

Designing Experiential Activity Themes in Teaching Maths to Lower Secondary Students Congruent with the New General Education Curriculum in Vietnam

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Abstract The new general education curriculum was officially announced by Ministry of Education and Training in July, 2017. In that curriculum, experiential activity is compulsory and experiential activity in Maths is mentioned. It aims at making a basic and complete innovation of the quality and the effectiveness of general education. It combines teaching knowledge, educating people with vocational orientation; makes a good contribution to changing the education focusing mainly on teaching knowledge into the one that helps develop the learners' quality and competence totally; and harmoniously develops the virtue, mind, physical strength, aesthetics; well develops the learners' potentials. Basing on the study results of the research group at provincial level in 2017 and in 2018 and those of Vietnamese and international researchers, in order to carry out training mission and to train maths teachers capable of constructing the experiential activity themes for lower secondary students, we put forward the procedure and the content of the designing of experiential activity themes in teaching Maths to lower secondary students congruent with the new general education curriculum in Vietnam.

Keywords: *experiential activity, The Kolb's experiential learning model, General education curriculum, experiential activity themes, teaching Maths at lower secondary schools*

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1. Introduction

Central Committee of the Vietnamese Communist Party issued the Resolution No 29-NQ/TW about innovating training and education basically and completely on November 4th, 2013 [1]; To be fully aware of the spirit of the Resolution No 29 -NQ/TW dated November 4th, 2013 and The Resolution No 88/2014/QH13 of The National Assembly dated November 28th, 2014, The Vietnamese Government issued the Resolution No 404/QĐ-TTg about approving the project of curriculum and textbook innovation on March 27th, 2015. In the new curriculum, the learners are centered. It develops students' active, creative and self-teaching nature; strengthens the interaction between teachers and students, students and students, teachers and teachers to ensure the succession of grades, classes, subjects, special learning subjects and experiential activity; guarantees the practical characteristic, updates the international modern educational tendency; succeeds the present curriculum and textbooks' advantages and selectively acquires the experience of the countries with well-developed educations to meet the demand of international integration. After a long period of preparation, Ministry of Education and Training officially

announced the new general education curriculum (the new curriculum). It states that experiential activity is compulsory for students from grade 1 to grade 12 with 105 periods each class. Maths education forms and develops students' basic characteristics, common and mathematical competence; develops knowledge and key skills; gives students opportunities of experiencing and applying Maths into real life. It helps make the connection among mathematical ideas, between Maths and other subjects, between Maths and real life. On the other hand, the new curriculum is designed with an open tendency. It ensures the nationally core compulsory content, and only sets the common orientations, principles and requirements of students' quality and competence, of the educational content and methods, of evaluating education results. It gives the provinces and schools the self-controlling right to choose the content suitable with their conditions. Teaching Maths at lower secondary schools at the basic education stage provides students with a basis to use in daily life or to continue the study in the next grade. The experiential learning model was fully and particularly recommended by Kolb in 1984 and it is also mentioned by a lot of scientists world-wide such as John Dewey, Kurt Lewin, Jean Piaget, lev Vygotsky, David Kolb, William James, Carl Jung, Paulo Freire, Carl Rogers... [3,4]. However, designing themes for this activity to meet the

requirements of Maths curriculum in Vietnam has not been deeply researched. In April, 2017 a group of Vietnamese scientists such as Tuong Duy Hai, Nguyen Thi Hang etc... first announced some themes for experiential activity for subjects at lower secondary level. Therefore, the designing of the themes in teaching Maths in general and teaching Maths at lower secondary school in particular is really necessary. This article addresses the content, the role and the imperative need of the designing of experiential activity themes in teaching Maths to lower secondary students congruent with the new general education curriculum in Vietnam; puts forward the procedure and steps to design them.

2. Content

2.1. Some Features of the Present General Education Curriculum

2.1.1. Some Advantages

The present Maths curriculum has some advantages. It complies with the aims and the regulations stated in the present general education curriculum; ensures the general, basic, modern and practical feature. To be fully aware of the Maths unity spirit, it applies the views of modern Maths and contributes to making the unification of "mathematical basis" of Maths in Vietnam secondary schools. Curriculum structure conforms to the succession of content and concentric spiral structure, broadens through grades, but always guarantees the general of the new common general education curriculum. It inherits and applies the achievements of pedagogical science to develop Maths syllabus suitable with our country's conditions. It initially creates good conditions to innovate teaching methods and evaluating students; makes a contribution to ensuring the quality and the effectiveness of Maths teaching process. It helps sensibly solve the problem of the relationship between Maths education generalization and developing the students' learning ability.

