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Applying Experiential Learning to Teaching the Equation of a Circle: A Case Study

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Abstract: Methods of education in schools should promote students' activeness, self-awareness, initiative and creativity; be suitable with the characteristics of each class and subject; foster self-study methods, ability to work in groups, practice skills to apply knowledge into practice, and impact emotions to bring joy as well as excitement to students. Experiential education is a method of teaching and meets the above requirements. Experiential activities are closely related to teaching and educational activities in schools, in order to create an environment for learners, associate theory with practice, and unify awareness with action and learners, and have the opportunity to experience their behaviour. The study was aimed at assessing the performance of activities through experience in solving problems about the equation of a circle and investigate students' attitudes as well as beliefs in such activities. The experimental class included 30 10th grade students and was taught by the experiential learning model, while the control class also had 30 students and was taught in a conventional way of teacher's guidance. Both quantitative and qualitative analysis methods were utilised to analyse and evaluate the collected data. The results showed that the experimental class achieved better mathematical results than the control class as well as had a positive learning attitude, showing interest in the learning topic.

Keywords: *Active learning, experiential learning, Kolb's learning model, the equation of a circle, mathematics education.*

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Introduction

Experiential activities are concerned by most countries, especially those that access general education programs towards capacity development; paying attention to humanities education, creative education, quality education and life skills. In Korea, the activities mentioned in the national program are called creative experiential activities. It is a component of the national primary curriculum (along with the system of compulsory subjects, elective activities) and is carried out throughout grades 1 to 12. In Singapore, experiential activities include extracurricular activities (co-curricular activities or extracurricular activities) and programme for active learning, including outdoor education. Extracurricular activities and dynamic learning programs are affirmed as a "core component of the entire school experience", providing a factual foundation for the learning to take place, and this is a mandatory activity in parallel with school learning. In the UK, schools place great emphasis on students' extra-curricular activities. They believe that education has to be comprehensive, and they do not want to turn schools into places where examinations are organised. Therefore, extracurricular activities are designed incredibly realistic but no less impressive. For many students, the experiences of participating in extracurricular activities can accompany them throughout their lives. What roles do experiential activities play in acquiring the knowledge that countries are interested in?

Experiential activities increase the attractiveness of learning, in particular, they mainly help students become familiar with problems and situations in reality, then solve them and gain knowledge more easily (Weinber et al., 2011; Davidvitch et al., 2014). Hence, experiential education is a critical bridge between teaching in the classroom and applying it in practice. Besides, these activities promote positive, creative thinking for students since they have to think for themselves. Consequently, experiential activities will unlock the potential and help students shape their habits. This method of learning does not impose students but maximises their creativity.

Furthermore, experiential learning in schools is a bridge between the school, the knowledge of subjects with real life in an organised manner, with a direction to actively contribute to the formation and consolidation of competence and

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personality qualities for learners (Breunig, 2017; Sharlanova, 2004; Waite, 2018). Through these activities, learners are nurtured and developed an emotional life, created the will to motivate them to work and to become active. Also, experiential tasks assist educators in realising the purpose of integration and differentiation in order to develop practical capacity and personalise, diversify creative potential (Parahakaran, 2017; Sand, 2014; Weinbern et al., 2011).

In addition to the above roles, experiential activities also have their valuable meanings. Indeed, they significantly contribute to the formation and development of skills, behaviours, emotional education, beliefs in learners, mainly help learners form and develop life skills to enjoy corresponding to the ever-changing living environment, creating the basis for the holistic development of learners' personality, meeting the requirements of society (Miettine, 2000; Roland, 2017; Waite, 2018). Moreover, experiential activities give support to the school and teachers in developing educational programs, create a cultural and educational environment in schools, build a school culture and friendly environment as they are considered as organic parts of the education process in high school as well as integral parts of the school's educational plan. The learning method which emphasises students' experience creates an active learning environment of the learners' activities to shape and develop personalities and aids the school in mobilising resources to educate students in all aspects in order to build friendly schools and active students (Falloon, 2019; Katranci & Bozcus, 2014; Polk, 2013).

Despite the advantages, there are still some difficulties when organising experiential activities in the school. Implementing creative learning experiences is an encouragement activity at current high schools; however, this is not an easy task. When schools embark on implementation, they will face many difficulties, in which the difficulty of organising time is also noticeable. The development of teaching plans and curricula is quite tight in terms of duration. Also, it is necessary to mention the factors of space and geography. Typically, places such as monuments, museums, landmarks or industrial areas, farms are often quite far from the school. At the same time, the implementation cost is not small difficulty (Davidovitch et al., 2014).

A vital factor to consider is that when experiential activities are organised, without psychological and methodological preparation, students are more likely to fall into passivity when approaching the experiential object or will turn the experience into a tour. Moreover, the element of safety in the organisation of experiential learning activities is critical. Due to geographic distance, transportation and object experience, ensuring the safety in the process of organising a large number of students participating in learning will face many obstacles (Tuyen, 2018).

To achieve the purpose, requirements and effectiveness of creative experience at high schools to innovate educational methods, each school needs a valid program, plan and scientific, relevant organisational method. When developing a program, it is required to pay attention to this activity during the program duration so that the arrangement and organisation are both rational and practical. Local schools need to base themselves on the working conditions to plan and conduct experiential learning activities effectively, do well in coordination with the representative board of parents' students, unions and localities while organising (Westera, 2011; Waite, 2018).

Many researchers have come up with experiential learning processes, including Kolb's circular procedure (1984*)*: concrete experience, abstract conceptualisation, reflective observation, reflective experimentation. In 1972, the Learning Style Inventory to evaluate individual learning style was developed by David Kolb (cited by Kolb & Kolb, 2017), and it consisted of 4 component learning styles such as diverging, assimilating, converging, and accommodating. Kolb's learning model was interpreted in a mathematical context and considered students as capable people such as allegorisers, integrators, analysers, and synthesisers. (cited by Chesimet (2016)). Boud & Walker (1992) added two crucial elements: experience and reflection. (cited by Beaudin (1995)). Meanwhile, Dean (1993) proposed the process of developing and implementing an experiential learning activity in classes with six steps, including planning, involvement, internalisation, reflection, generalisation, application and follow-up (cited by Beaudin (1995)). Besides, some authors chose the Kolb's model; some others followed the model of Laura Joplin (1981) with five stages: focus, action, support, feedback and debrief (cited by Beaudin (1995)). Kolb's teaching model has a wide range of use since it has been applied in teaching various fields such as mathematics (Avelino, 2017; Chesimet, 2016; Davidovitch, 2014), clinic (Sand, 2014), agriculture (Baker, 2012), science and technology (Parahakaran, 2017). Moreover, the research objects associated with this learning model are also very diverse such as students in elementary school (Falloon, 2019), middle school (Chesimet, 2016; Tuyen, 2018), high school (Weinbern, 2011), university students (Mendoza, 2019) and prospective teachers (Girvan et al., 2016; Efstratia, 2014; Katranci & Bozcus, 2014).

The researchers, Avelino et al. (2017) selected 187 junior high school students in the Philippines to investigate the relationship between the goals of mathematical achievement and learning styles. The results indicated that participants tended to approach the goals of mathematical achievement were interested in an assimilative learning style based on feedback observation and abstraction. Meanwhile, students who avoided the goal of mathematical achievement were more likely to study accommodative learning methods that operated on their experiences and specific experiments. Another satisfying result was that there was no significant difference in the goals of mathematical achievement based on learning styles.

