized into 3 main groups: Social Sciences and Humanities, Languages, and Science and Mathematics. The courses are focused on producing graduates knowledgeable whether in theory or in practice, as well as being able to apply these subjects to their life. It also motivates the learners to think and analyze as well as a systematic synthesis along with trying to seek knowledge on their own. Moreover, the learners also communicate with others very well. However, this course does not focus on any specific subjects.

Every subject in General Education program at Valaya Alongkorn Rajabhat University under the Royal Patronage, Pathum Thani has been focused on Project-based learning management to promote the self-development of learners naturally by doing a mini-project. Nonetheless, doing the project could use systematic thinking skills or scientific thinking skills. The skill has been difficult, especially for the learners who were not in Science Faculty or familiar.

A skill that could be used to address the thinking skill is the Information literacy skills. It required the skills (Pritchard, 2017): 1) quick access skills, 2) credibility assessment skills, and 3) creative use skills. Media creation and communication tools could be used in a variety of ways, such as video, audio, podcasts, etc. Moreover, Panich (2010) also said that the Center for Media Literacy stated that media skills include the ability to access, analyze, evaluate and create images in a wide range of formats including print, graphics, animation, audio video, games, multimedia, websites, and more. Nowadays, information technology has played a role in many daily lives, and developed potential to be more efficient. No matter what technology, communication, computer, or various types of ready-made programs especially video media, it is a type of teaching and learning media that is ready in the form of multimedia that combines the distinctive style and complete presentation approach. Including animation, sound effects, computer graphics and many other special techniques, it could help to build teaching efficiency, reduce the complexity of the course content, and there is a variety in the imagination of teaching communication effectively. Including being able to stimulate interest and attract them as well, another thing is an important feature that is can be reopened as needed (Phawut, 2013). The use of technology in education about Active Learning Style has to be chosen methods that are suitable for students, education level, and the desired objectives for maximum benefit. However, the impact of using information technology has two aspects: both in the positive and negative aspects (Kongrit, 2017), which if used improperly may cause more harm than good.

According to the mentioned above, the use of technology as a teaching media with both images and sounds could help the learners to learn better in the concepts or summaries of learning content that are created accurately and quickly. Moreover, using the media to manage learning in General Education courses that focus on Project-based learning, the interests of the learners are followed: to promote self-development naturally and to full their potential (Nuiplot, 2021; Susaorat, 2013) with the instructors only pointing out doubts. The students then search for the answers themselves and practice the process of researching scientific knowledge including the presentation of

information in various formats (Thada-Thamrongvech, 2012). This integration is suitable for use in the management of learning of science subject that is difficult to understand, to create fun and attitude in learning where students and teachers can interact with each other through the system or the Internet, or do not need to be in the same place like in a normal classroom (Na Songkhla, 2007).

Research objectives

The objectives of this research are to investigate the effectiveness of video tutorials on students' scientific thinking skills through:

1. Comparing students' scientific thinking skills on using video tutorials in the project lesson
2. Investigating the students' scientific thinking skills after using video tutorials
3. Studying the students' satisfaction with using video tutorials in the project lesson

Literature Reviews

Panich (2010) stated that the skills in using science and technology which have advanced thinking skills could be applied to more knowledge in further study or career. Focus on developing oneself and the country according to their roles were able to lead and serve the community in various fields (Ministry of Education, 2010). The teacher or lecturer should act to promote and support learning as a stimulus; create an environment for learners to learn, and be able to find knowledge on their own (Nilacupt, 2015). In this regard, teachers must encourage learners to have a systematic thinking as well. That is, activities in which the components of the system are arranged to be related to each other continuously step by step for effective planning of work (Poonsuwan, 2013). The development of students' thinking is therefore a very important goal of organizing the education system. The ability to think advanced is therefore very important to enhance the country's ability to develop and compete with foreign countries (Khemmani, 2011). However, developing any skills in a course usually needs longer time in the classroom, even students added learning hours outside the classroom time (Agama & Solikin, 2020). From the results of the ranking of the competitiveness in education between Thailand and the world, it was found that Thailand's education competitiveness in 2018, ranked 58th out of 63 countries, shows that Thailand should accelerate its efforts to develop its human resource capacity more efficiently (The Secretariat of the Education Council, 2018). In addition, the results of the National Basic Educational Test or O-NET

in 2018 found that the achievement scores in science subjects of secondary school had an average score of 36.10 points. It could be seen that the management of science learning in Thailand is still a problem that needs to be urgently addressed.

