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Development of academic achievements using inquiry-based learning together with educational games

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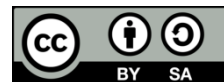Department of General Science, Faculty of Education and Educational Innovation, Kalasin University, Kalasin, Thailand

Article Info

ABSTRACT

The objectives of this action research were: i) To develop learning achievement in basic science subjects of grade VII students who received an inquiry-based learning (IBL) management system combined with an educational game on the topic of solutions to pass the requirement of 70%; and ii) To study the satisfaction of grade VII students toward the use of IBL together with an educational game. This was a classroom action research study with a target group consisting of 14 grade VII students in the first semester of the 2022 academic year in a public school located in Northeast Thailand. The research tools were eight learning management plans, an IBL questionnaire, an educational game about the solution, a learning achievement test, an interview form, and a satisfaction questionnaire. The statistics used were mean, standard deviation, and percentage. The result showed that the mean was 14.93, and the standard deviation was 1.44, which passed the criteria of 70%, which is in the level of satisfaction.

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1.   INTRODUCTION

Thailand has been participating in the programme for international student assessment or PISA test since 2000 [1]. The results indicate that Thai students have an average science score of 426 points, compared to the Organisation for Economic Co-operation and Development (OECD) average of 489 points. Furthermore, according to the PISA 2015, science scores increased by only four points, and Thai students' scores have not reached the OECD standard since 2000. This information suggests that all educational agencies must urgently solve the problem, which is a significant challenge for the country. It also indicates that Thai students still need more scientific learning, and alternative methods should be established in the classroom to develop such characteristics.

The problem of students' academic performance not meeting the standard partly stems from the teaching approach of teachers emphasizing knowledge transmission [2]–[6]. Students may struggle to acquire a comprehensive understanding of the subject matter within the given time frame, resulting in subpar academic performance in science subjects and falling short of the required score criteria each year. Therefore, it is important to incorporate activities that encourage active learning and knowledge exchange among students to enhance their engagement and interest in the subject matter [7], [8].

Inquiry-based learning (IBL) has become increasingly popular in science education as a means of promoting student achievement [9]–[19]. IBL is a teaching approach that emphasizes active engagement and exploration by students. Students develop their understanding of scientific concepts by asking questions,

investigating phenomena, and analyzing data [20]–[23]. This method of instruction is often contrasted with more traditional approaches that rely heavily on teacher-directed lectures and information memorization.

Research has indicated that learners' motivation is positively associated with their academic achievement. Motivation is a key factor that influences learners' behavior and engagement in the learning process [24]–[26]. Students who are motivated tend to be more engaged, persistent, and focused in their learning activities. They are also more likely to set challenging goals for themselves and work hard to achieve them. Academic motivation can be enhanced using educational games [27]–[33]. Games are a learning approach that stimulates the learner's interest, leading to better learning and creating fun and enjoyment. Integrating IBL management with educational games has the potential to enhance learner achievement. These reasons led to the conduct of this research.

The objectives of this research are: i) To improve the achievement of introductory science courses for grade 8 students who have received 5-step IBL in conjunction with the educational games on the topic of solutions to pass the requirement of 70%; and ii) To study the satisfaction of grade eight students with the use of 5-step IBLmanagement in combination with educational games.

2. RESEARCH METHOD
2.1. Research design
This action research is based on the concept of Kemmis *et al.* [34], which has four steps. The first is 'plan'. This step is to study the context of the school with the mentor and study the problems of student achievement by examining the learning achievement on the solution of grade VII students to identify the above issues brought to the design of tools to develop learning achievement. Research tools consisted of a 5-step IBL management plan combined with educational games. The tools used for data collection consisted of learning achievement tests. An interview form for students' opinions on the 5-step IBL management, combined with educational games and a satisfaction questionnaire. Implement a validation tool to determine the suitability and find a conformity index. Then improve the tools according to the advice of experts and then publish the tools for data collection.

The second is 'action'. Implementing the learning management plan that has been improved in step one to implement learning management with the target group, divided into two cycles. The first cycle is a 5-step IBL process with educational games using the learning management plan 1-4. The second operating cycle manages five steps of IBL together with educational games developed and improved from the 1st cycle using the learning management plan 5-8.

The third is 'observe'. This step studies the target group's behavior while conducting instruction after the teaching and learning activities end according to the operating cycle. Therefore, the learning achievement form and the interview form were used for the students' opinions toward the 5-step IBL management together with educational games for the target group of students.

