

Development of Learning tool for Understanding Concept of Set via Music rhythm

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Abstract

According to International Mathematics and Science Study (TIMSS 2007), Thai students' competence in Science and Mathematics is behind other countries. Thai students are inferior in mathematics. Teachers commented that the instructional media considered as the first concern in their opinions in the secondary school are not enough and are limited for students. Students are unable to apply the course content and learned skills from classrooms to use in their life. The aim of this research is to create a tool that can enhance mathematics learning through music. The tool was designed with the integration of Set operation lessons with music rhythms. Fourteen and thirty-three subjects from the Grade 9 and 11 were assigned to use the tool respectively. They were tested with pre and post-test with achievement test. The result shows that there is a significant difference at level 0.01 from grade 9 students who have not learned the set operation before. For the grade 11, students, there is a significant difference at level 0.05. Moreover, the subjects are highly satisfied with the tool.

Keywords: Learning tool/Math and music/Music sequencer/ Set operation/Learning Achievement

1. Introduction

In accordance with the research regarding the cause of Thai students' inferiority in mathematics [1], it appears that the instruction media are considered as the first concern in the teachers' opinions. There are not enough media available for all students. Some of them are not up to the standard and lacks of innovation. In terms of students' viewpoint, many students are afraid of their teachers. Many teachers do not use the instructional media, so the students are bored and study under pressure. In conclusion, there are two factors that affect on mathematics which are the deficiency of instruction media and the students' stress.

Ashcraft and Kirk[2] discovers that those students who are extremely stressful cannot remember things well and it results in the learning process. It affects the working memory which is very significant for the calculation. The brain cannot process new information while other parts of brain are still stressful. Boonkerd[3] said that the limbic system controls the human emotion. It implies that limbic system in the brain is closed when students are not happy to learn. On the other hand, the music and activate areas of the limbic system which are important in producing arousing as well as pleasurable effects. When limbic system opens, the students can learn easily.

Mathematics and music are logically connected. For example, Mathematical qualities are also inherent in other aspects of music, such as rhythm, tempo and melody. When it comes to the written recording of both disciplines, the use of clefs, quavers, stave and bar lines

are the internationally-recognized symbols for music, whereas, for mathematics it is numbers, signs of equality/inequality and algebraic notation [4].

This study aims to develop mathematics learning tool for understanding concept of set via music rhythm (MLT) used in the classroom. This study will answer the questions how the students learn from MLT. How can MLT improve the atmosphere in the class and the attitude toward mathematics?

Research objectives

1. To develop the learning tool for high school students for understanding concept of set via music rhythm.(MLT)
2. To investigate learning achievement before and after using MLT.
3. To evaluate the satisfaction of students when using learning tools.

2. Method

For the experiment, there are two sets. The first one is to test the students from grade 9 who have not learned the Set operation before. For the second one, students from grade 11 who have learned the Set operation were tested. Both of them were tested with an achievement test before and after using the MLT. Then they can check the result from their answer with the correct rhythm. After each test, both groups rated the satisfaction of this tool.

2.1 Investigate the Set operation information

Investigate the content of "Set operations" which is studying in high school Mathematics from the teaching manual on issued by the Institute for the Promotion of Teaching Science and Technology, Ministry of Education.

2.2 Design sketches

Rhythm of music is based on time. Most music has a steady, recur rhythms are usually arranged with respect to a time signature, partially signifying a meter. The speed of the underlying pulse is sometimes called the beat. The tempo is a measure of how quickly the pulse repeats. The tempo is usually measured in 'beats per minute' (bpm) 60 bpm means a speed of one beat per second. Standard notation music is shown on Figure 1a

The evolution of music notation and rhythm continues even today as can be seen as the rhythmic information. In general, the basic concepts of rhythm have remained unchanged for thousands of years. Early tribal humans created the basis of modern rhythm, "Stomp-Step-Hop" still drives the rhythm and dance in modern music. The form is standard music notation. It can also convert to the grid notation format for instance as shown in Figure 1b

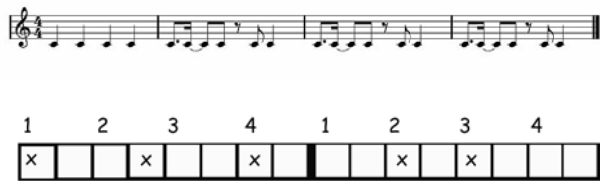


Figure 1 a) Standard notation of a clave pattern on audio clip
b) Grid notation of single a clave pattern

The above principles have led keypad design that is similar to the model grid notation, then the response button with light to bring out experiments to create exercises to challenge assessments.

2.3 Designing user interface for interaction with screen

The concept of action at the screen designed to compare the Venn diagrams to present design of the program button to create the following rhythm.

Table 1 Design concept of the Venn-Euler diagram transform to button for create the rhythms

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From the table 1, information has been designed to the exercises including union, intersect, subtract, and complement.

