PIONEERING THE FUTURE: DELVING INTO E-LEARNING'S LANDSCAPE

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Universiti Teknologi MARA Cawangan Pulau Pinang

PIONEERING THE FUTURE:
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PREFACE

The SIG CS@e-Learning committee extends its heartfelt gratitude to the divine for the invaluable contributions from the educators of Jabatan Sains Komputer & Matematik(JSKM), UiTM Penang Branch, in producing the eighth edition. We received **25** scholarly articles, all meeting our criteria and being accepted. Authors are encouraged to enhance their papers with additional findings and discussions for potential publication in journals indexed by SCOPUS, WOS, or ERA.

The eighth volume's central theme is "Pioneering The Future: Delving Into e-Learning's Landscape." Over the past few decades, e-learning has become a vital mode of education and instruction, demonstrating remarkable efficiency and effectiveness. The widespread use of smartphones and tablets has significantly boosted the reach of e-learning, extending beyond higher education and vocational training to primary and secondary education. Current trends in e-learning include artificial intelligence (AI), micro-credentials, big data, virtual and augmented reality, blended learning, cloud-based e-learning, gamification, mobile learning, the Internet of Things (IoT), and online video.

The SIG CS@e-Learning remains committed to actively publishing academically significant articles. We hope JSKM will achieve prominent publication levels in high-impact journals, with divine blessings.

Ts. Jamal Othman
Chief Editor
SIG CS@e-LEARNING
PIONEERING THE FUTURE: DELVING INTO E-LEARNING'S LANDSCAPE
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ARTIFICIAL INTELLIGENCE (AI) IN EDUCATION: BALANCING BENEFITS AND CHALLENGES IN TEACHING AND LEARNING

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ABSTRACT

Education has seen huge changes in the 21st century, with a paradigm shift in the methods of teaching and learning. The impact of Artificial intelligence (AI) tools on education has been a topic of debate with the rise of these tools, particularly advanced language models. Although integrating AI into the classroom is thought to be an option for obsolete educational approaches, issues with information learning, academic integrity, critical thinking, and interactions between educators and students are raised. This article explores the benefits and challenges of AI in teaching and learning based on various perspectives. Diverse perspectives on the impact of AI in teaching and learning balance the benefits of increased productivity and creative learning opportunities against major concerns about academic integrity, skill development, and moral issues. Careful planning and strategy are required to strike the correct balance between the benefits and drawbacks of artificial intelligence in education. Teachers, IT specialists, legislators, and other important stakeholders can employ AI to enhance instruction while managing associated dangers if they collaborate. The primary goal is to create an educational system in which AI is used as a useful tool to help teachers and students do their best work in a constantly evolving digital environment.

Keywords: Artificial intelligence (AI), teaching and learning, benefits, challenges

Introduction

Artificial intelligence (AI) has been used in education, particularly in classroom discourse, as technology has advanced (Wang et al., 2024). When AI first emerged, it was referred to as self-improving automatic machines that were created to address issues that were previously exclusive to humans. AI is rapidly transforming various sectors, and education is no exception. In recent years, the approaches to teaching and learning have evolved beyond our expectations (Shaziayani et al, 2023). The integration of AI in teaching and learning processes promises to revolutionize how education Is delivered, personalized, and managed.

The idea of artificial intelligence dates to the early 1950s, when Alan Turing suggested that a system could be considered “intelligent” if it could replicate human behavior (Russel and Norvic, 2016). Several definitions and applications of AI in education have been proposed over the years.

Recently, Popenici and colleagues defined AI as "computing systems that can engage in human-like processes such as learning, adapting, synthesizing, self-correcting, and using data for complex processing tasks" (Popenici et al,2017).

Artificial Intelligence has tremendous potential in education; applications include individualized learning environments, intelligent tutoring systems, automated grading, and predictive analytics. Artificial Intelligence (AI) can analyze large volumes of data to find patterns, forecast events, and offer previously unreachable insights by utilizing machine learning algorithms and natural language processing. With the use of these tools, educators may more effectively assess the strengths and weaknesses of their students, modify their lesson plans in real time, and offer focused assistance where it is required.

Every aspect of socioeconomic life is revolutionized by artificial intelligence, which also smoothly integrates virtual reality and communication technologies. AI has transformed education, changing not only the system but also how people learn, share knowledge, think, and advance civilization. However, a significant challenge remains: the educational sector has yet to fully embrace the value of technology in teaching, leading to prolonged delays in the integration of AI into educational practices.

