Enhancing mathematics achievement on solving linear equation for grade 7 students through technology integration under TPCK and SAMR model

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Enhancing mathematics achievement on solving linear equation for grade 7 students through technology integration under TPCK and SAMR model

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Abstract. The TPCK and the SAMR model play an important platform for classroom teaching through technology integration. This research aimed to develop the lesson plans on solving linear equation under the TPCK and the SAMR model for classroom teaching. The designed lessons include lessons created by Adobe Captivate 9 program, Plickers application, game on solving linear equation created by Construct 2 program, and Padlet application. Then studied on students' mathematics achievement and attitude in teaching and learning on the activities created by the researchers through these technology integration. The samples were 30 grade 7 students of Satree Yala School, Muang district, Yala, Thailand who studied in the second semester of 2018 academic year selected by purposive technique. Pretest was given to the students followed by the lessons created by the researchers and posttest was given after completing teaching and learning. The research found that, students' mathematics achievement on solving linear equation after learning was significantly greater than before learning at .05 significant level and students' attitude towards learning was in the highest level.

1. Introduction

In this era, seeking and developing an effective and precious tool for teaching and learning are challenging. Particularly in teaching and learning mathematics in a curriculum as the core subject could potentially take benefits from innovative technology and improvement of teacher's pedagogical practice with ICT. The use of technology which is considered as an effective and intellectual advancement has shown a positive impact on teaching and learning process. However, the effectiveness of teaching and learning is relied on capacilities of technology in light of collecting, organising, and evaluating data for problem-solving [1,2]. Kay [3] indicated that teaching and learning in 21st century is necessary to have a well organised process which provides the students with an effective participation in learning. Therefore, teachers are required to design lessons with the use of technology and able to use them in teaching in ordet to fulfill the goals of learning as prescribed in the curriculum [4]. Teacher's knowledge

and competence in pedagogical practice with the use of ICT are the key indicators contributing to a success in future education [5]. The first priority of the use of technology in classroom must support an enhancement in teaching and learning [6].

The TPCK and the SAMR model are the tools used to describe technology integration in classroom teaching. The TPCK is a tool to examine how technology can support teacher's and students' knowledge in technology, content, and pedagogy [7]. The TPCK is regarded as an effective classroom teaching and learning encompassing with three componentys, namely, the Technological Knowledge (TK), the Pedagogical Knowledge (PK), and the Content Knowledge (CK) [8]. While the SAMR is the model used for assessing and evaluating technological practices and impacts on classroom which could be examined by teachers' abilities in redefining the traditional tasks by the use of new technology [9,10].

This research focusing on how the TPCK and the SAMR model can enhance mathematics achievement of 7 grade students in solving linear equation through technology integration in classroom teaching and learning. Since solving linear equation in grade 7 is one of the problematic content which is connected to many mathematics contents in higher level, the researchers aimed to develop the lesson plans on solving linear equation under the TPCK and the SAMR model for classroom teaching and learning. The designed lessons include various technological tools such as lessons created by Adobe Captivate 9 program, Plickers application, game on solving linear equation by Construct 2 program, and Padlet application. Also, the present study would like to determine the students' mathematics achievement and attitude towards teaching and learning on the activities created by the researchers through these technology integration. This research will be an guideline for mathematics teachers supporting the utilise of the TPCK and the SAMR model for an effective teaching and learning which serves the students' needs.

2. Theoretical Background

2.1. The TPCK Framework

Technological Pedagogical Content Knowledge (TPCK) is viewed as a notion which connects with content, pedagogy and technology knowledge together. The TPCK has been taken into consideration as the basis of successful teaching which integrates the use of technology. This terminology provides the teachers with the understanding as the representation of the concepts of using technology and pedagogical techniques. Following this, technology is used constructively to deliver teaching content knowledge of what leads to either easy or difficult concepts for learning, together with how technology can help the students to solve the problems that the students must handle with their knowledge before expanding knowledge and theories of epistemology; the knowledge of how technology can be used to expand the existing knowledge to create new epistemologies or strengthen the prior ones [8].

