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# Teaching Statistics in Lower Secondary School Mathematics Through Experiential Activities

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**Abstract: The application of experiential learning activities in teaching Mathematics at lower secondary schools has attracted increasing attention, as it helps students develop a stronger interest and passion for Mathematics while enabling them to apply mathematical knowledge to real-life situations. This article designs a teaching plan for the topic Statistics in lower secondary school Mathematics through the integration of experiential learning activities and conducts a pedagogical experiment to examine students' learning outcomes between the experimental class and the control class. The findings indicate that students improved their learning outcomes more proactively and actively, thereby contributing to the development of their qualities and competencies in accordance with the learning outcomes required by the 2018 General Education Curriculum. The study provides a useful reference for lower secondary school Mathematics teachers in designing experiential activities in their lesson plans.**

***Keywords:*** *Teaching, Mathematics, Lower Secondary School Students, Experiential Learning Activities, Mathematical Statistics*.

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## I. INTRODUCTION

The 2018 General Education Curriculum in Vietnam adopts a competency-based approach that emphasizes opportunities for experiential learning. Experiential components are embedded across subjects and learning activities, with the overarching goal of fostering students' holistic development in both competencies and personal qualities. Achieving this objective requires innovation in teaching methods that promote active engagement, inquiry, self-directed learning, and independent research, thereby enhancing learning outcomes and higher-order thinking.

Within the 2018 Mathematics Curriculum, the Statistics and Probability strand encompasses content such as data collection, classification, representation, analysis, and processing; frequency and relative frequency; identification of simple statistical patterns in real-life contexts; application of statistics to understand experimental probability and event probability; and recognition of the practical significance of probability. In Grade 8, this strand accounts for 14% of the curriculum. Consequently, integrating experiential activities into the teaching of Statistics is both relevant and necessary. Such activities not only enable students to construct knowledge through connections between mathematics and real-life contexts but also foster motivation, consolidate and deepen understanding, and cultivate agency, creativity, and essential life skills.

To date, numerous studies on mathematics education have confirmed the advantages of experiential learning in creating opportunities for students to observe, explore, investigate, and apply knowledge to solve both theoretical and real-world problems, thereby fostering the development of key competencies and personal qualities. However, in lower secondary mathematics teaching practice, the topic of Statistics often presents considerable challenges for lower secondary school students. Many encounter difficulties in understanding the practical significance of statistical concepts such as frequency, relative frequency, mean, median, and mode; in collecting, organizing, and analyzing real data logically and accurately; and in interpreting statistical results and applying them to problem-solving in everyday contexts.

One reason for these challenges is that instruction has traditionally remained highly theoretical, with limited connection to real-life experiential activities. Students typically engage with statistics through formulas and mechanical procedures, with few opportunities to practice using authentic data. As a result, they fail to recognize the practical relevance and significance of statistics in daily life. These limitations underscore the urgent need to innovate teaching methods for the Statistics strand, emphasizing experiential activities that allow students to actively explore, process, and apply data in meaningful ways. Thus, investigating the teaching of lower secondary school Statistics through experiential learning is both timely and necessary, contributing to the broader reform goals of the 2018 General

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Education Curriculum, which prioritizes the development of student competencies and qualities.

## II. RESEARCH RESULTS

### *A. Experiential Learning in Mathematics at General Education Schools*

The objectives of Mathematics in the 2018 General Education Curriculum are to contribute to the formation and development of students' key qualities, general competencies, and mathematical competency—considered a concentrated manifestation of numeracy—with the following components: mathematical reasoning and argumentation, mathematical modeling, mathematical problem solving, mathematical communication, and the use of mathematical tools and resources. Mathematics education is expected to develop essential knowledge and skills while creating opportunities for students to experience and apply mathematics in real-life contexts. It establishes meaningful connections between mathematical ideas and between mathematics and reality (MOET, 2018a). Accordingly, there are two fundamental innovations in mathematics teaching:

- Shifting from content transmission to teaching that fosters the development of mathematical competencies, namely reasoning and argumentation, mathematical modeling, mathematical problem solving, mathematical communication, and the ability to use mathematical tools and resources;