Maths in the present general education curriculum helps students gains the following expected results

a. Gaining basic knowledge of:

- Numbers and the operations on sets of numbers (from natural numbers to complex numbers); algebraic and transcendent expressions; equations (the first degree equation, quadratic equation, trigonometry, exponent, logarit); first order system of equations, inequations (the first degree inequation, quadratic inequation, trigonometry, exponent, logarit) and first order system of in equations.

- Function, limit, derivative, primitive function, integral and their applications

- The geometric relationship and some common figures (point, line, plane, polygonal, circle, ellipse, multi-interface, rotating circle) displacement of figure and analogy of figure in a plane; vector and coordinate, quantity and measure quantity.

- Statistics, combination, probability

b. Forming basic skills:

- Doing the operations: addition, subtraction, multiplication, division, power, extraction of a root, logarit; Changing

algebraic expressions, changing trogonometry, solving the equation, solving a set of equations, solving in equations, solving a set of in equations.

- Calculating limits, derivatives, primitive function, integral; examining the function continuity, studying and drawing the function graph.

- Drawing figures, drawing charts, survey, calculating the length, angle, area, volume; writing linear, circle, ellipse, plane equations

- Collecting and processing the figures; calculating combination and probability; estimating the measuring results and doing calculations.

- Using the measuring, drawing and calculating instruments.

- Reasoning and demonstrating

- Solving Maths problems and apply Maths knowledge to study and daily life.

c. Developing thinking ability

- Developing the ability to observe, predict, sensibly and logically reason; the ability to express their own ideas exactly and understand other people's ideas; developing the imagination in space; developing thinking quality especially flexible, independent and creative thinking.

d. Feeling and attitude

- Students have self-teaching awareness, interest and confidence in learning. They become honest, hard working, careful, exact, well-disciplined and creative. They are aware of the cooperation and know how to appreciate their own achievements and other people's. They realize the beauty of Maths, so they love Maths more.

2.1.2. Some Drawbacks

Analysing the drawbacks of the present Maths curriculum in terms of the way to approach the curriculum construction, the way to divide the content and the methods to organize teaching process, it is seen that:

- The way to approach the curriculum construction: the present Maths curriculum is basically to approach the content. That means focusing on defining and answering the question: What do we want students to know? Therefore, the present Maths curriculum has some disadvantages such as: It only pays attention to communicate knowledge and doesn't meet the demand for forming and developing students' competence. In general, the present Maths curriculum is constantly concerned with ensuring the unification of "mathematical basis". As a result, there are still situations that students are provided with unsuitable and impractical knowledge. For example, the effort to design closely in terms of Maths (following the logic of building Euclid geometry based on the Hilbert axiom) makes some of geometric content at lower secondary level become hard to a lot of students because it is unsuitable with students' logical geometric consciousness. Visual geometry should play an important part in conveying geometric knowledge to students. The view of integration and classification is not fully aware. The integration of Maths teaching content with real life and that of multi-subjects or inter-subjects are not clear. Students have difficulties in applying Maths knowledge to real life.

- The way to divide the content: The principle "concentric spiral" and broadening through grades is

necessary but the unreasonable application of the principle leads to the situation that some knowledge and skills are repeated, which makes unnecessarily overloaded situations or the knowledge is introduced too early and unsuitable with the student age. This results in the unreasonable knowledge division, then raises the studying time to the same knowledge and hence decreases the attractiveness of the subject. The designing of the present Maths curriculum does not guarantee the inter-connection between the classes and between the grades. Moreover, the identifying of the core content of Maths at lower secondary schools is not done well, so students do not know what knowledge is core and basic, what knowledge or what skills are practical. This forces students to memorize too much without realizing what is the main and most important. For instance, statistics is introduced to grade 7 students, meanwhile during the previous grades (including primary level) students have no preparation for this subject. After that, in grade 8 and grade 9, this subject is not taught, so students seem to remember a little of it. Singaporean curriculum introduces this subject from grade 1 by a natural way (such as a game), then increases the knowledge and continues to teach the subject until the end of secondary level.