Research on the effects of experiential teaching on the mathematical creativity of junior high school students in Kenya was conducted by the authors, Chesimet et al. (2016). Among them, 168 students were allocated to control class and

experimental class. In the experimental group, teachers used an experiential learning approach, while the control group was taught in conventional methods. To evaluate the effectiveness of experimental tasks, the mathematics creativity test was considered as a post-test for both groups. The tools of inference statistics were utilised to interpret data collected. It was known that the experiential learning approach had a significant influence on the students' mathematical creativity. The findings of the study were expected to help mathematics teachers adjust their teaching strategies because they identified the potential of experiential learning on students' mathematical creativity.

Davidovitch et al. (2014) had a case study of the compatibility between mathematics and experiential learning. Mathematics debate was presented to illustrate the trend of course planning according to a learning-focused approach. Many examples of mathematics debate were provided to show their value in solving problems, understanding mathematical solutions and understanding concepts and sentences. The researchers also noted that by engaging in mathematical debate, students changed attitudes toward learning in many ways such as: talking about mathematics in class as well as outside, asking many questions about the experiential activities, paying attention to mathematical problems with debate potential and playing in an active role.

A study of experiential education through project-based learning was theoretically implemented by a Greek researcher, Douladeli Efstratia (2014). In project-based teaching, there were many differentiated steps, such as activities, workshops, and researches so that teachers can organise the assessment of students' learning outcomes. Additionally, teachers could assess students' emotional-social and cognitive skills, while teachers only evaluate cognitive ones if students are taught by using traditional teaching methods. Also, thanks to the project-based teaching techniques, students were able to communicate, collaborate, and use thinking from teacher's feedback activities after they had presented their projects. Nonetheless, project-based teaching had some negative implications such as teachers' lack of motivation, limitations related to teaching period and syllabus, and evaluation issues.

Garry Falloon (2019) carried out a detailed study of the use of simulation to teach elementary students basic physical concepts as an experiential educational activity. The sample consisted of 38 5-year-old students engaged in simulation activities based on Kolb's experiential learning theory to discover circuit knowledge, electrical concepts and the function of circuits. The results indicated that students had developed their knowledge of the knowledge mentioned above units. Also, students were offered the opportunity to join reflective activities and clear thinking, which demonstrated high-level thinking processes. Several students' misconceptions had arisen and been corrected by teachers.

Girvan et al. (2016) studied the career development of junior high school teachers through the use of experiential learning. A sample of 38 teachers joined the experiential professional development program. The findings were found that these teachers demonstrated a changing role in teaching practice; overcame challenges to change; however, they also needed support structures to bring about a significant change in teaching. Similarly, Katranci and Bozkus (2016) also researched into the learning styles of prospective elementary school teachers. "Kolb learning style inventory" was used to collect data from 155 prospective teachers. It was revealed that more than 50% of teachers preferred the "converging" type and 36.61% of them liked the"converging" type, and the difference in age and grade levels also significantly affected the dominant learning styles.

Polk (2013) proposed theoretically a connection for fostering self-awareness between the team- teaching in the classroom and experiential learning. The author introduced The Honors College program, preparing leaders to participate in nine courses related to the topics such as problem-solving, scholarships, services, teamwork and leadership. This program was expected to facilitate leadership development based on reflection and creative thinking as integration in courses. The author, Tuyen (2018), had a theoretical proposal for approaching and implementing experiential activities in teaching mathematics for secondary school students in Vietnam. The author clarified the experiential activities in Vietnam's mathematics program and the orientation of organising experiential educational activities in junior high schools. Finally, the author devised a process for organising a 5-step math experiential activity such as: selecting the content and conditions, designing the activity, organising the activity for students to join, evaluating the activity, concluding and applying to the new situations. This process was also expected to be helpful for teachers as they performed experience-related tasks in mathematics.

Similarly, Weinberg et al. (2011) found out the effectiveness of four experiential teaching programs in science and mathematics based on students' interests and motivations. The authors used the expectancy-value model as a theoretical framework to affect 336 junior high school students. After implementing the programs, there was a tremendous positive change in student motivation, and interest for mathematics as well as science and the evidence suggested that there was a gender difference in the research, specifically that male students achieved better results than girls. Overall, this experiential educational program brought about a meaningful change for the participants.

Some educators also studied the equation of a circle. With the help of the GeoGebra dynamic software, 10th-grade students could predict the answers to mathematical problems and find strategies for solving them (Loc & Tuan, 2015). Similarly, students with low math achievement have been positively affected by this software as they participated in solving related exercises in the form of the equation of a circle $x^2 + y^2 = a^2$ (Khalil et al., 2018). Moreover, circles

were also taught in a lesson study model, from which it gave positive feedback to teachers (Arnigo et al., 2018). Also, teaching circles was accessible based on a discovery learning model that utilises sunflowers, and learning outcomes had a reasonable impact (Putriani & Rahayu, 2018). In general, the researches on the equation of a circle based on experiential activities have not been performed by previous studies.

Experiential learning, Equation of a Circle in Curriculum and Mathematics Textbooks in Vietnam

According to the General Education Curriculum (Ministry of Education and Training, 2018), teaching has to promote high levels of positive and creative thinking, independent cognitive activities, and dialectical thinking competencies for students. There are many new teaching methods introduced and taught in schools in Vietnam, in which experiential learning is one of the methods that can meet the above requirements. In Vietnam's general education program, the experiential activity is considered as an educational one that is oriented, designed and guided by educators, gives students the opportunity to approach reality and experience emotions, positive contact, exploits existing experience and mobilises the synthesis of knowledge and skills of the subjects to perform the assigned tasks or resolve problems of real-life in school, family, age-appropriate society. Through this, transforming past experiences into new knowledge as well as new skills contributes to promoting creative potential and adaptability to life, the environment and future careers.

Educational activities that emphasise students' experience are compulsory from grade 1 to grade 12. They are called experiential activities in elementary schools and experiential career activities in both secondary high schools and high schools. These activities assist students in applying the knowledge, skills they have learned from the school and their own experiences in real life. The experiential content of activities is highly integrated and differentiated. When participating in experiential activities, students have to mobilise the synthesis of knowledge and skills in many different fields to solve learning and life tasks. Due to joining activities, students can directly experience and express views as well as ideas, from then, they will form new knowledge and skills; develop necessary competencies, especially ability to deal with problems in learning and real life. Experiential activities aim to guide, create conditions for students to observe, think and participate in practical activities, create conditions for them to study actively, find new solutions and create new ones based on the knowledge learned in the school. Such activities can be organised in groups, by grade, school or inter-school. Nevertheless, the organisation according to group size and class size is more advantageous in many aspects such as simple, inexpensive, quick and good order.

Experiential activities are carried out in many different forms such as games, forums, interactive stages, field trips, contests, exchange activities, humanitarian activities, volunteer activities, community activities, collective activities, public labour, theatre (drama, poetry, singing, puppet show, skits, plays), physical training, organising festivals. Each form of activity has a particular educational meaning. Depending on the cultural characteristics, climate, regional characteristics, socio-economic conditions of each locality, the school may select the content and form of productive experiential activity accordingly.

