

An inquiry-based learning activities packages creation of title “solid, liquid and gas” for learning achievement and for critical thinking skills development in education of 21st century for upper secondary school students

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ABSTRACT

The purpose of this research aims at creating the inquiry- based learning activity series named “Solid, Liquid and Gas”, for developing the learning achievement and analytical skills following the 21st century learning and to study the students’ satisfaction by using the learning activity package. This research used a quasi-experimental technique with one-group pretest-posttest design. The research sample, selected by the purposive sampling methods, were 100 students in grade 11 of Thoen Wittaya School, in Thoen District, Lampang province, Thailand. The results indicated that the effectiveness of the learning activity package scored 77.58/79.25, which was higher than the prescribed criteria. The students’ achievement after learning by the package were statistically significant. The posttest score was higher than the pretest score at the .05 level of significance. The students’ satisfaction in using these learning activities was at the high level, with an average mean of 4.42.

Keywords: Learning activity package, Inquiry- based learning, Learning achievement, Analytical skills

Introduction

During the social adaptation beyond 21st century, changes affect people’s lifestyle. In this era, teachers should have an energetic scheme and be ready to transfer their skills to students by preparing effective intellectual tools and learning materials. The most important skill in 21th age is the learning skill. This changes the way of teachers to interact with their students, by creating a new body of knowledge, an ability to solve problems and memorization. This may cause by the revolution of knowledge management patterns that new learning facilities and learning support materials should be carried out. Studying in 21th century brings students to a new prudential perspective. This view has changed an old paradigm to a new real world that students are the center of learning process [ref Wicharn]. An inquiring-based learning activity refers to a method that involves students to the knowledge directly with scientific methodology. This method is used as a tool to search for knowledge that students have never retrieved before. The method then leads to in-class research experiments and tests of hypothesis [ref Chaiwat].

The scientific learning process is a method that changes student's behavior and also develop their skills via knowledge and scientific methodology. It has its own principles to search for knowledge and analyze whatever is necessary or not. The searching method is classified into steps as followed:

1. Engagement; introduces students to the context of subject by clues. Engagement also motivates students to question contexts that are related to the subject or an interested content.

2. Exploration; is a plan to establish ways to exploring answers of such clues, creating hypotheses, specifying possibility of choices and taking action to review supplementary information.
3. Explanation; is a method that brings information from exploration to analysis, interpretation, conclusion and presentations. The results may be in different forms, yet create new knowledge and learning interactions.
4. Elaboration; is a method that brings out knowledge from explanations, to make linkage with existing body of knowledge. A new exploration can make a conclusion to explain phenomena or events.
5. Evaluation; is a method that verifies learning processes that expose the student's knowledge, what and how they know and the quantity of context comprehensively. Evaluation also corrects the student's knowledge to facts and applicable to other courses by the learning process.

Learning activity packages are one of educational innovations that combine and classify interactive teaching techniques by contextualising, subjecting and noticing contents. This classification helps students to retrieve those contents attentively and effectively. Teachers will also be confident to teach the students by involving and sharing their skills and experiences in this activity series. This also brings opportunities to the students to have an independent learning by their own ability, proficiency and interests under teacher's supervision. The activity series also lets the students to have protocols by classifying their own work into job descriptions and work instructions via logical planning. These series lead to an effective learning process [ref Boonkeua].

According to the test scores of the Institute for National Educational Standardization, the scores of grade 12 fell to an average of 35.42, which indicated low quality of scientific education in Thailand. When considering details, it was found that the item No.3 entitled "Matter and Properties" was discussed. The standard identified that students should understand and get idea in properties of matter, including its structure and force of interaction between particles. In this part, students were less reviewed for additional information. This indicated that the teaching module did not meet the goal. Low students' learning achievement scores might be caused from inappropriate learning materials and activities. A good teaching scheme needs various techniques that help students to develop their own knowledge with ethnics (the balance of left and right brain). This will develop and extend the students in bringing their knowledge to their community with intellectual and prudent ability.

To comply with the 21st century social revolution, education planning should be susceptible in information searching method. This should involve evaluating a new teaching plan that will develop not only skills, but an ability to search for relevant information and knowledge in the learning contexts. This research was created to test if a new activity series entitled "Solid Liquid and Gas" will be effective for the learning achievement, skill development, and satisfaction of high school students, when such learning package was used in the learning process.

Research Objectives

1. To create an activity package "Solid Liquid and Gas" with the effectiveness of 75/75 learning criteria.
2. To examine the achievement of students' analytical skill development based on an activity package "Solid Liquid and Gas".