The concept of integrating the knowledge of technology, pedagogy and teaching content was developed by Shulman in which offers theoretical framework [11] focusing on the knowledge combined with pedagogy and teaching content (i.e., the Pedagogical Content Knowledge) or the PCK. With a recognition the role of technolog in education, however, Mishra and Koehler [8] developed a new theoretical framework which emphasised in the knowledge of integrating technology with pedagogy and teaching content as called the Technological Pedagogical Content Knowledge or the TPCK. As suggested by Mishra and Koehler [12] in order to provide an effective teaching and learning, the TPCK referred to the teacher's knowledge of integrating technology with teaching methods and content which include three compoments of knowledge; the Technological Knowledge, the Pedagogical Knowledge, and the Content Knowledge. Because of this, having the knowledge and understanding on how to integrate these types of knowledge are essential for the teachers. The TPCK framework is shown in Figure 1.

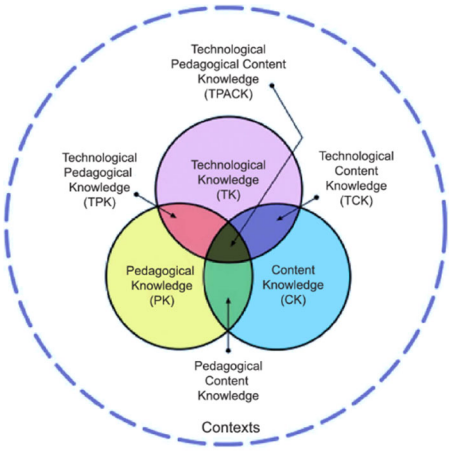

Figure 1. The TPCK Framework [12].

2.2. The SAMR Model

The SAMR model which has gained a popularity in 2012 was proposed by Dr.Ruben Puentedura. This framework is used to help the teachers improve the emerging of technology integration into their daily lessons. The SAMR model shows how computer technology gives an impact on teaching and learning by focusing on a progression towards redefining teaching and learning with technology in the teacher's teaching process [10].

The classroom applications of the SAMR model as shown in Figure 2 are explained as follows; (1) Substitution means technology acts as a direct tool substitute with no functional change, (2) Augmentation means technology acts as a direct tool substitute with functional improvement, (3) Modification means technology allows for significant task redesign, and (4) Redefinition means technology allows for the creation of new tasks being previously inconceivable. Within the SAMR model constructs, Substitution and Augmentation represent the use of technology for the enhancement of the existing non-digital resources while Modification and Redefinition are described when technology or application leads to transformation [10].

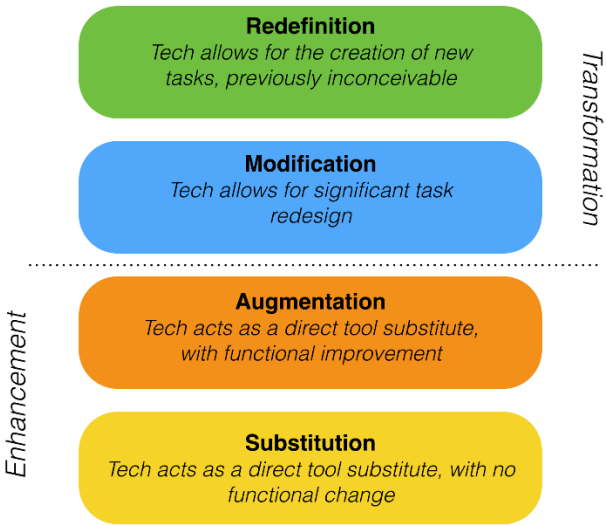

Figure 2. The SAMR Model [10].

However, the key success in utilising the SAMR model is not considered that the SAMR model are the steps to work through but using technology effectively means redesign traditional ways of learning and creating opportunities with the use of technology [13].

3. Methods

3.1. Research Design

This research employed the quasi-experimental research design using one-group pretest-posttest design. The pretest and posttest were given to the students before and after the intervention respectively.