Experience is a positive, productive and creative learning process. Through organised activities, students will promote their activeness, initiative, self-discipline and creativity as they are involved in all stages of the process from designing, preparing, implementing and evaluating results. Experiential education will provide opportunities for them to promote the spirit of cooperation, personalisation and collective spirit. Besides, they also express their ideas and choose other ideas, so they are really excited and very active when learning in the form of creative experiential activities.

Experiential activities help to absorb experiences that other styles of learning cannot. In education, the most crucial goal is to acquire the social and historical experiences of generations of human beings. Learners have to influence subjects to form in them the necessary qualities and competencies. There are many ways for learners to gain experience, but there are experiences that can only be acquired through experiential activities. For example, students need to know how to measure, how to express emotions, and how to show love for the homeland. These things are only available when learners engage in the experiments that other forms of learning do not work. Experiential activities aid students in promoting their creative ability, then gradually build and grasp the lesson content without having to memorise. Learning through experiential activity makes it easy for students to think on their own, can collaborate and work in groups, to collect and process information, to present ideas, to make large presentations in advance, and they will be proactively active in learning. In short, learning through experiential activity is an active learning method that can be implemented in many fields of knowledge, thus formulating capacity for learners and educate students' personality effectively.

Experimental activities require the coordination of many educational forces inside and outside the school. It can be seen that experiential activity demands to mobilise a combination of knowledge and skills in many different fields. The content of the experience is very diverse, integrated, synthesising the knowledge and skills of many subjects and lots of study fields. To execute these activities, there are many forms to organise, in which each form will involve different participating educational forces. Experiential activity may need the participation and coordination of many educational forces inside and outside the school such as homeroom teachers, subject teachers, youth unions, general manager of

teams, school administrators, parents' associations, local authorities, local agencies, organisations, businesses, social activists, artisans, workers.

In Vietnam, the current program and content of textbooks are too much for the majority of students. The amount of time for mathematics is not much, but textbooks contain quite a large amount of knowledge, are heavy in academia, the lack of useful contact or are completely separate from real life and create little interest for learners. Correspondingly, it is necessary to change new teaching and learning methods to overcome the above limitations. The Ministry of Education and Training of Vietnam stated in the new program of general education for mathematics: “Mathematics in high schools contributes to the formation and development of students' qualities and personality; develops key knowledge and skills and creates opportunities for students to experience and apply mathematics in real life; builds a connection between mathematical ideas, mathematics and practice, between mathematics and other subjects”. Educators sum up that human beings need to experience when experience can be right or wrong, but from then, people are aware of knowledge. Thus, the experience in the learning process is essential since students will develop their creative ability, self-possessing knowledge, and form their skills, values as well as qualities. The content of mathematics is often abstract and generalised, so in order to understand and learn mathematics, the mathematics program in high school needs to ensure a balance between "learning" knowledge and "applying" knowledge into the solution. If the students cope with a specific problem, this method is beneficial.

Mathematics today has many practical applications, basic mathematical knowledge and skills that help people solve real-life problems systematically and accurately. Nevertheless, the content of mathematics is often abstract and generalised, so it is not easy for students to acquire, especially mathematics 10 is a subject with much basic knowledge that lays the foundation for more difficult knowledge later. If the students do not absorb well the content of mathematics 10, it will be difficult for them to grasp the content that they will learn in the next grades. For this reason, for students to quickly apprehend the knowledge when teaching, teachers need to guide from concrete to abstract, from easy to severe. Not only attaching importance to the logic of mathematical science as a deductive science, but it is essential to pay attention to the approach based on students' experience.

The content of the circular equation in the plane is presented in Vietnam's 10th textbook (Hao et al., 2007). This equation takes the form $(x-a)^2+(y-b)^2=R^2$, where centre $I(a,b)$ and radius R. The three basic types of exercises are attached to this topic such as determining the centre and radius of a circle knowing its equation, writing the equation of the circle and writing its tangential equation. These forms of mathematics are often not yet associated with reality. Moreover, the requirements that need to be reached on this topic are presented in the Mathematics Curriculum of Vietnam (Ministry of Education and Training, 2018) as follows:

(1) Set up the circular equation when knowing the coordinates of the centre and radius; know the three-point coordinates through which the circle passes.

(2) Determine the centre and radius of the circle, knowing the equation of the circle.

(3) Set the tangent equation of the circle according to the coordinates of the contact.

As a result, the problem of applying knowledge about circular equations to resolve some practical problems is to be studied. For this reason, the application of experiential learning theory to teaching the topic of circular equations allows students to apply the knowledge they have learned in real life.

Methodology

Research Goal

The primary purpose of the study was to test the effectiveness of some experiential activities that had been designed to support the teaching of the topic “the equation of a circle” in Vietnam's 10th mathematics textbook. Also, finding out students' attitudes and beliefs in such activities is one of the desires of this research (See Appendix 2).

Sample and Data Collection

Experiments used some real-life situations to teach solving mathematical problems related to the equation of a circle. Based on the content as well as the purpose and specific requirements of each lesson, based on respect for the current curriculum and textbooks, it was essential to determine a relatively specific time of conducting experiments. The study was implemented on grade 10A3 of Thanh An High School, Vinh Thanh District, Can Tho City, Vietnam. Before choosing empirical sampling, the average score of students' mathematics was analysed at the quality survey at the beginning of the school year 2018 - 2019, then the experimental and control groups with relatively comparable results were selected (verified by using T-test). Based on program distribution and experimental content, the experiment period was from March 11, 2019, to April 28, 2019. During the experiment, the teacher conducted the impact on 30 students of class 10A3 in the experimental group by teaching according to the designed situation. The other group was 30 students of the control group who was still taught conventionally. This method meant that after learning new knowledge, they

only did homework in textbooks, that was, they did not participate in activities applying the knowledge about the equation of a circle to practice. The research design was generally illustrated in Figure 1:

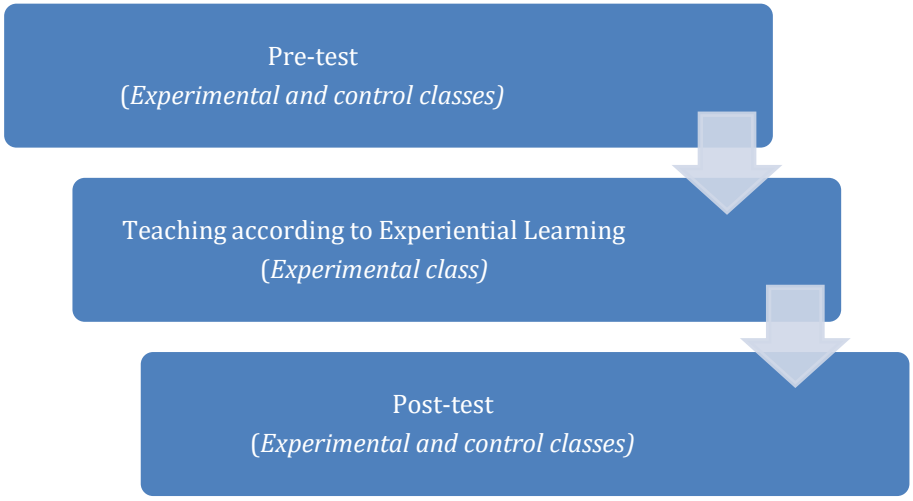

Figure 1. The process of research

The quasi-experiment was conducted similarly in the study of Yuberti et al. (2019). The explanations were explicitly presented in their research. In this design, the experimental class was applied interventions, while the control class was not experimentally impacted. The two classes were tested to make sure that the competencies related to experimental activities were similar. This design model allowed two classes to conduct pre-impact and post-impact tests. Results were measured by comparing the average score between the two post-tests. When there was a discrepancy, the researcher could conclude that the research activity had resulted. Also, for this study, experimental class students learned more about attitudes and beliefs about the experiential activities they participated in through the survey. Besides, specific activities were clarified in Table 1.