- The methods to organize teaching process: Teaching knowledge seems to consist too much. Students are required to do general exercises while they do not have the thorough understanding of the knowledge. This leads to overloaded situations. The methods to teach Maths are mainly conducted in class. Organizing experiential activity are not appreciated especially the experiential activity related to Maths outside the class. Teaching methods and evaluating education quality are still behind the times and do not pay attention to teaching methods promoting students' active and creative ability [7,8,9,10].

2.2. The Orientation of Maths Curriculum at Lower Secondary Schools in the Present General Education Curriculum

Maths curriculum at lower secondary grade is defined to be in the elementary stage and compulsory for students. It helps students systematically gain the Maths definitions, principles and rules most necessary for people and is the basis for the study in the next level or for using in daily life. Maths curriculum in this grade combines linear structure with "concentric spiral" one (concentric, widened and improved); turns around and integrates three main branches: Number and algebra, geometry and measures, statistics and probability. According to the new curriculum, Maths education must form and develop students' main characteristics, common and Maths competence with the core components: thinking ability, Maths reasoning competence, Maths medialization and solving problem ability; Maths communicative competence and the ability to manipulate Maths instrument and means of learning Maths. It also develops the key knowledge and skills and makes good conditions for students to experience and apply Maths knowledge to real life. Maths education helps connect the mathematical ideas, or connect between Maths and other subjects, or between Maths with daily life. Maths education is performed in a lot of subjects such as Maths, Physics, Chemistry, Biology, Technology,

Information Technology, Experiential activity etc... Among them, Maths is the core subject. [2,7,11].

2.3. Designing Experiential Activity Themes in Teaching Maths to Lower Secondary Students Congruent with the New General Education Curriculum in Vietnam

Learning through experiencing has become an education mainstream way of thinking associated with the psychologists and educators such as John Dewey, Kurt Lewin, Jean Piaget, Lev Vygotsky, David Kolb, William James, Carl Jung, Paulo Freire, Carl Rogers... These days the idea "Learning through doing, learning through experiencing" was still an American typical education philosophy. "Experiential education" has been introduced to schools in a lot of countries in the world. Experiential learning approach asserts that acquisition of skills and constructions of knowledge by the learners is direct result of experience. The learner is said to have the ability to select and participate in experiences that will further their growth [12]. Experiential learning can exist without a teacher and relates solely to the meaning making progress of the individuals direct experience. This is in agreement with Roger's opinion (1969) [13], he asserts that experiential learning is equivalent to personal growth and change. According to Newsome, Wardlow and Johnson (2005) experiential learning approach elevates students' recognition levels, increases use of critical thinking skills and therefore enhances students' ability to obtain, retain and retrieve knowledge hence increased achievement. Learning is a cycle that begins with experience continues with reflection and later leads to action which itself becomes a concrete experience for reflections. David Kolb (1984) developed a learning model based on experiential learning which is often known as the Kolb's learning model. It aims at "processing learning" with clearly defined stages and actions. Through this process of learning, both teachers and learners can continuously improve the learning levels. This is one of the models that are widely used in envisaging curriculums, planning lessons, in training and instructing for education courses. The Kolb's learning model consists of four stages as described below.

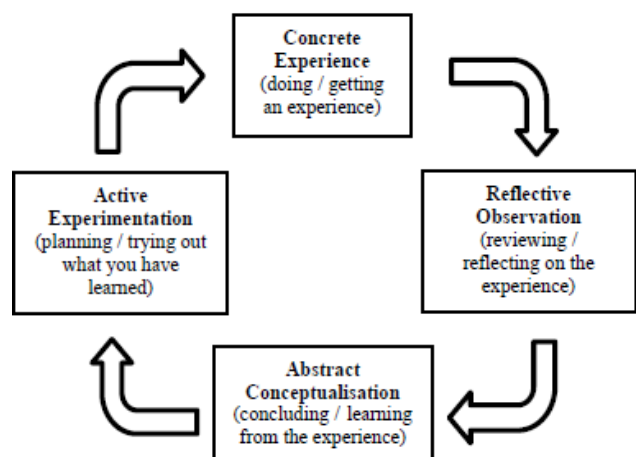


Figure 1. The Kolb's experiential learning model

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In this process, Kolb recommended that the order of experiential learning model is followed, but it is not necessary to start at certain stage of the process. However, Kolb based on an important assumption of learning-knowledge originates from experience. Knowledge needs creating (or re-creating) by learners not remembering what has existed. Therefore, Kolb's process should be used to gain greatest effect.