Research Framework

The research framework was shown as figure 1:

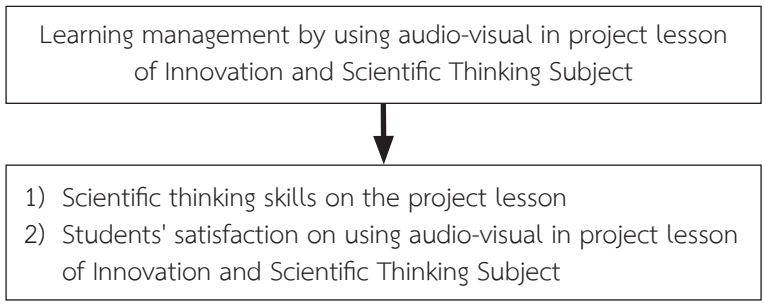

Figure 1 Research framework
Source: Nuiplot, 2021

Research Methodology

1. Research scopes

Population: All students who had enrolled in Innovation and Scientific Thinking Subject of semester 2, academic year 2022 in General Education Program of Valaya Alongkorn Rajabhat University under the Royal Patronage, Pathum Thani.

Sample: 150 students who had enrolled in the section of the researcher. Independent variable: Learning management by using audio-visual on project lesson of Innovation and Scientific Thinking Subject

Dependent variable: 1) Scientific thinking skills on the project lesson, and 2) Students' satisfaction with using audio-visual in the project lesson of Innovation and Scientific Thinking Subject

2. Research methodology

A purposive sampling method was used to select the sample in this research. A preliminary experimental research model (Pre-experimental Design) was used by studying a single experimental group to compare the learning outcomes before and after assessing thinking skills and assess the satisfaction of the students

3. Research tools

The tool used consisted of 5 lesson plans by using audio-visual or video tutorials

in the project lesson. The video tutorials were a pre-recorded video lessons by a researcher that students had to watch before attending class and they could also watch every time they would like to revise the content. The topics of each lesson were: Unit 1 Definition of Science, Technology, and Innovation, Unit 2 Application of Science, Technology, and Innovation in daily life, including the impact, Unit 3 Thinking Skills for everyday life, Unit 4 Scientific Method, and Scientific Process Skills for doing project and everyday life, and Unit 5 Mathematics in academic study and everyday life. The length of each video tutorials section in each lesson varied. The audio-visuals of each Unit were divided into several episodes; each episode was 10-15 minutes, and around 1 hour in total. Normally, the content in each Unit was taught within 1-2 weeks (4-8 hours). After finishing every unit, the project section was continued for 3-6 weeks. The pre-test and post-test in each lesson plan; 20 items in total, students' scientific thinking skills tests on the topic of Project lesson, and questionnaires of students' satisfaction on using audio-visual for project lesson. The characteristic of pre-test and post-test was the abstract part of a study with the following 3-5 questions per each abstract. The questions were about scientific skills used in the study, the innovation, or about the variables. The projects were produced and set by the students themselves in group work, the lecturer just acted as a mentor. The questionnaire consisted of 20 items that were divided into 3 aspects: learning activities, audio-visual, and the benefit of learning with audio-visual. The collected data were analyzed by using SPSS for descriptive analysis and t-test independence.

4. Data collection

Researchers had made agreements with students before managing the learning about the procedures while organizing the learning activities, project-based, and then proceeding according to the learning management plan. Students took the test before and after studying. During the last week of the academic sector, researchers had meticulously assessed their thinking skills. The students' judgments were assessed through a project assessment form that measured three aspects: creativity, project making process, and implementing the project in daily life (Table 1; adapted from Nuiplot, 2021). The assessing the students' satisfaction with the structured learning management was done through an online questionnaire.