- Emphasizing instruction oriented toward the application of mathematics in real-life contexts. With respect to teaching methods, the curriculum specifies: "Flexibility in applying active teaching methods and techniques; creative integration with traditional teaching methods; and the combination of classroom learning activities with experiential practice, enabling students to apply mathematical knowledge in real-life situations" (MOET, 2018b). Research on the application of experiential learning in mathematics education has been widely documented. Biehler & Pratt (2023), in the chapter "Technology for Teaching and Learning Statistics" within the edited volume by Ben-Zvi, Makar & Garfield, focused on the role of technology in teaching statistics in schools. They emphasized that technology is not merely a supportive tool but also an active learning environment that enables students to engage in authentic, autonomous, and visualized experiences of statistical exploration. Appropriate integration of technology can therefore enhance the effectiveness of experiential approaches in mathematics education, particularly in teaching statistics (Biehler & Pratt, 2023).

Cobb and McClain (2024), in their article "Design Research: Theoretical and Methodological Issues", highlighted design research as a methodology for developing and improving instructional practices in mathematics, including statistics. They argued that instructional designs should create opportunities for students to interact with one another and with data through activities such as group discussions, surveys, and real data collection, thereby fostering statistical thinking. Their work provides a theoretical and methodological framework for designing mathematics learning activities that cultivate cognitive competencies—especially relevant when applying experiential methods to the teaching of statistics in the Grade 8 mathematics curriculum (Cobb & McClain, 2024).

Dimitriadou and Meletiou-Mavrotheris (2024), in their study "Evaluating the Impact of Active and Experiential Learning in Mathematics: An Experimental Study on Eighth-Grade Student Outcomes", evaluated the impact of active and experiential learning methods on Grade 8 students' mathematics achievement. The findings showed that students engaged in experiential learning demonstrated significant improvement compared to those taught through traditional methods (Dimitriadou & Meletiou-Mavrotheris, 2024). Nguyen Huu Tuyen (2020) also addressed the effectiveness of organizing experiential activities in teaching mathematics at lower secondary schools, stating: "Experiential learning in mathematics teaching is a process in which students directly observe, analyze, and predict within the subject or in real contexts to discover new mathematical knowledge and transform their learning experiences under the teacher's guidance" (Nguyen Huu Tuyen, 2020).

Similarly, Nguyen Danh Nam and Trinh Ngoc Lien (2021), in their research on organizing experiential activities for Grade 6 students in geometry, presented perspectives on experiential learning and its role in the general education curriculum. They evaluated the status of experiential learning activities in Grade 6 mathematics teaching, analyzed the underlying causes of limitations, and proposed steps for experiential teaching based on David Kolb's experiential learning cycle (Nguyen Danh Nam & Trinh Ngoc Lien, 2021).

In summary, the application of experiential learning in mathematics teaching plays a crucial role in achieving the goal of enabling students to apply mathematical knowledge to solve real-life problems, thereby fostering a greater interest and engagement in learning mathematics. Within the Grade 8 Mathematics curriculum under the 2018 General Education Program, the content of Statistics and Probability often poses difficulties for students, who tend to perceive it as abstract. Students struggle with applying statistical and probabilistic knowledge to solve exercises and real-life situations, and their application skills remain limited. Many students show little interest and lack motivation to engage with this content.

This situation requires mathematics teachers to pay particular attention to innovating their instructional methods by more frequently organizing experiential activities in mathematics teaching. Such approaches can foster active and autonomous learning, stimulate students' interest, and encourage them to apply mathematical knowledge to their daily lives. Ultimately, this contributes to the development of students' qualities and competencies in alignment with the objectives of the 2018 General Education Curriculum.