This article discusses the advantages and challenges of AI in teaching and learning. By understanding the role of AI in education, we can better prepare for a future where technology and human ingenuity work hand in hand to enhance the educational experience.

Benefits of AI in Teaching and Learning

Artificial Intelligence (AI) has had, and will continue to have, a significant impact on Higher Education (HE) in recent months (Lee et al., 2024). AI has great promise for educators and students, ranging from customized learning programs to streamlined administrative procedures. However, it also presents several challenges that need to be addressed to maximize its potential. In this article, we will explore the advantages and disadvantages of AI in teaching and learning. The benefits of AI are:

1) Personalized Learning

According to Olga and Nadezhada (2022), Personalised learning is a trend in the modern educational system related to the global digital transformations of all aspects of socio-economic life. The introduction of artificial intelligence technologies makes it possible to increase the efficiency and quality of education focused on the needs and demands of students. Besides that, AI enables educators to customize learning programs to each student's needs, allowing them to follow their own learning curve and preferred method.

2) Always-on access

Learning has been transformed by AI-powered educational systems and services that offer constant access to resources and assistance. Due to the 24/7 operation of these tools, students can participate in education at their convenience, regardless of their schedules or time zones. Students from different geographical locations and with different requirements will particularly benefit from this accessibility, which gives them the freedom to learn, work together, and access resources whenever and wherever they choose. Thus, by breaking conventional barriers of time and place, AI-driven educational technologies greatly help democratize education and creating a more inclusive and accessible learning environment on a worldwide scale.

3) Interactive Learning Experiences

AI powered interactive learning experiences transform education by adjusting learning routes based on individual needs, adjusting pace and content, and utilizing AI-driven analytics and adaptive feedback. Artificial Intelligence (AI) uses virtual reality and simulations to build immersive settings for hands-on learning, and natural language processing enables conversation and quick concept clarification. Gamification strategies increase user engagement by using progression and rewards. With the help of AI's data-driven insights, educators may enhance their pedagogy and encourage lifelong learning by suggesting appropriate courses and chances for skill improvement.

4) Effective Administrative Work

Automating administrative tasks through AI can significantly streamline educational processes. For example, AI is more effective than traditional techniques at handling activities like tracking attendance and evaluating assignments. Because of this automation, educators have more time spent to lesson planning, giving students individualized feedback, and creating an engaging learning environment. Additionally, AI may support the maintenance of accurate records and offer insights through data analysis, empowering educators to decide on the best course of action for their students' learning. In addition to increasing productivity, this switch from manual to automated administrative work also improves educator satisfaction and the general quality of education.

Challenges of Implementing AI in Teaching and Learning

Implementing AI in teaching and learning can bring about numerous benefits, but it also comes with a variety of challenges. Some of the challenges are listed below:

1) Educators and Students Readiness

According to Alina et.al (2023), the successful integration of artificial intelligence (AI) into education requires a robust and efficient framework, significant investments in digital equipment, and infrastructure upgrades. To guarantee the effectiveness of the system, it also entails providing training to all those engaged in the teaching-learning process. Establishing a strategic vision for AI implementation is also necessary for institutions and the educational system. This difficult transition to AI will cost money and human resources. Educators must adapt to new techniques, but many lack the training they require because of inadequate and previously unallocated funds.

2) Ethical Issues

The ethical implications of implementing AI in teaching and learning are increasingly being debated. Key topics include the accountability for the actions of algorithms, chatbots, and robots, the ethical responsibilities of AI creators and operators, as well as data privacy and security. A significant concern is that students might be tempted to cheat using highly accurate software and chatbots, such as ChatGPT, which can produce academic work for them. This temptation raises additional ethical dilemmas.

3) Data Privacy and Security

Data privacy and security are significant challenges in the integration of AI in education. Concerns included loss of privacy, confidentiality and data storage security, as they were thought to be susceptible to hackers and other people with criminal intent in the virtual world. AI systems often require large amounts of personal data to function effectively, which raises substantial concerns about educators and students' privacy. The collection, storage, and use of sensitive data, such as academic performance, personal identifiers, and behavioural patterns, necessitate stringent measures to protect against unauthorized access and misuse. Strong data privacy and security policies are necessary to protect information and preserve confidence in AI-powered learning tools.