2.4 Designing Tool

The tool in this experiment can be represented into two parts as shown in Fig.2. The first one is math exercise on the software. The second one is hardware which has a light turn on of each set members. The second one shows the aspect of tangible interaction base on Arduinome's project. The tool was designed as a matrix (8 by 8). One row contains the members of a set. Students can use the set operation to union or subtract between the first and second row. Since there are a lot of subjects participating in this project, the software is used as a tool for this testing. After students finished their calculation, they can check their answer from the sound that machine provided.

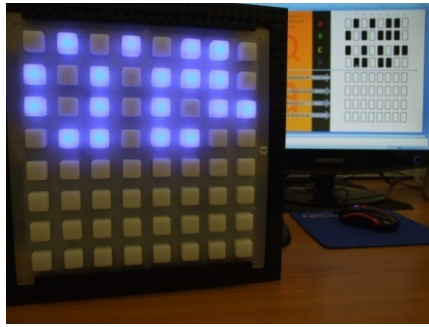


Figure 2. MLT tool and exercise

2.4.1 Testing learning tool

The simple prototyping is to express ideas, and to build simple functional proof-of-concept prototypes. The interface in this example can be seen as an interface between users and simple prototype. It shows how users access the information by using the LEDs light feedback. Users of this product receive the meaningful information when they are interacting with button. For this simple prototype, users can interact by pressing the button then the feedback of that answer will be informed by the light on LEDs. This interaction stage make users know how the grid notation works.

2.4.2 Improve the learning tool

The prototype is not completed since programming of the keypad still does not work 100% . It is still complicated and not appropriate to test with the subjects. As a result, the researcher changes. the format from the hardware to software programming. The software still contains the same behavior as those in FL studio. This Studio is a fully featured, open-architecture music creation and production environment for PC with a complete set of instrument and studio tools. The Studio functions as both a pattern and track based sequencer. A tool used to replace the hardware.



Figure 3 The software FL studio music sequencer program

2.5 Population and procedure

To test the effectiveness of the learning tool, the experiment was conducted as shown in Fig.4. The numbers of subjects were 14 and 33 students from grade 9 and 11 respectively.



Figure 4. a) Introducing the tools b) Testing the pre-test c) Learning the MLT tool and d) Doing post-test and satisfaction test

3. Result

Table 1.2 Result of pre-test and post-test from grade 9 and 11

	No. of subjects	Mean	Std.	Sig.
Grade 9				
Pre-test	33	1.09	2.337	0.00**
Post-test	33	17.76	3.783	
Grade 11				
Pre-test	14	17.28	3.292	0.037*
Post-test	14	18.36	3.783	

** Within significant difference at the level of .01

*Within significant difference at the level of .05

3.1 The comparison of the learning achievement on Set Operations

The result from Table 1.2 shows that there is a significant difference at level 0.01 from grade 9 who have not learned set operation before. For grade 11, there is a significant difference at level 0.05. The tool is effectiveness for students who have not learned that mathematics lesson before comparing to the ones who already learned.

3.2 Evaluation of student satisfaction after using the developed learning tool

The result from the 5 rating scale of Likert shows that the total average score of grade 9 is 4 (SD=0.75). They rated that the tool is good for creativity, substantive and entertaining. For grade 11, the average score is 4.16(SD = 0.5). Subjects rated that the lesson with music is exciting and attracts the attention from them.

The satisfaction of Grade 9 students with the MLT tools in Set Operations. It can be concluded when considered in each aspect as follows:

In terms of substance, Grade 9 students are acceptable with the context at high level (mean equals 4.18 and the standard deviation equals .636). These topics can be properly permuted from higher to less average

point – ‘the context is very good for creativity’ (mean equals 4.39 and the standard deviation equals .747), ‘the context of Set learning lessons through music is very interesting’ (mean equals 4.18 and the standard deviation equals .392) and the last one is ‘knowledge from Set learning lessons through music is very useful for everyday’s life’ (mean equals 3.97 and the standard deviation equals .770).

In terms of teaching, Grade 9 students are pleased with the teaching process very much (mean equals 3.93 and the standard deviation equals .785). From the data analysis, it is found that ‘the method of Set teaching with music is substantive and entertaining is the highest (mean equals 4.24 and the standard deviation equals .663), ‘the Set lesson with music is exciting and attracts the intention from students’ (mean equals 4.18 and the standard deviation equals .635), and ‘this kind of teaching method gains attraction from students more than before’ (mean equals 3.61 and the standard deviation equals .998).

In terms of media and application, Grade 9 students are highly satisfied with all factors (mean equals 4.03 and the standard deviation equals .758). From the data analysis, the students have the opinion that ‘the controlling by various buttons is suitable’ is the most suitable point (mean equals 4.18 and the standard deviation equals .584), and ‘the illustrations are suitable for the lessons.’ is at the last rank (mean equals 3.85 and the standard deviation equals .906).