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*B. Steps for Teaching Mathematics Through Experiential Learning Activities*

In the scope of the article, the author approaches Kolb's research (1984) as a basis for building a theoretical foundation for the research. The experiential learning cycle consists of four steps as follows:

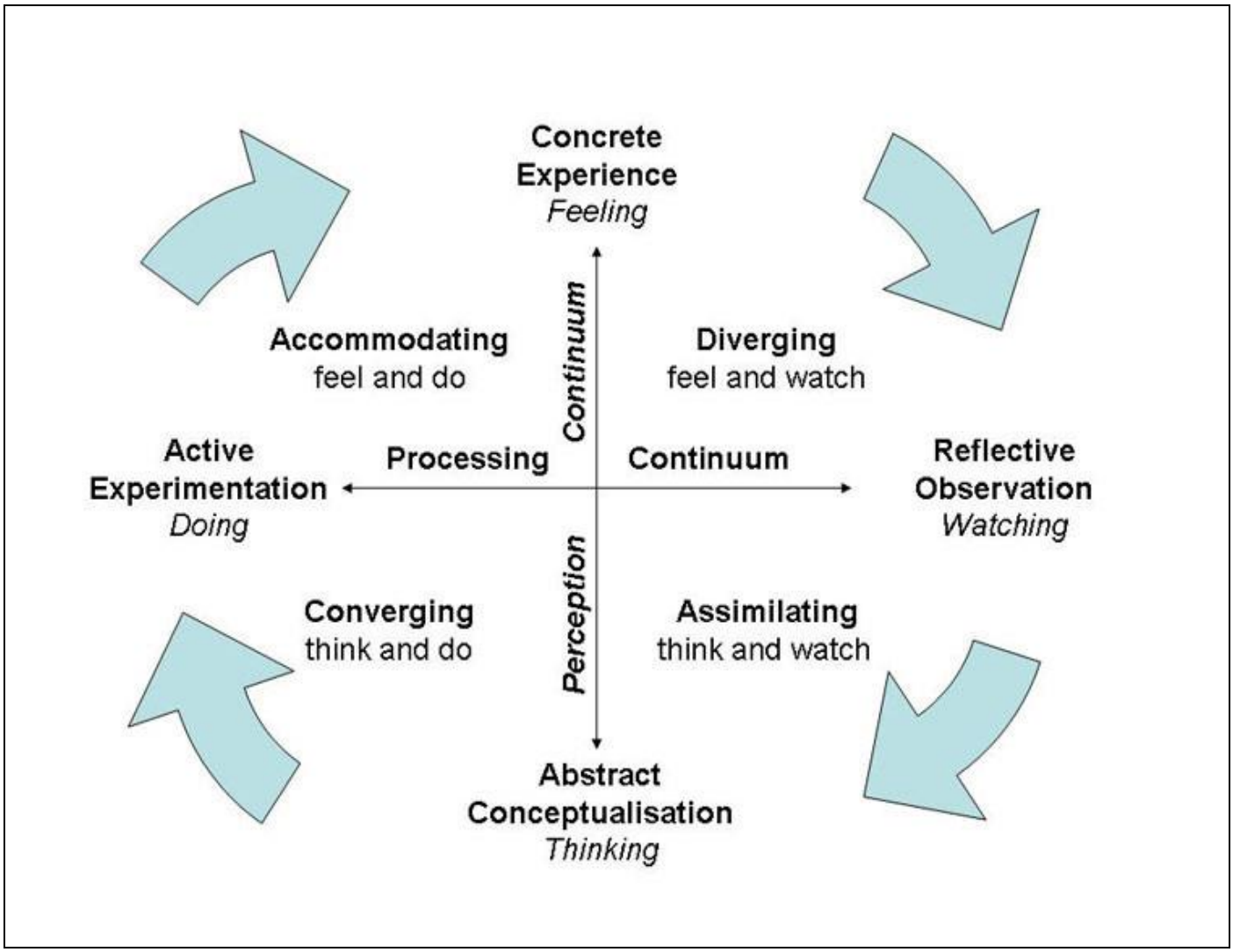


Fig 1 David Kolb's Experiential Learning Cycle (Kolb, 1984)

➢ *Concrete Experience:*

At this stage, teachers organize students to recall/give opinions on their experiences and knowledge based on their experiences and knowledge, such as: recounting what they have done, reading documents, listening to lectures, watching videos, observing, etc.