Table 1. Activities designed in the experimental and control classes

Class	Contents
Experimental class (10A3)	- Taking a math pre-test. - Conducting experiential activities designed by the teacher. (see Appendix 1) - Group evaluation. - Personal evaluation. - Taking a math post-test. - Taking a survey about attitudes and beliefs.
Control class (10A2)	- Taking a math pre-test. - Taking a math post-test.

Based on Kolb's learning model, a process of teaching through experience was concretized in the context of teaching mathematics in Vietnam used in this lesson, and the teacher in the experimental classroom utilised this teaching process. The process was described as follows:

Activity 1: Organising for students to participate in specific experiences.

Teachers organise for students to take part in specific activities and situations in order to exploit the real experiences of students, connect with new situations. The situations selected for the experiential activities have to be designed so that learners use, exploit and connect the old experience with the new context.

Activity 2: Organising analysis and processing experience.

Students learn the nature of activities and situations which they have just joined, then they observe, consider, ponder, contemplate the activities and phenomena experienced, make predictions, find out, test how the activity is conducted, and find the principle of the activity associated with old experiences. This stage is the period when learners directly join activities, observe, frequently ask questions and find answers.

Activity 3: Generalising.

Teachers ask students to describe what they have experienced, analyse the meanings of those experiences for themselves, from which they generalise and summarise into their knowledge. This activity will support students in forming new knowledge as well as skills.

Activity 4: Applying and positive testing.

Teachers ask students to state how to apply newly learned things to perform learning tasks, practice, apply knowledge and skills into a new learning situation.

The steps mentioned above of designing and organising activities are directional suggestions, not a rigid process. The design and organisation of experiential activities in subjects should be flexible, creative, suitable for students, learning content, school and local conditions. Explicitly, lesson plans were presented in Appendix 1.

The role of teachers in teaching according to experiential learning theory: Design activities, divide groups, explain activities, supervise students' activities, elicit motivations for students, assess student performance, organise students to do pre-test and post-test.

The role of students in teaching according to experiential learning theory: Participate in solving mathematical problems, ask teachers to explain (if necessary), report the results, discuss, evaluate and complete the tests.

Analyzing of Data

Quantitative and qualitative analysis methods were utilised to clarify and evaluate the effectiveness of experiential activities. In particular, quantitative analysis assessed the input and output math scores of the two classes by using T-test to verify the impact on the experimental class. For the pre-test, the researchers collected and processed the average of the two grades; then the researchers conducted a T-test with consistent results to confirm that the two classes had the equivalent mathematical ability. For the post-test, once again, the researchers used the T-test to show the difference, and from here, the researchers had evidence to confirm the effectiveness of the experiential activities. Also, the qualitative analysis method clarified students' attitudes and beliefs after they engaged in experiential tasks. Correctly, after collecting students' worksheets, the researchers classified and processed them to assess students' ability to solve problems as well as pointed out the difficulties they still faced. For the survey on students' attitudes and beliefs, the researchers collected the student's answer sheets, then processed and calculated the frequency and percentage, and finally explained and commented based on the obtained results.

Results

Results related to pre-test

Two classes had the same number of participants and the same ability to study mathematics. To ensure this, we used the T-test method to check whether the two levels of math were equivalent to each other. Suppose that the two levels of mathematics were equivalent to each other with a significant level $\alpha = 0.05$.

$H_0 : \mu_D = \mu_1 - \mu_2 = 0$ (Which μ_1, μ_2 in turn, were the averages of the pre-test of 10A3 and 10A2).

- $H_a : \mu_D \neq 0$.
- Rejected domain: $|t| \geq 1,96$
- The average deviation of points of two classes: $\bar{d} = \frac{[(-1,5)+(-1)+...+0]}{30} = -0,115$
- The variance of difference: $s_D^2 = 0,1202 \Rightarrow s_D = 0,3467$
- We have: $t = \frac{\bar{d} - 0}{s_D / \sqrt{n}} = \frac{-0,138}{0,382 / \sqrt{30}} = -1,8168$

As $|t| = 1,8168 < 1,96$ H_0 was accepted, that was, two classes had equivalent math qualifications.

Results related to post-test

For class 10A3 in the experimental period, the teacher used experiential activities to solve an exercise about the circle equation. In general, after a time working in groups, they found a direction to solve the problem given by the teacher. The key to the problem was to set up the coordinate system.

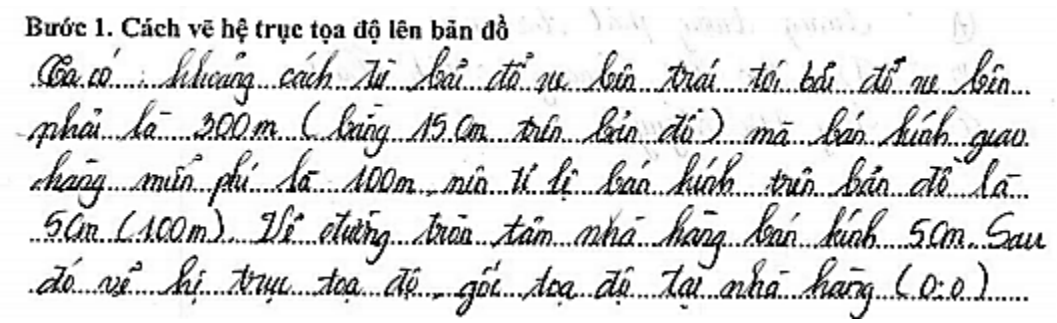

Figure 2. How to build the coordinate system of students

(Translate in Figure 2: Step 1. How to draw the coordinate system on the map. Because the free delivery radius is 100m, the scale of the radius on the map is 5cm. Draw a circle with a centre of the 50cm radius. Then, draw the coordinate system with the origin as a restaurant (0,0).)

At the same time, the groups worked and produced the results to look for:

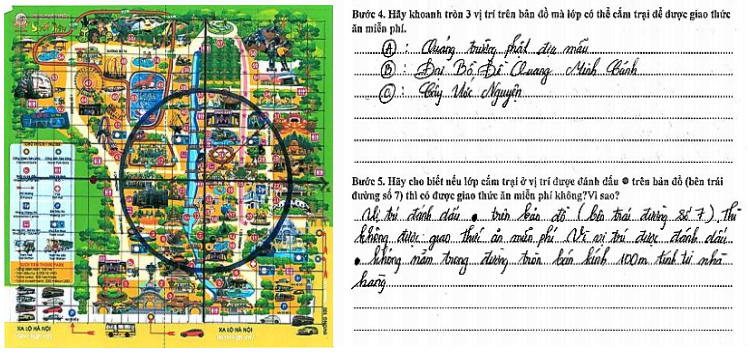

Figure 3. Student's assignment

(Translate in Figure 3: Step 4. Circle 3 locations on the map where the camping class can get free food delivery. A. Mayor of the local Buddha; B. Great Bodhi luminous wings; C. Wishing tree.

