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INNOVATION IN ACTION: TURNING IDEAS INTO REALITY

Chapter 51
Improving Students' Mastery in Finding Stationary Points

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ABSTRACT
Stationary points play a vital role in mathematical analysis, particularly in the study of optimization and understanding the behaviour of functions. A stationary point in mathematics is defined as a point on a curve where the derivative is equal to zero. This concept is crucial for identifying local maximum, minimum, and inflection points, and is widely applied in real-life problem solving. In the context of matriculation-level mathematics, understanding how to find and classify stationary points is a key learning outcome in the "Application of Differentiation" topic. Despite its importance, many students struggle with mastering this concept. Reflections from previous teaching experiences revealed that over 75% of students had difficulty identifying and analysing stationary points correctly. Among the factors contributing to this issue were ineffective teaching methods, the absence of clear, structured techniques, and a lack of student engagement in the learning process. This research aimed to identify the root causes of the problem and propose a practical solution to enhance student understanding. The study involved 169 randomly selected students from the Computer Science Department under the Two-Semester System. Data collection was conducted using observations, interviews, and a set of pre- and post-tests consisting of subjective questions. To overcome the identified challenges, a mnemonic-based innovation called DOXYJA was introduced. This method uses a simple acronym to guide students through the steps of solving stationary point problems systematically. The findings showed that DOXYJA significantly improved students' understanding and performance. It also encouraged better organization of their working steps and boosted their confidence in solving differentiation-related problems

Key Words: DOXYJA, Stationary point, Mnemonic, Differentiation

1. INTRODUCTION

Mathematics is a critical foundation in higher education, supporting disciplines such as engineering, economics, and the sciences. However, students entering university often possess diverse academic backgrounds influenced by varying curriculum standards, instructional quality, and exposure to mathematical concepts. These disparities can impede their transition into more abstract mathematical thinking, making the matriculation phase vital for addressing foundational gaps.

Differentiation, particularly the application of the first derivative in analyzing functions, is a key challenge in university-level calculus. Differential calculus is essential for developing critical thinking and problem-solving skills (Omoniyi, et al., 2025). The first derivative helps identify stationary points, where the rate of change of a function is zero, and is crucial in determining local maxima, minima, and inflection points. Mastery of this concept requires both procedural fluency and an understanding of how derivatives reflect function behavior. Many students struggle with derivative rules due to limited practice and a shallow understanding of earlier concepts.

This study explores how students' academic backgrounds influence their comprehension of stationary points and derivative application, aiming to identify misconceptions and inform targeted instructional strategies.

1.1 Focus of the Study

The focus of this study is to assist 169 students from the Computer Science under the Two-Semester System at Negeri Sembilan Matriculation College in mastering the technique of solving questions related to finding stationary points using the DOXYJA method. DOXYJA is a method developed by a lecturer as an innovative approach to teaching and learning in the Mathematics course. This method utilizes a mnemonic acronym strategy to guide students through the process of solving stationary point problems systematically. Mnemonic strategies are used in various ways. They are employed by teachers whenever important information needs to be remembered by students (Kleinheksel, K. A. et al., 2003). It is anticipated that the DOXYJA approach will help students obtain full marks in questions involving stationary points and, consequently, improve their overall performance in the Mathematics course.

1.2 Problem Statement

Students face several challenges in mastering the steps required to determine stationary points. These issues include:

i. Inability to write systematic and organized working steps, often omitting crucial steps in the process of finding stationary points.
ii. Difficulty in providing accurate final answers.
iii. Confusion about the requirements of the question whether to find the stationary points or to determine their nature.
iv. Struggles in remembering the method or sequence of steps needed to solve stationary point problems.

1.3 Research Objectives

1.3.1 General Objectives

The general objective of this study is to enhance the teaching practices of lecturers at matriculation colleges while improving students' achievement in the Mathematics course. Ultimately, this approach aims to contribute to a higher percentage of students attaining Grade

A in the Mathematics subject in the Matriculation Programme Semester Examination. The DOXYJA method is designed not only for use by matriculation lecturers but can also be effectively applied by secondary school teachers in the teaching and learning of Additional Mathematics, particularly under the Form Four topic of Differentiation.

1.3.2 Specific Objectives

The implementation of this innovation is guided by the following specific objectives:

i. To ensure students can write clear, structured, and systematic working steps when solving for stationary points.
ii. To enable students to provide accurate and complete final answers.
iii. To help students better understand the requirements of the question.
iv. To assist students in remembering a simplified and effective method for solving stationary point problems.

2. LITERATURE REVIEW

The following section presents the literature review for this study, providing a discussion of previous research, theoretical perspectives, and key concepts that form the foundation and context for the current investigation.

Myers, D. E., (1989) said that stationarity, in one form or another, is regarded as an essential characteristic of the random function used in geostatistical practice. Unfortunately, the term is often misunderstood and misused. While not all ambiguities or disagreements can be resolved in this presentation, an overview is provided and a standard terminology is proposed, so that a common basis for communication can be established among practitioners. The importance of stationarity is reviewed, and distinctions between its various forms are illustrated through selected examples.

The subject of differential equations is recognized as vast, diverse, and highly valuable across numerous disciplines. Differential equations are often studied independently due to their intrinsic mathematical interest, or they may be examined by professionals such as physicists, engineers, biologists, economists, physicians, or political scientists, as they can be used to model and quantitatively explain various physical and abstract systems. A differential equation, in which y is treated as the dependent variable (or unknown function) and x as the independent variable, is typically expressed in the following form:

$$F\left(x, y, \frac{dy}{dx}, \ldots, \frac{d^n y}{dx^n}\right) = 0$$

for some positive integer n. When n equals zero, the equation is no longer considered a differential equation but is instead classified as an algebraic or transcendental equation (Ross, C. C., 2004).