The fourth is 'reflect'. After completing each instructional cycle, the researcher collects data by taking the learning achievement test, using the data obtained from the test, the observational data, and the interview to analyze and summarize the data. To use the results to improve teaching in the operational cycle and take the satisfaction questionnaire to the students to answer after completing the instruction according to every operational process.

2.2. Participants
The target groups are 14 students at grade VII in a public school in Kalasin Province, Thailand, studying in the first semester of the academic year 2022. They were obtained by purposive sampling from students in the room taught by the researcher. The students in this group had scores on the academic achievement test in basic science subjects below the criteria of 70%.

2.3. Instruments
The tools used in this research are, a comprehensive IBL management plan with five steps, supplemented by an educational game focused on solutions, was developed. The plan encompasses following steps: i) The composition of the solution; ii) Checking the composition of the solution; iii) Solubility and factors affecting the condition, solubility; iv) Solute and solvent affecting solubility; v) Temperature affecting solubility; vi) Concentration of solution 1; vii) Determination of the concentration of solution 2, and viii) Daily use of the solution. The total learning management time is 16 hours. The tool was qualified and reviewed by three experts (content experts, teaching experts, and measurement and evaluation experts). The average suitability was 4.56, the highest suitability level, with a consistency index of 0.50–1.00. As well as learning achievement test, unit 3, solution, grade VII, multiple-choice type, multiple choice, four options, 20 items, with a consistency index of 0.60-1.00, difficulty (P) 0.20.–0.80, the

discrimination (R) from 0.20 and higher, and the confidence of the test using the KR-20 formula according to the Kuder-Richardson method were 0.74. Also, the satisfaction questionnaire on 5-step IBL together with 10 educational games is a rating scale with five levels according to Likert's principle. There is a consistency index ranging from 0.80-1.00.

2.4. Data analysis

Analyzing the data from the results of the learning achievement test after the end of the learning activities in each operating cycle by using the obtained scores to find the mean, standard deviation, and percentage. If the score is less than 70%, it is not passed the criteria, and if receiving a score of 70% or more, passing the requirements. Analyzing the students' satisfaction with the 5-step IBL management together with educational games at the end of both operational cycles. The mean and the standard deviation were compared with the objective criteria. The rating scale has five levels according to Likert's principle, namely 4.50 or higher means most satisfied, 3.50-4.49 means very satisfied, 2.50-3.49 means moderately satisfied, 1.50-2.49 means less satisfied, and below 1.50 means least satisfied.

3.   RESULTS AND DISCUSSION

Development of academic achievement in basic science courses on the topic of solutions for grade VII students through IBL together with an educational game to pass the requirement of 70%. The result is shown in Table 1. In operational circuit 1, students who received IBL management with an educational game have an achievement score. The mean was 14.93. The standard deviation was 1.44, representing 74.76%. There were 11 students had academic achievements that passed the assessment criteria of 70%, representing 78.57%, who did not pass the requirements, and three students, representing 21.43%. While operational circuit 2 students have an achievement score in the mean was 16.79, the standard deviation was 1.05, representing 82.86%. The 14 students had achieved through the assessment criteria of 70%, representing 100%, and the difference in test scores is a range between 1-3.

Table 1. Achievement test results in operating circuits 1 and 2, a total score of 20 points

No.	Operating circuit 1		Operating circuit 2		Score difference
	Score (20)	Percentage	Score (20)	Percentage	
1	15.00	75.00	17.00	85.00	2.00
2	14.00	70.00	15.00	75.00	1.00
3	13.00*	65.00	16.00	80.00	3.00
4	18.00	90.00	19.00	95.00	1.00
5	15.00	75.00	16.00	80.00	1.00
6	15.00	75.00	17.00	85.00	2.00
7	16.00	80.00	18.00	90.00	2.00
8	16.00	80.00	17.00	80.00	1.00
9	13.00*	65.00	16.00	80.00	3.00
10	16.00	80.00	17.00	75.00	1.00
11	14.00	70.00	16.00	80.00	2.00
12	15.00	75.00	17.00	85.00	2.00
13	16.00	80.00	18.00	90.00	2.00
14	13.00*	65.00	16.00	80.00	3.00
Average	14.93	74.76	16.79	82.86	1.86
Standard deviation	1.44		1.05		0.77

*Denotes students who do not pass the criteria 70%

The results of the study of the satisfaction of grade VII students towards IBL management combined with an educational game. Grade VII students received an IBL management system combined with an educational game. The average satisfaction was 4.44, and the standard deviation was 0.65, a high level of satisfaction as seen in Table 2.