➢ *Reflective Observation:*

At this stage, students use the experiences in stage 1 as a foundation to reflect, compare, argue, etc. what they have learned with what they have observed. Students need to analyze and evaluate the events and experiences they have had.

➢ *Abstract Conceptualization:*

After having detailed observations plus deep thinking from stages 1 and 2, students proceed to conceptualize their experiences, form new concepts or knowledge and draw lessons for themselves.

➢ *Active Experimentation:*

Conclusions in stage 3 are considered as a hypothesis and must be put into practice to test. This is very important in forming new knowledge, learners confirm or deny concepts from previous stages.

Thus, from Kolb's (1984) four-stage experiential learning model above and the concept of teaching Mathematics through experiential activities, refer to Nguyen Huu Tuyen (2020), applying to teaching the content of Statistics chapter Data and Charts of Math grade 8 through experiential activities includes the following steps:

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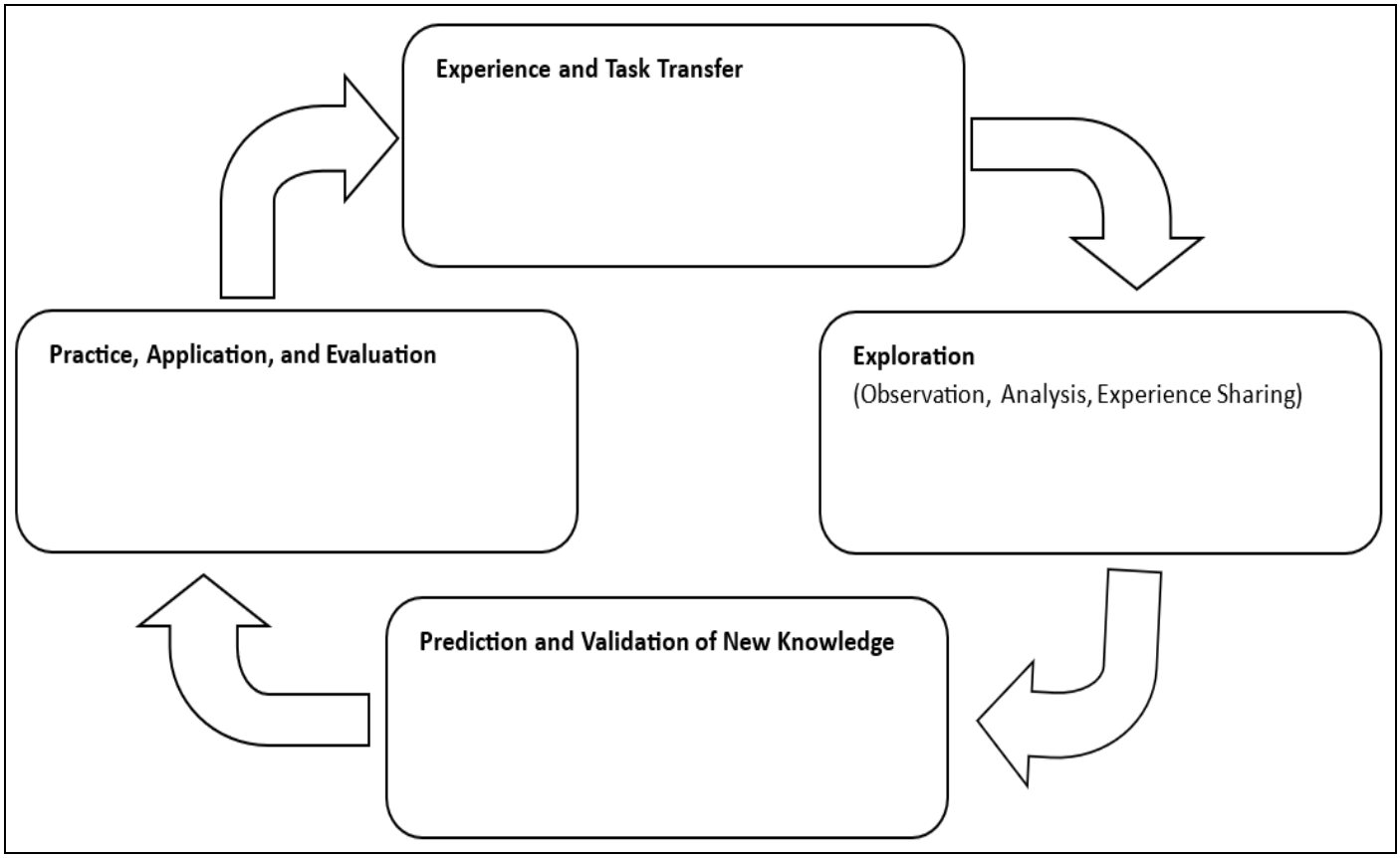