The satisfaction of Grade 11 students with the MLT tools in Set Operations. It can be concluded when considered in each aspect as follows:

In terms of substance, Grade 11 students are satisfied with the context at high level (mean equals 4.14 and the standard deviation equals .455). According to the opinion of the students, they thought that ‘the context is very good for creativity’ comes as the first point (mean equals 4.36 and the standard deviation equals .497), ‘the context of Set learning lessons through music is very interesting’ (average point of it equals 4.14 and the standard deviation equals .363) and the last one is ‘knowledge from Set learning lessons through music is very useful for everyday’s life’ (mean 3.93 and the standard deviation equals .475) which correspondent with the opinions from Grade 9 students (written in results and conclusions).

In terms of teaching, Grade 11 students are pleased with the teaching process very much (mean equals 4.05 and the standard deviation equals .535). From the data analysis, it is found that ‘the Set lesson with music is exciting and attracts the intention from students’ is the highest (mean equals 4.50 and the standard deviation equals .519), ‘the method of teaching is not too serious’ (mean equals 4.21 and the standard deviation equals .699), and the last is ‘this kind of teaching method

gains attraction from students more than before’ (mean equals 3.86 and the standard deviation equals .535).

In terms of media and application, Grade 11 students are very pleased with all factors (mean equals 4.14 and the standard deviation equals .567). From the data analysis, the students have the opinion that the first is ‘technique of pictures and sound on each page is interesting’ (mean equals 4.36 and the standard deviation equals .497), ‘the design of the display is fit for the usability’ (mean equals 4.29 and the standard deviation equals .611), and ‘size of the font, pictures and graphic display is obviously seen.’ is at the last rank (mean equals 3.86 and the standard deviation equals .663).

4. Recommendation

There are lots of ways to help student learn and develop, but most of students require special needs activities or innovative tool to learn. Participation in MLT tools lessons at an early stage can improve learning ability by encouraging different patterns of student development. By exercising the tools, student enhances the learnability.

The lessons are designed to collaborate with ‘Fruity loops program’ which has buttons like the prototype tool and plays music for the enjoyment. Students can choose any exercises to do by their own. Different sounds of music and various graphic displays in each exercise can draw attention from students. The applications are used easily, so all students can interact with the Math instruction media ‘Set Operations’ as well as achieve the learning objectives.

The results from the experiment on mathematics learning tool about ‘Set operations’ of Grade 11 students showed that MLT is appropriated and effective for students’ learning.

Furthermore, it is found that the media can be applied for the study of secondary school since user interface is easy to use for novice. The result of data analysis reveals that the interface used in this program is suitable for the students. The concepts of four formats are simple to understand and analyzed by those students. Thus, the atmosphere in the class is filled with pleasure because the lessons are interesting and draw attention in the auditory sense from the students very well. Refer to Theory of Brain Based Learning the music exercise tool encourages long-term enhancement of visual-spatial, verbal, and mathematical performance. However, the underlying neural bases of such enhancements and whether the intensity and duration of instrumental training or other factors, such as attention, motivation, or instructional methods can contribute to or predict these enhancements are yet unknown. The answers of mathematic problems played in various tunes are also interesting for students. They can freely set time to read and think up to their

ability. Making the exercise at the end of lesson also helps the students practice their hearing, seeing, touching with their friends.

4.1 Recommendation for usability

1) Before applying learning tool for understanding concept of set via music rhythm, the teachers ought to study the contents in the lesson thoroughly. They also need to know how to use the MLT tool properly by learning from the manual and practice by themselves.

2) There should be enough computers and earphones for all attendants.

3) MLT tools have no limit. The teachers can MLT tools with other Math topics such as fraction, or art in order to promote creativity for students.

4.2 Recommendation for further research

1) From the observation the students are enthusiastic for doing the exercises toward the researcher with appreciation when using the MLT tools. They tried to make new rhythm in different tunes of the answers and mix them with other musical instruments as they prefer. The students want to share their ideas by creating their new experience and fondness with enjoyable.

2) M.L.T. should be designed from simple to the difficult step. The teachers should spend more time or record the answers of students. For example, students write some choices and compare them. Moreover, if the students have a chance to use their perceptual skill, they have learned better from graphic displays in the exercises and the rhythm. The teachers should screen the proper questions for each student.

3) The teachers should make a summary for each objective taught in the class in order to test the apprehension of the students and to review the lessons. It helps the students understand what they study better because the summary contains merely main ideas in each lesson. Besides, the summary also helps recall former knowledge. Wachira Inudom (1994) found that students who study the lessons through the computers which include the summary have better school record than those who study through the computers without it.

4) Students understand the concept set via music rhythm through MLT. It is found that the students are able to understand the main idea of Set Operations by using this program as same as using Venn-Euler Diagram, but students need less time. Furthermore, all students seem to be happy and enjoy the lessons, thus it will be useful to create this kind of media more (by extending the contents of the lessons apart from Set Operations.)

5) MLT tools should be brought to use in other subjects in the form of knowledge integration.

In summary from the observation the students are enthusiastic for doing the exercises toward the researcher with appreciation during the test of M.L.T. The students want to share their ideas by creating their new experience and fondness with enjoyable. The future development is

to integrate advanced mathematics lesson into the program.

9. References

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