Step 5. Please indicate if the camping site is at the marked location ● (on the left of the 7th street), will the class be given free food delivery? Why?

The class is not given free food delivery because the marked location is not within a circle of radius of 100m from the centre of the restaurant).

A post-test was distributed to all students in two classes after completing the content of two classes 10A3 and 10A2. The outcomes indicated that, when encountering real situations, the students in the experimental group could deduce and found ways to solve quickly. The control class was still confused to find a solution in practical situations, and they also had difficulty in building the coordinate system, which was a pivotal stage to address the problem.

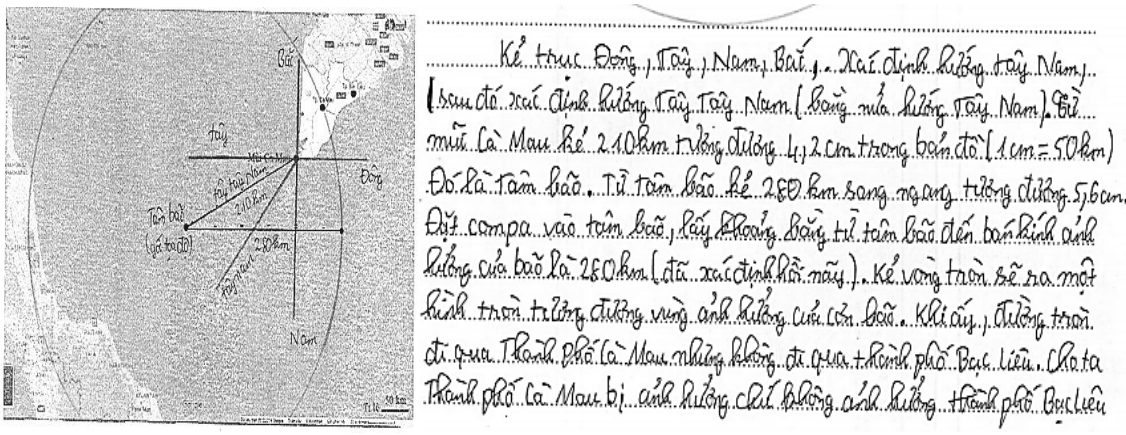

Figure 4. Student's assignment in the test after the lesson

(Translate in Figure 4: Draw east-south-west axis, determine southwest direction. From the cape of Ca Mau, draw 210km or 4.2cm of the map, that is the centre of the storm. From the centre of the storm 280km to the equivalent of 5.6cm on the map. Place the compass on the centre of the storm, taking the distance from the centre of the storm to the

impact radius of 280 km. Draw a circle similar to the storm-affected area. At that time, the circle traversed Ca Mau city but not Bac Lieu city. This result shows that Ca Mau city is affected by the storm, but Bac Lieu city is not).

The empirical data from the post-test was collected, processed, evaluated, and presented in Table 2:

Table 2. Post-test results of classes 10A3 and 10A2

Experimental class (10A3)			Control Class (10A2)		
Score	**Frequency**	**Percentage**	**Score**	**Frequency**	**Percentage**
0	1	3%	0	0	0%
1	0	0%	1	0	0%
2	0	0%	2	0	0%
3	0	0%	3	2	7%
4	0	0%	4	2	7%
5	1	3%	5	5	17%
6	7	23%	6	8	27%
7	11	37%	7	9	30%
8	7	23%	8	4	13%
9	2	7%	9	0	0%
10	1	3%	10	0	0%
Sum	30 (students)	100%	Sum	30 (students)	100%

Based the numbers on Table 2, it was demonstrated that 97% of students in the experimental class 10A3 had above average score, the highest score in grade 10A3 was 10, and that of grade 10A2 was 8. Besides, the scores of 7 and 8 of the control class were higher than those of the experimental class. In class 10A2, many students scored below average. This score documented that the experimental class results were higher than the control classes. Consequently, it was concluded that learning through experiential activities has brought efficiency since the students engaged in activities enthusiastically and were attracted to study and were also promoted their active initiative.

To check the results, it was indispensable to use statistical methods to test the hypothesis. Assuming the hypothesis H_0 that the output quality of the two classes was equivalent, while the oppositional hypothesis H_a that the average score of the experimental class was higher than that of the control class with a significance level of $\alpha = 0.05$.

- $H_0 : \mu_D = \mu_1 - \mu_2 = 0$ (Which μ_1, μ_2 in turn, were the averages of the post-test of 10A3 and 10A2).
- $H_a : \mu_D > 0$.
- Rejected domain: $|t| \geq 1,96$.
- The average deviation of points of two classes: $\bar{d} = 0,867$.
- The variance of difference: $s_D^2 = 0,8092 \Rightarrow s_D = 0,8996$.
- We have: $t = \dfrac{\bar{d} - 0}{s_D / \sqrt{n}} = \dfrac{0,867}{0,8996 / \sqrt{30}} = 5,277$.

Because $|t| = 5,277 > 1,96$, H_0 was rejected; that was, the experimental class had better math results than the control class. Thus, the experimental results in the worksheets and the test results for the two experimental and control groups indicated that the effectiveness of teaching through experiential activities had motivated students to proactively and actively explore knowledge and think to solve problems; from there, they could master and inculcate knowledge.

Results related to attitudes and beliefs of students, group and individual evaluation

Following the process of pedagogical experiment, it was observed that in general, most of the students learnt more actively, more enthusiastically, interested in problems that were attached to a real-life situation. Also, the appeal of mathematical problems with practice was in linking mathematical knowledge with diverse and vivid real-world applications. It was essential to distribute questionnaires of students in the experimental class towards lessons through experiential activities in order to verify students' attitude and belief towards learning by this method (see more

Appendix 2). From there, it was able to consider the effectiveness of the topic. Thirty students of class 10A3 were surveyed with the questions designed based on a 5-level Likert scale.

Table 3. Results of the survey after the lesson of experimental class

Items	Survey contents	Levels				
		Very dislike (%)	Dislike (%)	Neutral (%)	Like (%)	Very like (%)
1	Students like the last lesson	0	0	20	30	50
2	Students like how the teacher has just taught	0	0	15	30	55
3	Students like to acquire new knowledge in the way that teachers have just used	0	0	5	60	35
4	Students like the group activity method just implemented	0	0	15	35	50
5	Students like how to relate to reality in a new way	0	0	5	30	65
6	Students like such many lessons	0	0	20	25	55

Through the above survey results in Table 3, from items 1 and 4 generally, students in the class prefered the method of learning through activities organised by teachers. Specifically, in 10A3 class, the number of students interested in such activities was 30%, 50% of them was very interested in the tasks. With the group activity method that they worked in the lesson, 60% of students in grade 10A3 felt intensely interested. From items 2, 3 and 5, it was speculated that students liked how teachers create situations to help them discover knowledge and find solutions to problems. There were 55% of students of 10A3 who seemed to like the way teachers had just taught. With the way of acquiring new knowledge in the way that teachers have used, up to 60% of students 10A3 enjoyed. Up to 65% of students in the class, 10A3 felt very fond of how to relate to reality in a new way. With the question of whether or not they liked the many lessons, 55% of students in class 10A3 seemed to like having many such lessons.