3. To examine the students' satisfaction in information searching activities when the "Solid Liquid and Gas" package was applied.

Methodology

The authors explored the 20-hour period class in the first semester of year 2014. The research methods were listed below:

1) Types and research platform: The research was designed to meet semi-experiment platform with one-group interpretation. The pretest and posttest scores were then carried out for comparisons and analyses.

2) Samples: 100 samples of Grade 11 students were sampled by the purposive sampling method. The students were in Sciences and Mathematics Program of Toen Wittaya, Toen, Lampang province, Thailand.

3) Tools

3.1 An information searching activity package "Solid Liquid and Gas" was developed and implement to investigate the students' learning achievement and analytical skills. The topics of activities were:

3.1.1 Solid

3.3.2 Liquid

3.3.3 Gas

3.2 Multiple-choice thirty items standard test papers in the chapter of "Solid Liquid and Gas".

3.3 Satisfaction scoring form of the activity series under the title "Solid Liquid and Gas".

4) Research Protocols

4.1 Creation and performance testing of an activity package:

Three supervisors verified for the validity of contents, then the package was applied to grade 11 students in Sop Prap Pittayakom school in Lampang province, Thailand. The experiment was classified into an individual study (1:1) with three samples, a group study (1:10) with nine samples and bulk study (1:30) with 30 samples. Supervisors verified the tools using standard educational indicators such as effectiveness, learning scores, levels of analytical skills and satisfaction. The data was then interpreted using statistical methods.

4.2 Applying activities to the course:

The series were then applied to the students. The pretest-posttest analytic scheme in this research was then carried out. The "Solid Liquid and Gas" package was then implemented and interpreted.

4.3 Students' satisfaction

The students scored in a satisfaction form. The derived data was then analyzed to present levels of the students' satisfaction.

5) Data analysis and evaluation

5.1 Effectiveness of a package by progress (E1) and results (E2) in average

5.2 Analysis of the learning achievement and analytical skills based on t-test analysis, average mean scores, and standard deviations.

5.3 Evaluation of the students' satisfaction using an average mean scores and standard deviations.

Results

Table 1: Analysis of Information Searching Series in "Solid Liquid and Gas" with effectiveness of 75/75 Criteria (100 samples)

Topic and activities	Progressive (E ₁)	Results (E ₂)	Effectiveness (E ₁ / E ₂)
Solid	76.25	78.87	76.25/78.87
Liquid	78.43	79.53	78.43/79.53
Gas	78.06	79.36	78.06/79.36
Average	77.58	79.25	77.58/79.25

From Table 1, it was found that an activity series yielded a progressive performance of 77.58 and yielded a the results of 79.25. The effectiveness of the package was 77.58/79.25, which was higher than the standard criteria.

Table 2: Comparison between Pretest and Posttest Scores when Applying an Activity Series to Search for Information (100 samples)

Comparison	Test	Max score	Result	S.D.	d	S.D. _d	t	Sig. (2-tailed)
Achievement	Pre	30	11.21	3.70	13.02	2.73	36.68*	0.0000
	Post	30	23.78	1.07				
Analyzing skill	Pre	20	6.92	2.09	8.41	2.84	22.73*	0.0000
	Post	20	15.91	1.50				

* Calculated with the statistical significant at the confidential level of .05

From Table 2, it was found that the achievement of students in context of topics and their analyzing skills for the posttest score seems to higher than the pretest score with different in statistical significant at the confidential level of 0.05. The pretest achievement average score was 11.21 while the posttest score was 23.78. The pretest skill average score was 6.92 while the posttest showed 15.91.

Table 3: Evaluation of satisfaction when applying an activity series to 100 students

Evaluation contents	Score	S.D	Satisfaction
Inputs	4.32	0.36	high
Process	4.50	0.40	high
Outputs	4.44	0.39	high

Average	4.42	0.67	high
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From Table 2, it was found that the students were highly satisfied in the learning package with an average score of 4.32, 4.50 and 4.44, with inputs, process and outputs respectively.