Kolb and other researchers further realised that the choice of the point to start and the bias in favor of certain stage reflect the learning method of each learner (or each subject). The basic point of view of this learning model based on experience is that learners need to reflect their own experience then generalize and formalize the ideas so that they can apply these ideas in real world to see whether they are right or wrong, useful or useless etc... After that, the learners have got new experiences to get started for the next learning process. The processes are repeated until the planned objectives can be achieved. This process requires learners have discipline in learning by planning, doing, reflecting and applying theory.

Detail description of the stages of Kolb's process

Concrete Experience: Learners can have some experience by reading material, attending lectures, watching videos relating to the topic that they are learning or trying following the instructions of some introductory lessons, or self-performing with the teachers' assistance. All of those factors help students have a certain experience that then becomes an important input material of the learning process. This stage provides the basis for the learning process in which the lessons engage the individual personally: learning relies on open mindedness and adaptability rather than a systematic approach to situation and problem. There is involvement in personal experiences and an emphasis on feeling over thinking. Creative work involves a certain amount of pre-existing domain knowledge and its transformation into new knowledge [14]. The role of the teachers is describing the activity and learners do it. However, the most important experience is the one that learners can feel on their own.

Reflective observation: Learners need to analyse and evaluate the existing facts and experience. There must be reflection in this stage that is learners self-consider the experience carefully to see how they feel, whether they can understand the ideas or not, whether it is logical or not, whether they choose the right way or not etc... In learning process, reflection deeply implies that learners always ask themselves and give answers to a question: "Is this way going on well?" and purely use their intuition to answer the question. In the reflection process, learners take down the consideration in a natural way on their own. Hence, learners not only draw themselves some lessons but also have new orientations to make the next stage more interesting and effective. For teaching, teachers use the same technique for both teaching and learning so as to

gain effective solutions and activity. There are some kinds of reflection that apply more deeply than consultation, analysis or generalization from different sources and bring forward the evaluation of the experience. When reflecting, learners actively take part in the learning process, therefore learning is helped. If reflection is good enough, it will help learners improve, enhance and regulate the learning growth. Learners develop logical thoughts, verbalize those thoughts relate to others in the group and compare experiences and opinions. The applications of classroom knowledge in the context of real life situations are the focus of learning [2]. The role of the teacher is to promote the atmosphere of acceptance of individual participants and diverse thinking, to design activities that help learners to construct meaning and take the initiative becoming more creative in mathematical learning.

Conceptualization: After experiencing detail observation and deep consideration, learners conceptualize their gained experience. New ideas are derived from experiences. This stage is very important for the experience to transform into knowledge and a set of ideas kept in the brains. In this stage, learners assimilate and distil the observation and reflections into a theory. The students come to understand the general concept of which their concrete experience was one example by assembling their experience into a general model. Abstract conceptualization requires student to use logic and a systematic approach to problem solving. There is an emphasis on thinking manipulation of abstract symbols and tendency to neat and precise conceptual systems. The students share their reactions and observations about their experiences. The learners at this stage provide answers to the question arising from the experiences by providing solutions and making generalizations. According to National Council of Mathematics Teachers (2000), the abilities to solve a problem with several strategies or the abilities to reach different answers in a specific task are valuable evidences of the development of mathematical reasoning. Without this stage, the experiences can not be improved and developed into a more helpful new level, but it is only concrete experience gained during the learning and practicing process. Abstract conceptualization ends with our making plan for the next activity in the coming time. This stage usually proceeds the last stage naturally (reflective observation) by answering the important questions arising during reflective observation stage. It can be considered as the conclusion of the previous stage and the next one will be the stage to verify its accuracy.

Active Experimentation: In the last stage, the learners came to a conclusion based on reality with closely associated basis and thoughts. This conclusion can be regarded as a theory and we have to apply it in the real world to test. This is very vital for the constitution of real knowledge. According to Kolb and some constructivists, universal truth needs comprehending or verifying. This is the last stage for us to confirm or disclaim the concepts of the previous stages. In this stage, students use the theories they developed during the abstract conceptualization stage to make predictions about the real world situations. They connect subject matter and life skills discussion to the larger world. Students' action and wishes are new concrete experiences. The learners are expected to use or test the conclusion, generalizations and solutions in new situations (Kolb&Kolb, 2008). The learner involvement facilitates

personal growth and skill development, giving a measure of empowerment to the learners [3,4,5,12].