Fig 2 Steps to Teach Mathematics using Experiential Method

➢ *Step 1: Experience and Task Assignment*

This is an important starting point that engages students, stimulates their interest in the lesson, and enables them to approach real-life or mathematics-related problems. At this stage, students are encouraged to draw upon their prior knowledge and experiences to prepare for new learning, thereby creating opportunities to ask questions, express ideas, and make initial predictions. The teacher organizes experiential activities by posing a problem situation or a task that needs to be solved—often connected to real-life contexts. Open-ended questions and challenging scenarios are provided to stimulate thinking, while learning tasks are clearly assigned and tailored to students' characteristics. Students then engage in the task, attempt to solve the problem, and explore the situation, thereby mobilizing relevant prior knowledge and skills that will serve as a foundation for constructing new knowledge.

➢ *Step 2: Exploration*

This is the core of the experiential learning process, during which students begin to analyze and investigate the learning problem in depth, constructing new knowledge based on their prior experiences and understanding. Students develop analytical, evaluative, and comparative thinking. In mathematics lessons, this step involves analyzing data, figures, and problems to identify patterns, relationships, or mathematical principles. Students propose initial ideas and hypotheses, which they then test. Teachers facilitate individual and group presentations, provide timely guidance, encourage generalization of the problem, and support struggling students with worksheets and guiding questions. Students engage in observation, reflection, and comparison, connecting new phenomena with prior knowledge to analyze and explore the problem. They examine data, diagrams, or problems; compare similarities and differences; and relate findings to previously acquired knowledge. Students articulate ideas, reasoning, and predictions; express opinions; suggest solutions; and collaborate with peers by discussing, listening, and refining ideas collectively.

➢ *Step 3: Prediction and Conceptualization of New Knowledge*

This step serves as a crucial bridge between exploration (Step 2) and application (Step 4). Students synthesize results from exploration to form predictions, concepts, rules, or theorems, thereby consolidating and affirming their understanding through reasoning and evidence. This process enables students not only to memorize results but also to deepen comprehension and foster self-directed learning and independent knowledge construction. Teachers assist by guiding students to validate new knowledge through clarifying related concepts and outcomes. Students engage in observation, reflection, and feedback, selecting from the experiences gained to make predictions or confirm new mathematical concepts, theorems, or problem-solving strategies.

➢ *Step 4: Practice, Application, and Evaluation*

At this stage, emphasis is placed on reinforcing the acquired knowledge through practice, verification, and adjustment of predictions and understandings from Step 3. Students apply their knowledge to real-life situations, new

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contexts, or advanced problems. This helps them develop evaluative and self-evaluative skills, reflect on their learning, and enables teachers to assess their level of comprehension, identify gaps, and adapt teaching methods accordingly. Teachers select exercises or scenarios suited to students' abilities, summarize core issues, and encourage reflection on the process and outcomes of applying knowledge to new situations. Through prediction-based activities, students consolidate newly acquired knowledge and practice to test hypotheses, refine abstract concepts, and transfer experience to similar or new contexts, including advanced or extended problems. They then participate in peer or teacher-guided reviews and evaluation of results.