3.2. Samples

The samples of this research are one class of 30 grade 7 students in the 2018 academic year of Satree Yala School, Muang District, Yala, Thailand who were selected by purposive technique.

3.3. Instrument

3.3.1. The designed lessons on solving linear equation for grade 7 students

The designed lessons on solving linear equation for grade 7 students which integrated technology in the designed lessons under the concepts of the TPCK and the SAMR model include 1) lessons created by Adobe Captivate 9 program, 2) Plickers application, 3) game on solving linear equation created by Construct 2 program, and 4) Padlet application. The created lessons included the contents of 1) equation and the answer of equation, 2) solving linear equation, and 3) problem on solving linear equation. The lesson plans were validated by three experts and the experts' comments were used for consolidation.

3.3.2. The pretest and posttest for assessing students' achievement on solving linear equation

The pretest and posttest for assessing students' achievement on solving linear equation for grade 7 students which were validated by three experts and was pilot-tested to find reliability, difficulty, and discrimination. Cronbach's alpha coefficient was used to find the reliability and the reliability of the pretest and posttest was 0.94 and difficulty and discrimination were acceptable.

3.3.3. The questionnaire for assessing attitude towards learning

The questionnaire for assessing attitude towards learning through the designed lessons under the concepts of the TPCK and the SAMR model was validated by three experts and was pilot-tested to find reliability of the questionnaire. Cronbach's alpha coefficient was used to find the reliability and the reliability of this questionnaire was 0.91.

3.4. Technological tools for learning

3.4.1. Plickers Application

This tool is for students to register for attending the class and for teacher to check the attendance of students before learning. This tool is utilised in the level 3 of the SAMR model.

Figure 3. Plickers application (Level 3 of the SAMR Model).

3.4.2. Lessons created by Adobe Captivate 9 program

This tool is for students to learn the concepts of solving linear equation. The researchers created this tool by using Adobe Captivate 9 program which showed the utilising of level 4 of the SAMR model.

Figure 4. Lessons created by Adobe Captivate 9 program (Level 4 of the SAMR Model).

3.4.3. Padlet Application

This tool is for students to make comments, asking questions regarding on the contents, and submiting their homework assigned by the teacher. This tool utilised the level 3 of the SAMR model.

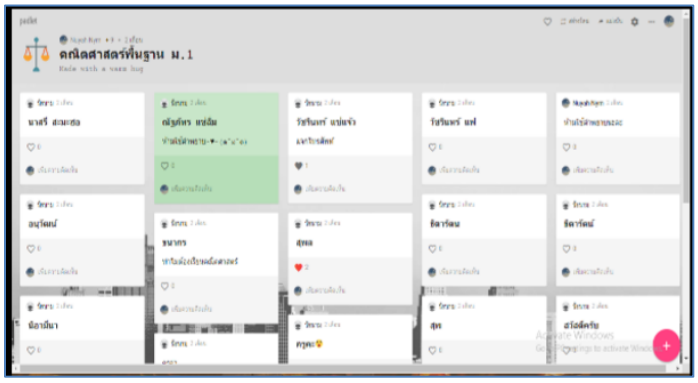

Figure 5. Padlet Application (Level 3 of the SAMR Model).

3.4.4. Game on solving linear equation created by Construct 2 program
The game on solving linear equation created by Construct 2 program is for students to practise on the problems of solving linear equation. There are 20 items under this game in which students have to pass through to complete this activities after they already have the understanding on the concepts of this content from the previous session. This tool showed the utilisation of level 4 of the SAMR model.

Figure 6. Game on solving linear equation created by construct 2 program (Level 4 of the SAMR Model).

3.5 Data Collection
The pretest on solving linear equation was given to 30 of grade 7 students who are the samples of this research followed by the lesson of solving linear equation on Adobe Captivate 9 program then practiced on the problems of linear equation with game on solving linear equation created by Construct 2 program. After finish learning, posttest was given to the students for assessing students' achievement and followed by the questionnaire for assessing attitudes towards learning.