With a view to meeting the requirements of training and education innovation congruent with the new general education curriculum and with the mission to train and retrain the lower secondary teaching staff, we did scientific research at provincial level in 2017 and in 2018 to organize experiential activity for lower secondary students. The research content was discussed many times between the members of the research group and many scientists with the close help of Associate Professor -Dr Vu Quoc Chung. The research group agreed to design experiential activity themes in teaching Maths to lower secondary students as following:

First, organizing teaching math using experiential activity themes is conducted in the subject curriculum or out of the curriculum (the second period with schools having two periods a day: in the morning and in the afternoon or extracurricular program)

Second, the content is designed to teach new lesson or to revise or to consolidate the knowledge, skills and apply it to reality.

Third, the place to hold the activity depends on factual condition. It can be in or outside the classroom.

Theme structure:

Stage 1: Define the theme name: the name must be suitable with the content and attractive. It depicts the core activity and fits well with lower secondary students' psychological characteristics, and has a clear, pure and dear language.

Stage 2: Define the theme objective: It needs to be made clear about the knowledge, the skills, the attitude and the abilities to be formed and developed.

Stage 3: Define the time: time length, the order of the lesson in math curriculum

Stage 4: Prepare materials for each activity including pre the lesson, during the lesson and other material facilities needed to complete the teaching and learning mission.

Stage 5: The way to organize: define which activity is for groups, which one is for individuals.

Stage 6: The place to organize: in or outside the classroom

Stage 7: Design the activity: this is the most important stage where the teacher is a designer, an organizer, an assistant and a specialist while students perform, directly take part in and use their own experience to observe, reflect, conceptualize and actively experiment following the Kolb four-stage model.

Stage 8: Evaluate students' learning activity: teachers give out the criteria, the standards, set up evaluating sheet and organize the evaluation. Teachers should pay attention to coequal evaluation, group evaluation and the teacher's comments during the activity.

2.4. An Illustrating Example

Design teaching basing on experiential activity: A mathematical problem: Draw a angle given the measurement (Grade 6, 2003, Phan Duc Chinh- the General Editor, Vietnam Education Publishing House, page 83)

Stage 1: the theme name: Draw an angle given the measurement

Stage 2: Define the theme objective:

Students acquire the knowledge that on the half of a plane consisting Ox ray, they can always draw only one

Oy ray so that $\widehat{xOy} = m^{\circ}$ ($0 < m < 180$).

Students also acquire the skill to draw an angle given the measurement using rulers and protractors exactly and carefully.

Students form reasoning and solving problem ability; use instrument and means to measure angle; develop discussing competence in the group discussion.

Stage 3: Teach in the math lesson in the curriculum

Stage 4: materials: A4 paper, rulers, protractors and textbooks

Stage 5: The way to organize: activity 3 and 5 are for groups, activity 1,2,4 are for individuals.

Stage 6: The place to organize: in the classroom

Stage 7: Design the activity:

Warm-up:

- Activity 1: Each student has an A4 paper. Use rulers, protractors to draw Oa ray, then draw two angles aOb, aOc, after that measure the angles and speak out which ray is between two other rays.

In this activity, students know how to draw and measure an angle but they don't know how to draw an angle with given measurement. Therefore the results will be different: Ob ray can be between Oa ray and Oc ray or Oc ray is between Oa ray and Ob ray or Oa ray is between Ob ray and Oc ray.

Discovering:

- Activity 2: With the above instrument, students draw Ox ray then draw angle $xOy = 40^{\circ}$

How many Oy rays drawn meet fully the requirements of the task? Comment on the half of a plane consisting Ox ray, how many Oy rays can be drawn?

Through the activity 1, students know to use their experience in using protractors to measure the given angle to use the protractors to define Oy ray so that angle $xOy = 40^{\circ}$

After doing activity 1, students can realize that they can draw two Oy rays meeting the requirement of the task and on a half of a plane consisting Ox ray, they can only draw one Oy ray so that angle $xOy = 40^{\circ}$

Applying as the model

Activity 3: Group discussion: each group consists of from 3 to 5 students, the group leaders guide other members to discuss to draw angle ABC given $\widehat{ABC} = 30^{\circ}$ and give the way to draw. After that, each group member freely chooses angle ABC as they like to draw, then present the result and the way to draw in groups.