5. Data analysis

5.1 Analyzing the information of the learning outcomes before and after learning. The scores obtained from the pre-test and after studying the scientific process

were analyzed for the percentage. Then the scores were taken to find the mean, standard deviation, and t-test statistic.

5.2 Analyzing information and thinking skills with critical thinking by taking the scores obtained from the project assessment form for percentage analysis. Then the scores were compared with the specified criteria.

5.3 An analysis of the students' satisfaction with the audio-visual management in the class was obtained from the online questionnaire in the evaluation system of researcher's university. The evaluation form was included the question of the learning method as learning management. The scores were then analyzed the average value, and the standard deviation, both on each and whole aspect.

Research Results

1. Learning outcomes before and after classes (Pretest-Posttest)

The learning outcomes were shown in Table 1. A researcher had measured the learning outcomes before and after the students enrolled in the Innovation and Scientific Thinking subject. The pre- and post-test, four-selection multiple choices 10 items, the research results were shown in Table 1.

Table 1 The results of learning before and after studying of the students

Test	$\bar{X}$	S.D.	t
1. Before studying (Pre-test)	7.65	1.58	13.59*
2. After studying (Post-test)	9.87	0.70	

*Sig. (1-tailed) = 0.0000

According to Table 1, the results of the pre- and post-learning outcomes were shown. It was found that the pre- and post-study tests of enrolled students with an average score ±S.D. as 7.65±1.58 and 9.87±0.70, respectively. Comparing between the scores before and after, it was found that the post-test scores of students were higher than pre-test with a statistical significance of .05 level.

2. Results of Scientific thinking skills

Effects of Thinking Skills using a project lesson by assessing during the study section and in the last week with audio-visual learning management were shown in Table 2. The assessment was done by using rubric score evaluation as shown in Table 3.

Table 2 Scientific thinking skills scores with project lesson evaluation rubric score

Criteria	Total score	$\bar{X}$	S.D.	Number of students who passed the criteria
1. Critical thinking	12	11.6	0.37	147
2. Project preparation process	12	10.8	0.53	138
3. Applying the project in daily life	12	11.4	0.46	150
Total	**36**	**33.8**	**0.45**	**145**
Percentage	**100**	**93.89**	**-**	**96.67**

Table 3 A rubric score evaluation of project lesson in 3 aspects

Assessment Issues	Quality level			
	Very good (4)	Good (3)	Fair (2)	Improve (1)
1. Critical thinking	analyze and assess the situation with evidence diverse and able to draw reasonable conclusions.	analyze and assess the situation with evidence and can come to a reasonable conclusion.	analyze and assess the situation with evidence and can come to a conclusion that is not reasonable.	analyzed and assessed the situation, but no evidence to draw conclusions.
2. Project preparation process	Find interesting issues and work together to plan the operation. Implemented as planned. Periodic results are presented.	Find interesting issues, work together to plan the operation. Implemented as planned. Results are presented periodically.	Identify issues of interest, no operational planning but there is a real practice are recorded.	Find interesting issues. No operational planning. No evidence of actual work.
3. Applying the project in daily life	Objectives and local practice guidelines are presented in order to find and answer the objectives. There is an exchange. Experienced with relevant people, summarizing what was learned from the study, referring to academic evidence and bringing knowledge that has been published for use in daily life.	Objectives and local action guidelines are presented in order to find and answer the objectives. Reference studies to scientific evidence and to apply the knowledge gained to use in daily life.	Objectives and local practice guidelines are presented in order to find and answer the objectives, and to disseminate the knowledge gained to use in daily life.	Guidelines were presented in the local area, but the objectives were not met. Unable to apply the knowledge gained to use in daily life.

Source: Adapted from Nuiplot, 2021

According to Table 2, it was shown that a group of 150 students, who had received their scientific thinking skills assessed project evaluation, had a project evaluation average score of 27.8 with a passing score of 80 percent as 24; the highest score as 30 and the lowest score as 25. The average score was calculated as 92.67 percent, with 145 students passing the criterion, representing 93.89 percent. The examples of the project work were "Smart Agriculture, one-click watering", "Turn off Lights as Smart Home", "Tripod cane SOS", "Kalimba Chromatic", "Semi-automatic Fish Scooping Machine", "Alcohol gel ball", and "Cat care Chatbot".