3.6 Data Analysis
Pair sample t-test was employed for comparing students' achievement on solving linear equation before and after learning and descriptive statistics were employed for finding the mean and standard deviation of the attitude of the students toward learning through the lesson design by the researchers based on the concepts of the TPCK and the SAMR model.

4. Results and Discussion

4.1 Results

Table 1 Comparing students' achievement on solving linear equation before and after learning through the lesson designed by the researchers based on the concepts of the TPCK and the SAMR model.

Test	Number of students	Mean	SD	t	p-value
Pretest	30	4.47	2.417	-10.10	.000
Posttest	30	14.57	2.487		

Table 1 shows that the achievement of grade 7 students on solving linear equation after learning through the lesson designed by the researchers based on the concepts of the TPCK and the SAMR model was significantly greater than before learning at .05 significant level.

Table 2 The attitude of grade 7 students toward learning through the lesson design by the researchers based on the concepts of the TPCK and the SAMR model.

Students' Attitude	N = 30		Level of attitude
	Mean	SD	
Attitude on content and teaching content			
1. The clarity of teaching outline.	4.69	0.61	Highest
2. The clarity of learning objective.	4.59	0.63	Highest
3. The clarity of learning assessment.	4.60	0.60	Highest
4. The completeness of contents and corresponding to the curriculum.	4.64	0.59	Highest
5. Supporting students' analytical thinking.	4.59	0.58	Highest
6. Encouraging students' understanding.	4.73	0.58	Highest
7. Interesting and have the clarity on the explanation and examples.	4.65	0.62	Highest
8. The knowledge gained from learning.	4.74	0.63	Highest
The integration of technology with teaching content			
1. Clarity instruction and explanation on the integration of technology in teaching and learning.	4.62	0.67	Highest
2. Students be able to understand and review the lesson by themselves.	4.71	0.71	Highest
3. Various of classroom activities which relied on student-centered learning.	4.61	0.74	Highest
4. The technology integration activities are interesting, and students have fun in learning.	4.68	0.65	Highest
5. The technology integration activities lead to the understanding of students in the teaching contents.	4.57	0.66	Highest
6. The learning assessment using technology is appropriate.	4.69	0.61	Highest
Students' Attitude	**4.65**	**0.63**	**Highest**

Table 2 shows that, the attitude of grade 7 students towards learning through the lesson design by the researchers based on the concepts of the TPCK and the SAMR model is in the highest leve)Mean = 4.65(The maximum mean score of the students is on the knowledge they gained from learning) Mean = 4.7 4 (which is in the highest level. Followed by the teaching and learning encourage students'

understanding)Mean = 4.7 (3 and students be able to understand and review the lesson by themselves)Mean = 4.71 (respectively which are in the highest level.

4.2 Discussion

The results of this research reflect on the effectiveness of the technology integration under the concepts of the TPCK and the SAMR model on solving linear equation for grade 7 students which show the enhancement of students' achievement after leaning through this process and students' attitude towards learning is in the highest level. This because of teaching through technology integration helps in making the abstract mathematics concepts become more concrete, technology can create various of activities which relied on student-centered. They will be easy to understand and review the lessons by themselves and the lessons are more interesting and fun for the students which lead them to understand the teaching contents effectively. These results are consistent with the study of Jason [13] which found that integrating technology in the classroom through the SAMR model and the TPCK lenses are effective.

5. Conclusion

This research highlighted on the effectiveness of the TPCK framework and the SAMR model in classroom teaching and learning by giving the importance to the technology integration. The researchers designed the lesson on Adobe Captivate 9 program for students to learn the concepts of solving linear equation, using Plickers Application for checking attendance of the students, let students play game on solving linear equation created by Construct 2 program for practising on the problems of solving linear equation, using Padlet for students to make comments and asking questions regarding on the contents or submiting their homework assigned by the teacher. These will be the guidance for the teachers who are interested in designing classroom teaching under the concepts of the TPCK and the SAMR model for an effective learning of students as shown the positive results on students' achievement and their attitude in this research. The further research will highlight on in-service and pre-service teachers' professional development or a learning community for enhancing their knowledge in designing classroom teaching with technology integration.

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