In addition to distributing questionnaires to survey students after the lesson, two forms of assessing the attitudes of students were also used, namely group assessments and individual assessments of students. Specifically, the evaluation form was given to the group leader, and after the group leader evaluated, teachers would re-evaluate and individual evaluation form for each student. Regarding group evaluation, it was revealed that most of the group members actively participated in the activity. Specifically, the rate of regular participation in 10A3 was 65.2%. The rest were occasional and always engaged in activities; there were no cases of non-participation and rarely. From this result, it was believed that teaching through experiential activities attracted students to take part in. About the individual assessment of students, it was reported that students were always enthusiastic and responsible for the work (46.7% of 10A3). The evidence was that they had the spirit of cooperation, respect, and listening; participated in organising and managing groups; gave valuable comments; contributed to the completion of products and work efficiency in a positive way (assessment scores at 3, 4, 5). From here, the findings revealed that teaching through experiential activities enhanced students' activeness and initiative and offered assistance to them in developing some of their abilities.

In summary, it was concluded that lessons taught through experiential activities created interest in lessons for students in the experimental class. As a result, they were more active in thinking, analysing, anticipating and then discovering and acquiring knowledge. Through solving situations built by teachers, students were trained in many necessary competencies such as independent thinking, problem-solving, mathematical communication and teamwork. Besides, due to self-discovery and problem solving, many students gradually became more confident and more responsible for their learning. Nonetheless, most students thought that they understood the lesson, but through the activity results, the groups did not achieve the lesson goals. Reasons leading to the students not complete the lesson objectives were that teachers had not mobilised all students to participate in the task, resulting in some students working on their own such as doing English exercises, talking, and the time of teaching three periods was relatively long, so it affected the teaching and learning. For computational problems, the students still got confused as they did not have the habit of analysing practical problems. Even because of an extracurricular lesson, a few students did not want to participate in the activity.

Discussion and Conclusion

In the experiment process, it was considered that the method of teaching through experiential activities was highly effective, helping students be proactive and positive in learning (Beaudin & Quick, 1995). The introduction of practical situations in teaching supported the students in developing mathematical modelling competencies. In parallel, students' attitudes were investigated after studying with the lesson, and the findings indicated that students were more

interested in the subject (Chesimet, 2016; Falloon, 2019; and helped them quickly identify and solve problems. Learning this topic was better received in the process, not in the results. It meant that experiential education was not only concerned with the outcome of that learning but also, more importantly, how students learned in the learning process. As such, the outcome was not the deciding factor for all learning, but it was necessary to consider the whole process of achieving that result (Avelino et al., 2017). Experiential learning associated with the topic of circle equations was a continuous process derived from experience to create knowledge of mathematical problems, in other words, there is a compatibleness between mathematics and experiential learning model (Davidovitch et al., 2014). This outcome was explained that the source of the knowledge students had from practice rather than a theory of circles. From the experiences already there, they were combined with what students felt with their senses to build, a piece of new knowledge or expand their knowledge rather than just remembering what the students saw (Tuyen, 2018). Such positive activity assisted students in achieving excellent results in their mathematical achievements, learning motivations and competencies (Damrongpanit, 2019). Additionally, students also control mathematical anxiety such as the scope of use of mathematics or the difficulty of mathematics (Aydın & Aytekin, 2019). Experience activities associated with the topic of the circle equation also contributed to enhancing the capacity of problem-solving for students; more explicit is the ability to apply mathematics to solve real-world situations (Yuberti et al., 2019).

Experiential learning approach included interactions between people and subjects. This approach meant that the knowledge of "equation of a circle" gained by students was not due to the teacher imparting to the students or the students were passive, sitting still, but the only approach to learn through experiential education was that the student had to be proactive, and had a positive exposure, impact on that environment (Weinbern et al., 2011). During the experience process, the students who were the centre were the subject of the experiential activity. Accordingly, experiential education required students to have the motivation, needs, interests, curiosities with the object of experience since interest and curiosity that would motivate students to participate in the experience and self-experience process to understand the world around them. Together with students, the teacher was the one who guided and directed students into the experience environment, as well as the observers, helpers, testers, instructors, and they needed to systematise the knowledge gained by the students. The experience environment was an essential and necessary element in the experience process, and it had to exploit students' experience fully; ensure safety and full experience for students to be proactive and actively interact with the environment. Despite this, this study also had certain limitations. For example, some students did not actively participate in activities but instead used the phone or talked privately during lessons. The reason for this was that the activities were organised only as extra-curricular hours and they did not participate in evaluating their mathematics performance. In addition, the organisation of activities also had difficulty in organising time. Development of teaching plans and curricula is often tight in terms of time; If teachers want to organise a supplementary experience activity for the subject, the program is challenging to arrange in the interval between lessons. It is not possible to conduct an experiential activity within one lesson when the time for another lesson must be taken. Consequently, arranging a reasonable time fund for experiential activities should be researched and distributed appropriately.

Some implications are drawn from the research findings on experiential teaching associated with the topic. First, this model becomes a method to promote learning because it asks students to use critical thinking, problem-solving and decision making to provide a training module. Second, the simulation of real-life situations creates some challenges that participants will eventually face after completing the lesson. Also, mistakes arising are inevitable in the learning process. Simulation is like taking students to a playground, letting them have fun, trying new things and learning, in a safe, controlled environment. Next, there is a shortening of the gap between theory and practice as by crossing the theory to the field of "learning through practice", learners first experience practising what was taught; consequently, this plays a vital role in remembering concepts and ideas (Parahakaran, 2017).

Experimental activities create an apparent change in students' thinking because they have to mobilise many thinking manipulations to solve problems raised by teachers. Furthermore, a high level of focus on collaboration and mutual learning will benefit participants as it increases the level of interaction. On the other hand, as students immediately embark on problem-solving or events, the level of grasping the problem will be higher. Learning through personal and sufficient experience in practice affects both feelings and emotions as well as improve knowledge and skills (Polk, 2017). It goes beyond learning in the classrooms and ensures that there is a high level of storage, thereby providing a benefit that goes beyond a traditional curriculum. Assessing the effectiveness of training programs for learners' benefits is a crucial element of any learning program. Most assessments involve oriented data and traditional tools, using tests to measure effectiveness. When it comes to experiential learning programs, the products acquired from experience tasks become a valuable and reliable data that used to provide assessment results in a way that is relevant accurately through cognitive learning, influencing skills and objective results. Evaluation tools are used to analyse and provide detailed reports of participants' interactions throughout the experiential activities.

Organising for students to engage in experiential activities will provide opportunities for them to explore, self-form lesson knowledge, practice skills, and form the right attitude and behaviour. Nonetheless, no method is optimal. The effectiveness of teaching depends on many factors, the most important of which is the teacher. The teacher has to combine knowledge with necessary skills so that they can turn into productive and meaningful experiences; know

when to apply the method of direct communication to specific students or groups of students, when to apply the discoverable method to stimulate excitement and develop students' curiosity; and know what students are thinking and how they are learning (Kolb & Kolb, 2017; Girvan et al., 2016). Hence, to make effective use of the experiential teaching approach, it requires each teacher to master teaching theories, must have specialised knowledge and feelings, love profession, creativity, flexibility in applying methods and measures.