*C. Example of Teaching the Content of "Statistics" (Math 8) using the Experiential Method*

➢ *Content: Data collection.*

- Objective: Students can perform and explain data collection; students can choose appropriate data collection methods and collect data.
- Content: Task: Learn about data collection. What are the methods of data collection?
- Product: Students take group notes in their study materials, students' answers to questions, students can choose data collection methods.
- Implementation:

✓ Step 1: Experience, transfer tasks. The teacher asks students to divide the class into 3 discussion groups to perform the task, make a table to record the results: Group 1: Conduct an experiment to measure and record the results of the temperature of water during the boiling process; Group 2: Make a questionnaire about your favorite fruits in class; Group 3: Look up the number of Covid cases in countries around the world in 2020.
✓ Step 2: Explore: The teacher observes and asks groups of students to perform the task well; students perform the task, discuss the results; the teacher asks group representatives to answer the questions; students perform.
✓ Step 3: Predict and confirm new knowledge: The teacher asks students to state data collection methods; students predict that data collection can be direct or indirect; students observe, listen, and perform the teacher's tasks; the teacher monitors, supports, and guides students to reaffirm the data collection methods.
✓ Step 4: Practice, apply, and evaluate: The teacher asks students to do Exercise 1. Students perform Exercise 1: Please indicate whether the data collection method in each of the following cases is direct or indirect.

- Nam went to the website of the General Statistics Office and recorded the number of districts/counties of the provinces/cities in the Northern Delta.
- The Physical Education teacher measured and recorded the 1000 meter running time of the 8th grade students.

The teacher asked the question: a) In your opinion, to record the number of districts, what data collection method should we use?; b) To record the running time, what data collection method should we use?

Students report the results after completing the task. Teacher: Call on 1 student to stand in place and report the results of Exercise 1 and call on another student to comment and add. The teacher commented on the student's attitude and answer plan.

Application: The teacher assigned students to do the exercises in the learning materials; supported the materials, urged students and answered students' questions. Students work on Exercise 5.1 (p. 92) from the Grade 8 Mathematics Textbook, Connecting Knowledge to Life series. What type of data is obtained in each of the following questions?

- How tall are you?
- What kind of phone network are you using?
- How many people are under 18 in your family?

Students work on Exercise 5.1 (p. 92) from the Grade 8 Mathematics Textbook: Which method of collection should be used to obtain each of the following data?

- Name the 10 countries with the largest area.
- Your opinion on the place to visit next week.
- The height of the areca seedlings after 6 months of planting.

After the students work individually to solve the above questions, the teacher lets the students discuss discussion in groups to finalize their group's answers and sends a representative from each group to the board to present the solution. Then, the remaining groups comment, discuss and the teacher finalizes the answer. Finally, the teacher summarizes and evaluates the overall product to evaluate the student's performance in the lesson. The teacher can work with the students to develop evaluation criteria for the corresponding activities in the lesson. This criterion is agreed upon by the teacher and the students in advance. Students can use the evaluation criteria table to self-evaluate or evaluate group activities.

The assessment criteria table for the activities in the lesson is designed as follows:

Table 1 Evaluation Criteria

| Activity | Assessment Criteria | Maximum Score | Score Obtained |
|---|---|---|---|
| **Group Tasks** | 1. Accurate identification of the assigned task:<br>• Group 1: Conduct an experiment to measure and record the water temperature during the boiling process. | 2.5 | |

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| | | | |
|---|---|---|---|
| | • Group 2: Develop a survey on classmates' favorite fruits.<br>• Group 3: Collect data on the number of COVID-19 cases worldwide in 2020. | | |
| | 2. Accurate statistical recording of data. | 1.5 | |
| | 3. Correctly identifying the method of data collection. | 1.5 | |
| **General Criteria** | 4. Ability to solve applied exercises. | 1.5 | |
| | 5. Comprehensive notetaking of all activities in the notebook. | 1.0 | |
| | 6. Effective group collaboration: appointing a leader and secretary, assigning specific tasks, and ensuring active participation of all members. | 1.0 | |
| | 7. Active listening and engagement with other groups, including providing feedback and constructive comments during presentations. | 1.0 | |
| **Total** | | **10.0** | |