By addressing these issues head-on, the educational industry can maximize AI's potential to improve instruction while reducing any dangers or disadvantages.

Conclusion

Artificial intelligence (AI) integration in education offers a dynamic landscape with both significant advantages and challenges. A bright future for education is presented by AI's capacity to tailor instruction, provide constant access to learning materials, generate interactive learning environments, and expedite administrative duties. These developments facilitate the creation of a more efficient, engaging, and inclusive learning environment that meets the varied requirements of both educators and students.

However, the successful implementation of AI in educational systems is contingent upon addressing several critical challenges. Managing ethical dilemmas, protecting data security and privacy, and ensuring that both educators and students are adequately prepared are paramount. The shift to AI enhanced education necessitates large infrastructural investments, thorough training curriculums, and the creation of strong ethical frameworks to regulate AI usage.

AI in education has several advantages but balancing them all requires planning and smart thinking. Through the promotion of cooperation among educators, technologists, politicians, and other relevant parties, the educational sector can efficiently utilize artificial intelligence to improve instruction and minimize associated hazards. This collaborative effort is essential to navigate the complexities and ensure that AI integration is both effective and responsible.

The ultimate objective is to establish an ecosystem for education in which artificial intelligence (AI) serves as a helpful tool, enabling educators and students to realize their full potential in a rapidly evolving digital landscape. AI has the power to transform education and make it more inclusive, individualized, and flexible for all students by tackling the problems head-on and capitalizing on the benefits.

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SEMANTIC MODEL OF PARAMETERS PASSING IN IMPERATIVE PARADIGM WITH PROCEDURAL PROGRAMMING USING C

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ABSTRACT

Programming language can be classified as imperative, object-oriented, functional, logic and scripting programming paradigms. Imperative is based on commands that update the variables which exist on the computer memory. Imperative requires functions for every step to solve a problem. Imperative specifies on how the problem is to be solved, which requires a detailed step-by-step instruction. Procedural programming is the derivative of the imperative paradigm which adds functions which are also known as subroutines or procedures. Procedural programming encourages the programmer to subdivide the codes into specific tasks as a function to improve the modularity of the program or looks structured. C programming provides different types of semantic models in terms of parameter passing to the subroutine from the main program or vice versa. The parameters could be variables with primitive data type, arrays or pointers. The type of parameters passing can be characterized into three semantic models such as the in mode, out mode and in-out mode. The semantic models are predetermined through the implementation model either the parameters are passed as pass by value, by pointer or reference, by value-result, by result or by array.

Keywords: imperative, procedural, in mode, out mode, in-out mode

Introduction

Imperative paradigm is the oldest programming approach. The origin of the imperative paradigm is the machine language and assembly language. Imperative programming closest to the actual mechanical behavior of a computer. Imperative program related to sequence of instructions that change the memory state until it achieves the desired end state (Jes´us & Pablo, 2022). The imperative paradigm is useful for small scale applications, but cumbersome for big scale projects and parallel programming. Most of the imperative programming paradigm such as C programming language provides the control structure IF for branch execution and FOR or WHILE for loop execution. GOTO command is also provided for jumping between line executions. Procedural programming is the improvised version of the imperative paradigm which means the execution of the codes have to go through the entire code without skipping any commands. This can be concluded that the GOTO command is not allowed in procedural programming (Bartoníček, 2014). Examples of imperative programming languages are C, FORTRAN, ALGOL and COBOL.

The major strength of the imperative paradigm is its resemblance to the native language of the computer, which makes it efficient to translate and execute the high-level programming language into the imperative paradigm. Procedural programming decreases the expenses of program development as well the system maintenance. Procedural programming reduces duplication of codes or code redundancies. Code duplication is when the program fragment has a similar function in another part of the program fragment. Code duplication complicates the program maintenance or modification since we need to perform similar changes to all duplicated program fragments. Developers are encouraged to reuse the similar code fragment or segment by applying the subroutines or functions (Avacheva & Prutzkow, 2020). Subroutine reduces the length of the codes, increases the system efficiency, cuts the cost of system maintenance, provides modularity and divides the codes into abstraction level (Djikstra, 1968). This article will elaborate three (3) types of parameters passing semantic models either the parameter is passed as in, out or in-out mode.