3. The satisfaction of students on the learning management by using video

Student satisfaction with Audio-visual-Based learning management by using the online questionnaire was shown in Table 4.

Table 4 Student satisfaction on audio-visual-based learning management

Aspect	$\bar{X}$	S.D.	Level
1. Learning activities	4.16	0.72	High
2. Audio-visual	4.23	0.67	High
Overall	4.37	0.69	High

According to Table 4, it was shown that the overall score of satisfaction of students was at a high level ($\bar{X}$=4.37, S.D.=0.69). In the aspect of learning activities, the students' satisfaction was also at a high level ($\bar{X}$=4.16, S.D.=0.72), and also the audio-visual aspect ($\bar{X}$=4.23, S.D.=0.67).

Discussion and Conclusion

A study of the audio-visual tutorial in learning management of Innovation and Scientific Thinking subject in the project lesson, for students of Valaya Alongkorn Rajabhat University under the royal patronage was done to compare the results of learning before and after learning management. It was found that the score after learning was 80% higher than the threshold, with a high score in science thinking from the project lesson. Also, there was a high level of satisfaction with the teaching and learning management in this learning management, both individually and overall aspect. This may be because videos could help students to learn before they are taught in the classroom, and could also review after studying. Moreover, learners can learn independently on their own anytime and anywhere. This is consistent with the research by Nonpila (2013, as cited in Prommachan, 2018) which studied about the development of critical thinking skills of

Mathayom Suksa 3 students by using video clips in Mukdahan School, Mukdahan Province. It was found that students had the test scores after and before studying with average scores of 70.30 and 24.44, respectively. It was also consistent with the study of Agama and Solikin (2020) which students' readiness before participating in the practice activity through a tutorial video for practicing. It was found that the tutorial video was good and feasible to be implemented in the classroom activities. Moreover, it also had the positive impact on skill development of youth or university students which stated in the study by Iftikhar, Riaz, and Yousaf (2019). It was shown that video tutorials in YouTube could help in understanding and building software aptitude among youth and was thought as helpful in order to enhance students' academic performance. In addition, all students could pass the score on the test after passing the 50 percent criteria. It was also consistent with the research of Chantong (2004) which video media was used in science teaching on water pollution for grade 6 students. More than 80 percent of the students were able to complete the post-test, passing the standard 80 percent.

However, the researcher believes that improving the ability to think scientifically through video media alone may not be sufficient without the use of other teaching methods which was consistent with the study of Juicharoen (2000). It was found that student behavior was still a lack of enthusiasm for asking questions and seeking answers. However, when the researcher used open-ended questions in conjunction with the use of video media, it was found that students improved in asking questions for use in project work which was also consistent with Phromwong (1997); Charit (2004). As Erdman and Emerson (2007) suggested that asking open-ended questions could help students develop higher-level thinking skills, such as critical thinking and creativity.

The study of satisfaction with learning management by using audio-visual or video tutorials in teaching, both overall and in each aspect was at a high level. This was consistent with the research of Tunkhamdaeng (2011, as cited in Ditthabanjong, Thaesoongnoen, & Boonseng, 2018), who had studied the development of video media for creating three-dimensional works for students in Mathayom 5. It was found that the overall was at a very high level. It had a mean of 4.31 and a standard deviation of 0.37. It was also consistent with the research of Chantong (2004) who conducted research with Prathomsuksa 6 students at Wat Om Noi School. It was found that the students were satisfied with the learning management by using science video media at a high level.

Recommendations

1. Application of online video tutorials in learning management should concern about the availability of student's device and internet first. The problem of availability of devices in classes that were used to facilitate management would then be concerned; for example, projectors, screens, a speaker, and high-speed internet signal, etc.

2. Further research should be conducted to compare learning achievement with video tutorials with other techniques of video creation. For example, compare learning achievements between cartoons, or stop motion filming, or others than the videos created by a researcher.

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