*D. Experimental Results*

➢ *Overview of the Experiment*

The pedagogical experiment was conducted with two eighth-grade classes (8A7 and 8A8) at Nguyen Van Tiet Secondary School, Thuan An, Binh Duong. Class 8A8, comprising 44 students, was designated as the experimental group, while Class 8A7, with 45 students, served as the control group. The experiment took place between November 25 and December 6, 2024. Students' midterm examination results from the first semester were utilized as a pre-test measure. The analysis indicated that although there were slight differences in the mean scores of the two groups, these differences were not statistically significant. An independent samples t-test was employed to verify the equivalence of the two groups' mean scores prior to the intervention.

- *Design used: Pre- and Post-Test, for Equivalent Groups (Described in the Table Below):*

Table 2 Experimental Evaluation Design

| Group | Pre-test | Intervention | Post-test |
|---|---|---|---|
| Experimental | O1 | Teaching through experiential learning | O3 |
| Control | O2 | Teaching following the teacher's lesson plan | O4 |

In this design, the article uses the independent T-Test verification method. The pre-impact test is the mid-term test of the 2024-2025 school year, the general test of the school. The post-impact test is the test after completing lesson 18. Collect and classify data designed by the researcher. Then, code and cut the students' papers, ask the teachers who do not teach the experimental class and do not teach the control class to independently grade the papers according to the pre-agreed scale and answers.

➢ *Results before and after the Experiment*

- *Analysis of Results before the Impact*

The students of the two classes selected to participate in the experiment have many similarities in terms of academic performance ratio, specifically as follows: The results of the mid-term test in Math, the two classes are quite similar in terms of scores.

Table 3 Independent T-Test Verification to Determine Equivalent Groups

| | Control Group | Experimental Group |
|---|---|---|
| Mean | 6.25 | 6.49 |
| Standard Deviation | 1.98 | 1.52 |
| p | 0.41 | |

Since p = 0.41 > 0.05, it can be concluded that the difference in mean scores between the experimental and control groups is not statistically significant. Therefore, the two groups are considered equivalent.

- *Post-Intervention Result Analysis*

Table 4 Comparison of Mean Test Scores after the Intervention

| Comparison Content | Control Group | Experimental Group |
|---|---|---|
| Mean Score | 6.55 | 7.92 |
| Standard Deviation | 1.68 | 1.42 |
| P-value of T-test | 0.003 | |
| Standardized Mean Difference (SMD) | 0.81 | |

The analysis results indicate that the two groups of students were equivalent prior to the intervention. After the intervention, the independent T-test comparing the mean scores yielded p = 0.0002, showing that the difference in mean scores between the experimental group and the control group was highly significant. This implies that the difference

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in mean scores was not due to chance but resulted from the intervention. The standardized mean difference (SMD = 0.81) demonstrates that the effect size of experiential learning on the academic performance of the experimental group was substantial.

The findings of this study are congruent with Kolb's (1984) experiential learning theory, which posits that knowledge is most effectively constructed through a cyclical process comprising concrete experience, reflective observation, abstract conceptualization, and active experimentation. Within the context of this study, the experiential activities embedded in Statistics instruction enabled students to directly engage in data collection, processing, and analysis of authentic datasets, followed by reflective evaluation. Such practices facilitated the construction of statistical principles derived from real-world situations, thereby reinforcing the theoretical foundations of experiential learning. Moreover, the results resonate with previous international research, such as that of Dimitriadou and Meletiou-Mavrotheris (2024), which substantiates the claim that experiential learning yields significant improvement in students' mathematical performance, particularly in domains requiring engagement with authentic data, such as Statistics.