Applying

Activity 4: On the half of a plane consisting Ox ray, draw angles xOy , xOz given $\widehat{xOy} = 30^{\circ}$, $\widehat{xOz} = 45^{\circ}$. Define the relationship between the angles and the rays in this task and give general comment.

Applying and widening

Activity 5: Discuss in groups to draw the angles ABC, BAC so that $\widehat{ABC} = 30^{\circ}$, $\widehat{BAC} = 45^{\circ}$

Present the way to draw.

Students have practice the way to draw independently the angle ABC, BAC in the above activity. However, in this activity, students have to know how to analyze, reason, generalize to draw the second angle after finish drawing the first one.

Stage 8: Evaluate students' learning activity:

a. Students' record: the teacher observe students take part in experiential activity, then evaluate them basing on students' self-evaluating sheets and coequal evaluation to have the exact assessment of the students.

This record is divided into good or not good according to PISA level (Level 1: C1, Level 2: C2, Level 3: C3). The notes part is used to record other qualitative aspects (such as: attitude, creative solution...)

Table 1

No	Name	Activity 1			Activity 2			Activity 3			Activity 4			Activity 5			Notes
		C1	C2	C3	C1	C2	C3	C1	C2	C3	C1	C2	C3	C1	C2	C3	

Activity 1: Students are assessed at level 1 (Students remember the knowledge they learnt in the last lesson)

Activity 2: Students can draw the figure. They make progress from knowing how to measure an angle with free measurement to define an angle with given measurement and come to the conclusion that there is only one Oy ray, they are evaluated at level 2.

Activity 3: In this part, students do as guided and are assessed at level 1

Activity 4: In this part, students are assessed at level 2

Activity 5: In this part, students are assessed at level 3

The teachers can give students points for each level, for example: Not good: 0 point, Level 1: 1 point, level 2: 2 points, level 3: 3 points

b. Students' self-evaluating sheets:

In each activity, the teacher has to make clear about the knowledge, the skill and the procedure that need evaluating. That is the objective of each activity; the results are divided into good or not good.

Table 2.

Name	Self-evaluating activity 1			Self-evaluating activity 1			Self-evaluating activity 1		
	Content	Good	Not good	content	Good	Not Good	Content	Good	Not Good
	-measure the newly-drawn angle -define the ray between two other rays			-understand and explain the way to draw -draw two cases -come to the conclusion: on a half of a plane, there is only one ray			-draw the figure themselves - explain the way to draw		
Name	Self-evaluating activity 1			Self-evaluating activity 1					
	Content	Good	Not Good	Content	Good	Not Good			
	- draw a figure as required -comment Oy ray is between Ox and Oz; - finr the relationship			-draw the angle $ABC = 30^\circ$; -From A, put the ruler and draw the angle $BAC = 45^\circ$; -draw more than one way.					

The teacher can also give points as the above stage.

c. Group evaluation:

In this lesson, activity 3 and activity 5 are for groups, so the groups discuss and come to an agreement about the assessment according to the criteria given by the teacher

Table 3.

Activity 3:	Student 1:.....	Student 2:.....	Student 3:.....	Student 4:.....	Student 5:.....
-Actively takw part in group work					
-willingly to share with other students					
-able to draw and and present the way to draw					
-other comments					
Activity 5:					
-Actively takw part in group work					
-willingly to share with other students					
- able to present the way to draw					
-able to answer other students' questions					
-Fluently present the way to draw in front of the class					
- other comments					

d. Processing information, confirm the result

Basing on the information collected, the teacher can evaluate the class on a whole and each student's study result so that the students are assessed according to the above procedure.

3. Conclusion

To successfully carry out the education renovation and organizing the teaching according to the new general education curriculum, the teacher is the decisive factor. The organizing of experiential activity in teaching Maths to lower secondary students fits well with secondary students' psychological characteristics; transfers from visual learning, conceptual description at elementary level to learning based on conceptual definitions, and logical reasoning; and meets the requirements of the objectives and the point of view of the subject in the new curriculum. It helps students experience, apply Maths knowledge to reality and form the connection between Maths ideas, between Maths with other subjects. With the recommended procedure and content of the designing of experiential activity themes in teaching Maths to lower secondary students congruent with the new general education curriculum above, we hope that it will bring about a good impact on the teaching in the new stage.

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