Suggestions

Based on the outcomes of the research, the following suggestions are made for teachers and students to achieve high results in experiential activities.

Recommendations for teachers

(1) The teacher must combine knowledge with essential abilities so that they can turn into active and meaningful experiences; must know when to use the way of direct communication to specific students or groups of students, when to apply the discoverable method to stimulate excitement and develop students' curiosity; must know what students are thinking and how they are learning. Therefore, mathematics teachers need to master teaching theory, must have professional knowledge, love for the job, creativity, flexibility in applying methods and measures.

(2) Furthermore, the form and method of teacher evaluation must be appropriate for each specific outcome. Correspondingly, it can be said that the form and method of evaluating students through experiential activities must be diversified, and must be suitable with the characteristics of their students. Here are some common forms and methods of evaluation: Assessment by observation; evaluation by rubric; evaluation by questionnaire; evaluate through the article; evaluation through actual products; judge by the score; evaluate through seminars, exchange ideas and comments; assessment through exercises and presentations.

Recommendations for students

(1) Students need to be aware of experiential activities that are necessary for their knowledge acquisition because they provide opportunities for students to use their knowledge in real-world situations.

(2) Students participate and ponder the opening event, uncover the problem.

Students participate in learning situations built by teachers: Solve introductory exercises, describe situations in related life, participate in games, do experiments, observe and evaluate a problem in real life. From there, they discover the problem of research and express the problem with a question or a problem with enough information.

(3) From the information and research results achieved, the students formulate group products to report, exchange and discuss.

(4) Students also need to participate in product evaluation activities such as individual assessments or group product reviews.

References

Argino, J. C., Lim, E., Manalo, M. J., Pacheco, V. L., Secosana, B., Sy, A., & Elipane, L. (2018). Utilizing lesson study in teaching circles. *Advanced Science Letters*, *24*(11), 7876-7879. https://doi.org/10.1166/asl.2018.12447

Avelino, G., Ignacio, J., & Joseph, D. R. (2017). Exploring mathematics achievement goals using Kolb's learning style model. *Asia Pacific Journal of Multidisciplinary Research*, *5*(1), 19-24.

Aydın, D., & Aytekin, C. (2019). Controlling Mathematics anxiety by the views of guidance and psychological counselling candidates. *European Journal of Educational Research*, *8*(2), 421-431. https://doi.org/10.12973/eu-jer.8.2.421.

Baker, M. A., Robinson, J. S., & Kolb, D. K. (2012). Aligning Kolb's experiential learning theory with a comprehensive agricultural education model. *Journal of Agricultural Education. 53*(4), 1-16. https://doi.org/10.5032/jae.2012.04001

Beaudin, B. P., & Quick, J. (1995). *Experiential learning: Theoretical underpinnings.* Fort Collins, CO: HI-CAHS.

Breunig, M. (2017). Experientially learning and teaching in a student-directed classroom. *Journal of Experiential Education*, *40*(3), 1-18. https://doi.org/10.1177/1053825917690870

Chesimet, M. C., Githua, B.N., & Ng'eno, J. K. (2016). Effects of experiential learning approach on students' mathematical creativity among secondary school students of Kericho East Sub-County, Kenya. *Journal of Education and Practice*, *7*(23), 51-57.

Damrongpanit, S. (2019). From modern teaching to mathematics achievement: The mediating role of mathematics attitude, achievement motivation, and self-efficacy. *European Journal of Educational Research*, *8*(3), 713-727. https://doi.org/10.12973/eu-jer.8.3.713

Davidovitch, N., Yavich, R., & Keller, N. (2014). Mathematics and experiential learning- Are they compatible? *Journal of College Teaching & Learning*, *11*(3), 135-148. https://doi.org/10.19030/tlc.v11i3.8759

Efstratia, D. (2014). Experiential education through project-based learning. *Procedia - Social and Behavioral Sciences*, *152*(2014), 1256-1260. https://doi.org/10.1016/j.sbspro.2014.09.362

Falloon, G. (2019). Using simulations to teach young students science concepts: An experiential learning theoretical analysis. *Computers & Education*, *135*(2019), 138-159. https://doi.org/10.1016/j.compedu.2019.03.001

Girvan, C., Conneely, C., & Tangney, B. (2016). Extending experiential learning in teacher professional development. *Teaching and Teacher Education*, *58*(2016), 129-139. https://doi.org/10.1016/j.tate.2016.04.009.

Hao, T. V., Hy, N. M., Doanh, N. V., & Huyen, T. D. (2007). *Geometry 10* (2nd ed.). Ho Chi Minh City, Vietnam: Education Publishing House.

Katranci, Y., & Bozcus, Y. (2014). Learning styles of prospective mathematics teachers: Kocaeli university case. *Procedia - Social and Behavioral Sciences*, *116*(2014), 328-332. https://doi.org/10.1016/j.sbspro.2014.01.216

Khalil, M., Farooq, R. A., Çakıroğlu, E., Khalil, U., & Khan, D. M. (2018). The development of mathematical achievement in analytic geometry of grade-12 students through GeoGebra activities. *EURASIA Journal of Mathematics, Science and Technology Education*, *14*(4), 1453-1463. https://doi.org/10.29333/ejmste/83681

Kolb, A. Y., & Kolb, D. A. (2017). Experiential learning theory as a guide for experiential educators in higher education. *ELTHE: A Journal for Engaged Educators, 1*(1), 7-44. https://doi.org/10.5465/amle.2005.17268566.

Loc, N. P., & Tuan, N. T. (2015). "TSEWG" Model for Teaching Students How to Solve Exercises with GeoGebra Software in the Classroom. *The International Journal of Engineering And Science, 4*(5), 83-87.

Mendoza, J. K. R. (2019). The experimental teaching of the conics using the reflection of the light: The conceptual study of the Cassegrain telescope. *American Journal of Educational Research*, *7*(10), 699-707. https://doi.org/10.12691/education-7-10-5.

Miettinen, R. (2000). The concept of experiential learning and John Dewey's Theory of reflective thought and action. *International Journal of Lifelong Education*, *19*(1), 54-72. https://doi.org/10.1080/026013700293458

Ministry of Education and Training. (2018). *General Education Curriculum, Overall Curriculum*. Retrieved from https://data.moet.gov.vn/index.php/s/LETzPhj5sGGnDii#pdfviewer

Parahakaran, S. (2017). An analysis of theories related to experiential learning for practical ethics in science and technology. *Universal Journal of Educational Research 5*(6), 1014-1020. https://doi.org/10.13189/ujer.2017.050614

Polk, D. M. (2013). Cultivating self-awareness with team-teaching: Connections between classroom learning and experiential learning. *Journal of Leadership Education*, *12*(2), 122-135. https://doi.org/10.12806/v12/i2/a1

Putriani, D & Rahayu, C. (2018). The Effect of Discovery Learning Model Using Sunflowers in Circles on Mathematics Learning Outcomes. *International Journal of Trends in Mathematics Education Research*, *1*(1), 22-25. https://doi.org/10.33122/ijtmer.v1i1.26

Roland, K. (2017). Experiential Learning: Learning through reflective practice. *International Journal for Cross-Disciplinary Subjects in Education (IJCDSE), 8*(1), 2982-2989.