Systematic classroom observations, conducted through the application of structured assessment rubrics, further corroborate the effectiveness of the intervention. Most students demonstrated active engagement, enthusiasm, and positive attitudes throughout the learning process. This was manifested in their ability to allocate and assume group tasks efficiently, comply with time constraints, and participate proactively in collaborative activities. Notably, a subset of students exhibited strong academic curiosity, raising substantive questions with peers and teachers when confronted with new or complex concepts. The intervention also fostered the development of teamwork and collaboration, as students displayed improved capacity to negotiate, plan, and distribute responsibilities appropriately within groups. During the presentation of group outputs, most students attended attentively, provided constructive feedback, and demonstrated enhanced competencies in collaboration, self-regulated learning, problem solving, and creativity. Furthermore, students' digital literacy skills showed measurable improvement, evidenced by their effective use of keywords and search strategies to access relevant online information in support of group tasks. Importantly, students began to establish meaningful connections between mathematical concepts and real-life applications, which was reflected in their successful completion of applied tasks. Nevertheless, it should be acknowledged that a minority of students displayed limited seriousness and engagement, occasionally exhibiting indifference or passivity during group activities. This observation underscores one of the challenges inherent in the implementation of experiential pedagogies.

From a broader perspective, the empirical evidence obtained in this study provides a substantive contribution to the ongoing discourse on mathematics education reform at the lower secondary level in Vietnam, particularly in the orientation towards competency-based education. The findings offer a practical basis for further research into the design and implementation of experiential learning activities in teaching Statistics and other areas of mathematics. However, the study's limitations, most notably the small sample size, necessitate caution in generalization. To strengthen external validity, future research should incorporate larger and more diverse samples across multiple geographical contexts.

Notwithstanding these limitations, the positive outcomes highlight the potential for scaling the intervention to other lower secondary schools. Specifically, this could be achieved through the development of experiential lesson plans for Statistics, the design of contextually relevant experiential activities linked to local realities, the organization of professional development workshops for mathematics teachers, and the promotion of STEM integration within Statistics instruction. Such initiatives would contribute not only to improved student outcomes but also to the holistic development of students' competencies and dispositions.

It is equally important to emphasize that, within the current educational context characterized by large class sizes, limited instructional time, and a degree of resistance to innovation among teachers, the implementation of experiential teaching requires both flexibility and contextual adaptability. Teachers may consider structuring smaller working groups, employing technological support tools, and integrating theoretical exposition with practical tasks. Sustained professional support and capacity building for teachers, alongside fostering students' active participation, represent critical factors for ensuring the feasibility and long-term success of experiential pedagogical approaches. Additionally, the design of concise, clearly structured, and resource-efficient experiential activities may further optimize classroom time and enhance the practicality of implementation.

## III. CONCLUSION

This study has provided initial evidence that the implementation of experiential learning activities in teaching the topic of Statistics in Grade 8 mathematics exerts a positive influence on students' learning outcomes. Specifically, the mean score of the experimental group (7.92) was higher than that of the control group (6.55), indicating that this pedagogical approach not only facilitates better comprehension of the lesson but also fosters greater interest in learning. Through experiential activities, students were able to develop a deeper understanding of statistical concepts while simultaneously becoming more proactive in the learning process and enhancing their ability to apply knowledge to real-life contexts. Consequently, the intervention demonstrated its effectiveness in improving the overall quality of mathematics instruction, particularly by enabling students to acquire not only conceptual knowledge but also essential skills such as problem solving, critical thinking, teamwork, and the practical application of knowledge in everyday life situations. From the teachers' perspective, the organization of experiential learning activities requires meticulous lesson

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planning, the careful selection of appropriate and feasible experiential tasks that align with students' capabilities, and the provision of continuous monitoring and support throughout the learning process. These pedagogical requirements highlight the need for professional preparedness and adaptability on the part of teachers when implementing experiential learning in mathematics classrooms.

Although the findings of this study were encouraging, the relatively small sample size and limited research scope restrict the generalizability of the results to broader student populations across different contexts. To enhance both the accuracy and external validity of the findings, future studies should be conducted with larger and more diverse samples across multiple regions. Furthermore, teachers are encouraged to design problem-posing questions that are accessible and thought-provoking, thereby creating open learning spaces in which students can actively participate in discussions and collaboratively resolve mathematical problems. During instructional activities, it is also imperative that teachers provide sustained encouragement and support, cultivate a friendly and inclusive classroom environment, and facilitate group work to help students overcome challenges and achieve optimal learning outcomes.

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