Development of academic achievement in basic science courses on the topic of solutions for grade VII students through IBL together with an educational game to pass the requirement of 70%. In the 1st cycle, the students were treated with an IBL process combined with an educational game. It was found that there were 11 students whose academic achievement passed the assessment criteria of 70%, 3 of whom still need to pass the requirements of 70% of achievement development. In general, in the first step, the learners still need to gain basic knowledge and understanding of some subjects. An understanding may need to be revised, or some parts must be corrected, so students are not interested in learning. Step 4 of IBL is an introduction to previous knowledge or used to describe a situation for students to discuss and express opinions to link prior

knowledge with new knowledge created. Besides, the students still needed help to connect their previous familiarity with the newly created knowledge.

From the interviews of students' opinions on the IBL management with educational games of the three students who did not pass the criteria, it was found that the first student: Student does not concentrate on studying arising from absent-mindedness chatting with friends. There are things around to disturb the second person; the student is afraid and does not dare to seek answers. Refrain from making decisions in solving various problems. A lack of skill in thinking may cause this problem [35]–[37]. The third person is embarrassed, resulting in the next time he will not dare to think, not answer, fear to show the answer, and fear that the answer will be wrong. The researcher used test results and data from interviews with 70% of students who did not pass the evaluation criteria to analyze, improve and develop the flaws in the learning management plan 5-8. Each step had details, techniques, and learning management methods, teaching an IBL management plan with educational games clearly to be suitable for students to use in the 2nd operating cycle, with the 1st step (engagement), bringing the curriculum content to create a computer game following the learning objectives as an introduction into the lesson. The teacher introduced a computer game developed from the scope of the study, which was an interest in learning as a questioning activity that the children had to think about and answer immediately at that time [38]–[40]. In the 4th step (elaboration), the teacher brought educational games to expand knowledge and may use relevant events to make linking previous knowledge with new knowledge easier. After improving the learning management plan a result, in the second operating cycle, 14 people passed the criteria of 70%, representing 100%, in line with IBL is a teaching model that opens opportunities and lets the learners gain experience in building knowledge both in terms of concepts, methods, as well as process skills through a continuous step-by-step process [9], [13], [18].

Table 2. The results of the study of the satisfaction of grade VII students towards the 5-step IBL management combined with an educational game

List	Average	Standard deviation	Level of satisfaction
1. The students liked the search and inquiry learning activities	4.50	0.64	Most satisfied
2. The students were satisfied with the duration of the learning activities	4.35	0.68	Very satisfied
3. Students seek knowledge by themselves	4.77	0.42	Most satisfied
4. Students exchange knowledge and understanding with classmates	4.35	0.55	Very satisfied
5. The content in the lesson is a sequence of steps, easy to understand	4.15	0.99	Very satisfied
6. Allow students to express their opinions	4.27	0.65	Very satisfied
7. Use a variety of teaching methods and media	4.35	0.73	Very satisfied
8. Help students have higher academic abilities	4.35	0.92	Very satisfied
9. Students are happy in their studies	4.77	0.42	Most satisfied
10. Activities in the lesson are easy to understand to follow	4.58	0.49	Most satisfied
Average	4.44	0.65	Very satisfied

The results of the study of the satisfaction of grade VII students towards IBL management with educational games. The results showed that the average satisfaction of grade VII students was 4.44, and the standard deviation was 0.65, which was in the level of satisfaction. When considering individually, it was found that the students were the most satisfied in line with the list followed by Table 2. The students sought knowledge by themselves with an average score was 4.77, and the students were happy in their studies with an average score of 4.77 and found that students were least satisfied with the content in the lesson is a sequence of steps and easy-to-understand with an average score of 4.15. This is a result of the researcher having organized activities that allow students to study, research, and exchange ideas, as well as encouraging students to learn from real problem situations, which satisfied the students at the level of agreement [41], [42].

4. CONCLUSION

Achievement in the topic of solutions for grade VII secondary school students through an inquiry-based learning system combined with an educational game higher than the performance criterion, 70%. The overall average score was 16.79, with a standard deviation of 1.05, representing 82.86%. There were 14 students whose academic achievement passed the assessment criterion of 70%, representing 100% and making known the difference in test scores. There is a range between 1-3, which is acceptable according to objective 1. Satisfaction of grade VII students towards the inquiry-based learning management combined with an educational game. The average total satisfaction was 4.44, and the standard deviation was 0.65. Which was a high level of satisfaction, which is acceptable according to objective of studying satisfaction.

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