Sand, J. N., Elison-Bowers, P., Wing, T. J., & Kendrick, L. (2014). Experiential learning and clinical education. *Academic Exchange Quarterly*, *18*(4), 1096-1453.

Sharlanova, V. (2004). Experiential learning. *Trakia Journal of Sciences, 2*(4), 36-39.

Tuyen, N. H. (2018). The process of approaching and implementing experiential learning for teaching maths to junior secondary school students in Viet Nam. *American Journal of Educational Research*, *6(*6), 877-882. https://doi.org/10.12691/education-6-6-42

Waite, A. M. (2018). Examining experiential learning and implications for organizations. *International Journal of HRD Practice, Policy and Research, 3(*1), 23-42. https://doi.org/10.22324/ijhrdppr.3.105

Weinbern, A. E., Basile, C. G., & Albright, L. (2011). The effect of an experiential learning program on middle school students' motivation toward mathematics and science. *RMLE Online, 35*(3), 1-12. https://doi.org/10.1080/19404476.2011.11462086

Westera, W. (2011). On the changing nature of learning context: Anticipating the virtual extensions of the world. *Educational Technology & Society, 14*(2), 201–212.

Yuberti, Latifah, S., Anugrah, A., Saregar, A., Misbah, & Jermsittiparsert, K. (2019). Approaching problem-solving skills of momentum and impulse phenomena using context and problem-based learning. *European Journal of Educational Research, 8*(4), 1217-1227. https://doi.org/10.12973/eu-jer.8.4.1217.

Appendix 1

The process of organising experiential activities for solving mathematical problems related to the equation of a circle

1. Organising teaching with a situation "Locating a camping group" to teach to solve exercises for the circle equation, Geometry 10, page 81.

2. Operation progress

Activity 1. Organising for students to participate in specific experiences.

The teacher presents the problem:

"Suppose that our class is visiting at Suoi Tien tourist site and is preparing to stop for camping. Lunch will order food from Phu Dong Restaurant IV. This restaurant has free food delivery within 100m from the restaurant.

a. Identify camp locations where you can get free food delivery, why do you choose those?

b. Circle 3 locations on the map where the class can camp for free food delivery.

c. Is the food delivery free if the class chooses a camping site marked with a "●" on the map (on the left of the 7th street)?

(Know the distance from the gate (calculated from the bus station on the left) to the bus station on the right of the gate with a length of about 300m).

Figure 4. Map of Suoi Tien tourist site

To solve this problem, the teacher divides the class into four groups, giving each group a tourist map of Suoi Tien, together with a worksheet. The teacher ask groups to discuss and find various ways to solve the problem. The teacher observes working groups and supports them when needed.

Activity 2. Organising analysis and processing experience.

To let students know the key to solving this problem, they have to draw the coordinate system on the map that the teacher has distributed. Nevertheless, the teacher does not introduce from the beginning but will let students observe, consider, ponder the problem and make predictions and find answers based on the knowledge of the equation of a circle learned. If the students have not yet found a solution, the teacher can suggest to the student, helping them approach the solution by the following questions:

Question 1. Guess what the scope of camping is? (The expected answer from students is: circle).

Question 2. What factors must you write in an equation of a circle? (The expected answers are: Center and radius of the circle).

Question 3. How to determine the centre and radius of the circle? (The expected answer is: identifying its coordinates).

Question 4. To determine the coordinates, you need a coordinate system, but on the map, there is not any coordinate system, so how do you do it? (The answer the teacher expects: we will map a system of axes to determine the coordinates of the centre and radius).

The purpose of the above questions is to orient students who want to write an equation of a circle in this situation; they need a coordinate system to specify the necessary elements.

Activity 3. Generalising.

In this step, the teacher will have each group report their work. In the reporting process, the teacher can ask several questions to generalise the content that students have contacted in the content of the circle equation in the operation process. By answering these questions, students will gain knowledge and will be created chances to form new experiences, skills and attitudes.

Activity 4. Applying and positive testing.

In this step, the teacher will give similar problems for students to apply new things to learn in a new situation, thus providing conditions for them to apply knowledge and skills to solve a problem in practice, here the problem is: “Itada spicy noodle shop on February 3 street supports free delivery within a radius of 3km, a customer at Time Cafe on Nguyen Van Linh street ordered two portions of noodles. From the spicy noodle shop, go straight on February 3 for a distance of 1.2km then turn right on Nguyen Van Linh street about 750m to Time Cafe (see the way on the map, suppose two square roads corner together). Please let me know if the customer can get free shipping. Why?".

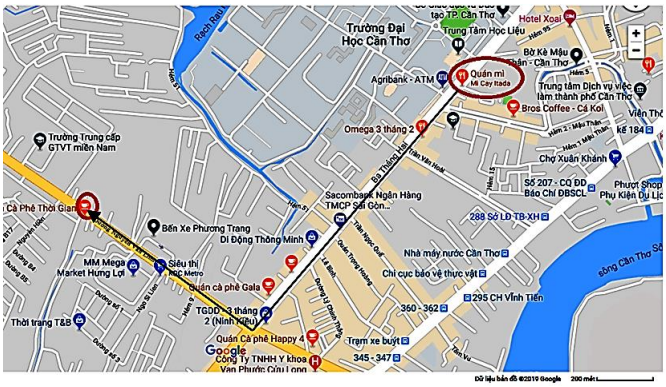

Figure 5. Delivery map of Itada spicy noodle shop

Appendix 2

Survey results of students after the lesson

Question 1. During the math learning time, do teachers often use different ways to make it easier for you to learn the lesson?

A. Not yet	21.9%
B. Sometimes	51.2%
C. Regularly	5.0%
D. Depending on the lesson content	20.4%
Another idea:	1.5%

Question 2. Do teachers usually use the following methods during math learning time?

Forms / **Levels**	*Never*	*Rare*	*Sometimes*	*Usually*	*Very usually*
Organise for class discussion	38.3%	23.4%	31.3%	5.0%	2.0%
Organise games to learn	67.2%	20.9%	8.5%	2.0%	1.5%
Organise contests (such as crossword puzzles, quizzes, etc.)	72.1%	15.9%	9.5%	1.0%	1.5%
Collective activities (such as singing, dancing, playing, ..)	67.7%	10.0%	16.9%	4.0%	1.5%
Organise the play (they will play a role in the play to build knowledge)	81.1%	10.0%	8.0%	0.5%	0.5%
Practice content learned after hours (such as measuring height, distance, angle, ..)	77,6%	11,4%	9,5%	1,0%	0,5%

Question 3. Do you like your teacher to organise one of the above activities at math learning time?

A. Dislike	13.4%
B. Normal	20.9%
C. Like	41.8%
D. Very like	23.4%
Another idea:	0.5%

Question 4. Are you actively involved in the activities the teachers organise?

A. Do not participate	13.4%
B. Not sure	18.4%
C. Will participate	46.8%
D. Will definitely participate	20.9%
Another idea:	0.5%

Question 5. When the teachers organise those activities, which activities do you usually do? (Can choose multiple answers)

A. Join and carry out the activity	50.7%
B. State my opinion	15.9%
C. Criticize classmates' opinions	3.5%
D. Exchange, analyse and discuss with classmates	45.3%
Another idea:	7.0%