Discussion

1. The activity contents were verified from three supervisors. When the contents were supplied to the activity series, the results showed that the students having participated in the series gained more quantity of contents as complied with the National Standard of Education (2007). The activity was then applied for non-sampling group with 3, 9 and 30 students to correct for errors from the application of package. The experiment met 75/75 criteria standard of E1/E2. Three sub-topics of series met average scores of effectiveness, 76.25/78.87, 78.43/79.53 and 77.58/79.53 respectively, and the overall score was averaged to 77.58/79.25. The effectiveness of the learning series met the standard and also conformed with Waro's (2003) study, that presented his idea in giving scores based on teacher's consideration. The contents of context without using such skill were 80/80, 85/85 and 90/90 for their effectiveness. But when focusing on the contents that contained skills, the standard scores for learning achievement might score down to 75/75 and the evaluation of the test should meet this standard with 2.5% higher than that of the criteria. The results also complied with Wanida (2010), that in an inquiry-based learning of grade 7 students entitled "Atmosphere", the researcher reported her study to have an effectiveness score of 76.65/75.46.

2. An inquiry-based learning activity series in the topic "Solid Liquid and Gas" was applied to high school student successfully in developing their achievement in learning and analytical skills. When comparing the pretest to the posttest, it was found to have a difference in statistical significance at the .05 level, with the pretest scores of 11.21 and the post test scores of 23.78, respectively. The results complied with Thareerat (2012), that the researcher created and studied an activity series of an informatics inquiry cycle in the topic of "Chemical in Everyday Life" for grade 6 students. Tharerat reported that the posttest score was higher than the pretest one at the .01 level of significance. The results also complied with Kanokwan (2008). Kanokwan studied an inquired-based learning plan in the title of "Hydrocarbon Compounds", and reported that the posttest score of learning achievement was higher than the pretest by an average mean at the .05 level of significance. These may explain that an inquiry-based learning might be an effective way to retrieve information and ideas from the activity from an individual perspective. The students had involvements and fun in all activities without feeling bored. They were also motivated by themselves to find out ways to solve problems to improve their skills. Boonkeua (1999) reported that an activity package transferred its knowledge to the students beyond its instructions. All of the skills were then practiced and met the student's interests. This could improve the students' positive attitude in topics they were learning and taking action.

3. An inquiry-based learning activity series in the topic of "Solid Liquid and Gas" was applied to high school students successfully in developing their analytical skills. When comparing the pretest to the posttest in analytical skills, it was found to be statistical significant at the .05 level, with the pretest score of 6.92 and the posttest score of 15.91 respectively. The results complied with Jaruwat (2010), that studied a mind map of learning plan with five concepts of knowledge inquiry in the topic of "Ocean Sky and Stars" among grade 5 students. The author reported that there was a statistically difference in the test scores,

where the posttest score was higher than the pretest one at .01 level of significance. Saowalak (2011) also studied the 5E activity series in physics II for grade10 student. The 5E met the design of context matching methodology. Students involved in Saowalak's experiment exposed the posttest score higher than the pretest one in analytical skills at the .01 level of significance. These might indicate that an inquire-based learning motivated the students to think continuously. Motivations led the students to take actions and get involved in problems. The analytical skill was then performed. Students also had an ability to classify, discover relations and facts, or answer of problems by themselves. This skill prolonged the basis of decision and determination to solve problems with the right tools. Pob (1999) reported that an inquiry based learning activity focused on the process of knowledge acquisition by students' own experiences.

4. For the students' satisfaction test, the activity showed high satisfactory scores. For the inputs of progress, students gave a score of 4.32 which was ranged in high level. Together with the progressive and output scores, two of items yielded as high as 4.50 and 4.44, respectively. The results showed that the satisfaction was from student-based activities. The method stimulated the students to get involved in knowledge inquiry by themselves, motivated students to work in groups without feeling bored. This result complied with Wanida's (2010) study, which stated that an inquiry-based learning package entitled "Atmosphere" for grade 7 students exposed a very high score of satisfaction in the learning methodology.

Conclusion

This research created an inquiry-based learning series entitled "Solid Liquid and Gas" to meet 75/75 standard of effectiveness. This series met the development of learning achievement and analytical skills, simultaneously created high satisfaction among the participating students. The proposed activity was applied to 100 students in grade 11 students. The results showed that the learning package achieved a level of effectiveness at 77.58/79.25, which was higher than the standard criteria. The posttest score for learning achievement and analytical skills was higher than the pretest one at the .05 statistical level of significance. The satisfaction score was 4.42, which also showed a very high level.

The research was also a platform for inquiry-based learning in the Chemistry subject. Self inquiry-based learning activities motivated students to get involve in problems and to take action in finding out supplementary information to solve the problems by themselves. The progress of learning was classified into instructions that related each topic of activities together. Students tended to search for facts and right tools for solving problems with core principles. Students also had prudent perspective that could determine the problem context definitely. This research also prepared the students to possess the skill that is appropriate to 21st century learning process.

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