3. METHODOLOGY

This study was conducted using a classroom-based action research approach, as proposed by Cain, T. (2011), with the aim of improving students' understanding of stationary point problems through the DOXYJA method. In the first phase, students received a conventional lecture on stationary points using standard teaching methods. They were then given a set of practice questions. The results of this pre-test indicated that many students struggled to follow correct procedures or provide accurate final answers.

In the second phase, students were introduced to the DOXYJA method, a mnemonic-based strategy designed to guide them through the solution process. A specially prepared instructional video was shown, and the lecturer provided step-by-step explanations to reinforce understanding. After the intervention, a post-test consisting of similar questions was administered to assess improvements in performance and procedural clarity.

Data were collected from four practicum classes to ensure a representative sample. Student performance was compared using average scores from both tests. Additionally, students were grouped into weak, average, and excellent categories to evaluate achievement levels. Standard deviations were analysed to assess consistency within each group. The data were analysed descriptively to observe trends, determine improvements, and evaluate the effectiveness of the DOXYJA method in enhancing students' systematic approach to solving stationary point

4. RESULTS AND DISCUSSION

A significant improvement was observed in students' ability to solve stationary point questions based on pre- and post-test comparisons. Initially, complete solutions were seldom produced. Following the introduction of the DOXYJA method, more structured approaches were adopted, and many full marks were attained, as illustrated in Figure 1.

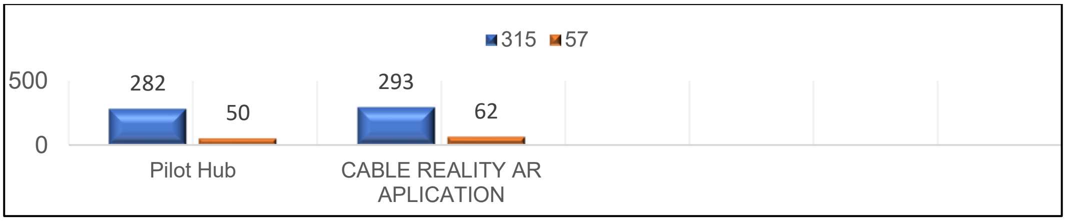

Figure 14: Comparison of The Number of Students Who Obtained Full Marks (12 marks) In Finding a Stationary Point between Practicum Classes

Students were grouped as weak, average, and excellent. The greatest improvement was observed among weak and average students, whose understanding and confidence increased markedly. Even excellent students displayed refined working and greater precision, as illustrated in the post-test results in Figure 2.

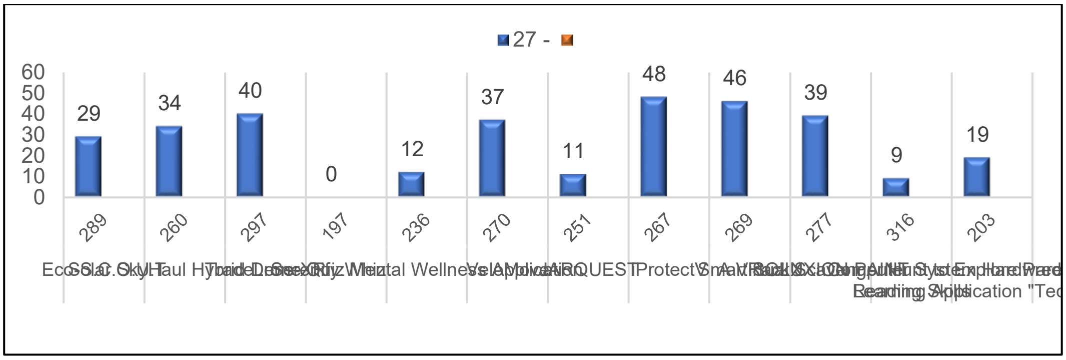

Figure 2: Comparison between The Number of Students by Achievement Level Category for Each Practicum Classes

Table 1 shows a reduction in standard deviation between pre-test and post-test scores observed in all four classes. This indicates a narrowing of the performance gap among students, suggesting that the DOXYJA method helped create a more balanced learning outcome across different levels of ability.

Table 4 Standard Deviation for Pre Test and Post Test between Each Practicum Classes

PRACTICUM CLASS	STANDARD DEVIATION	
	PRE TEST	POST TEST
K1T1	4.46	3.57
K1T2	4.27	3.15
K1T3	4.49	3.13
K1T4	4.71	3.60

5. CONCLUSION

This study found that the DOXYJA method significantly improved students' ability to solve stationary point problems in differentiation. It enhanced their solution clarity, accuracy, and confidence, especially among weaker learners. The method's structured, mnemonic-based approach also promoted greater classroom engagement and highlighted the value of student-friendly mathematics instruction.

6. RECOMMENDATION

Based on the study's findings, several recommendations are made to enhance the DOXYJA method's effectiveness and broaden its application. First, the method should be introduced in other matriculation colleges and secondary schools, especially in Mathematics and Additional Mathematics courses covering differentiation. Second, professional development programs, such as workshops and training sessions, should be implemented to ensure educators have the skills to apply the method effectively. Third, the method can be enhanced by integrating digital tools, such as instructional videos, interactive presentations, and online quizzes, to improve student engagement. Finally, further research should investigate its effectiveness across other mathematical topics and include a larger, more diverse sample.

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