Parameter Passing Semantic Models

Semantic models of parameter passing in C programming can be classified as in, out and in-out mode. Generally, the in and in-out mode semantic models are applied among practitioners. The following is an example of an in mode parameter passing model in C programming.

```
#include <stdio.h>

void calculateSUM(int,int);//prototype function
int main()
{
int x, y;
printf("\n Enter first number : ");
scanf("%d", &x);
printf("\n Enter second number  : ");
scanf("%d", &y);
calculateSUM(x,y);//calling function
return 0;
}

void calculateSUM(int a, int b) //definition function
{
int sum = a + b;
printf("\n The summation of %d and %d is %d ", a, b, sum);
return;
}
```

Figure 1: C Program with the in-mode parameter passing

The above figure 1, shows that the main program sends two (2) parameters `x` and `y` to the function named `calculateSUM` as pass by value. The function `calculateSUM(…)` receives `x` and `y` from the main program and passes over to `a` and `b` respectively at the function header. Both values of `a` and `b` will be used for arithmetic operations for summation. The result of summation is displayed and settled in the function. None of the updated values will be sent back to the main program. It shows that the values are sent to the function from the main program and none of the results will be sent back to the main program. This type of parameter passing is also called pass by value. The following diagram named structured chart shows the parameter passing flows between the main program and the subroutine or function.

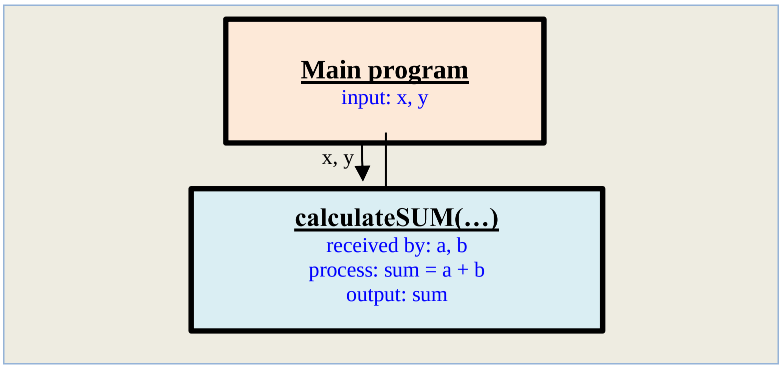


Figure 2: Structured chart that shows the parameter passing flows, in mode semantic model

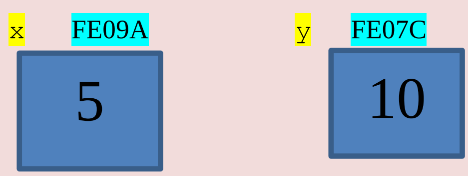
The second type of parameters passing the semantic model is the in-out mode as shown in the following figure 3.

```
#include <stdio.h>

void swap(int*,int*);//prototype function

int main()
{
	int x = 5, y = 10;

	printf ("\n The original value of X is %d ",x);
	printf ("\n The original value of Y is %d ",y);

	swap(&x,&y); //calling function

	printf ("\n The value of X after swap is %d ",x);
	printf ("\n The value of Y after swap is %d ",y);

	return 0;
}

void swap(int* a, int* b) //definition function
{
	int temp;

	temp = *a;
	*a = *b;
	*b = temp;

	return;
}
```

Figure 3: C Program with in-out mode parameter passing

The main function sends two parameters of computer memory address `&x` and `&y` to the `swap(…)` function. The two addresses of `&x` and `&y` will be received by the pointer variables `a` and `b` respectively in the `swap(…)` function header. These two addresses are actually pointed by the pointer variables `a` and `b` indirectly to address `&x` and `&y` respectively. Next, the pointer variable `a` which holds the address of `&x` will be pointing to variable `temp` as temporary. Then, the pointer variable `b` is assigned to pointer variable `a` which means the pointer variable `a` is now pointing to the address of `b`. Later, the variable `temp` is assigned to pointer variable `b`, which means the pointer variable `b` is now pointing to the address of `a`. Finally, the updated address pointed by variable `a` and `b` will be returned back to the main program and received by `x` and `y` with the latest address in the main function. This type of parameter passing is also called pass by value-result. C++ programming language does not provide a sending parameter with the pointer variable as applied in the C programming language (Othman, 2010). Nevertheless, C++ provides the pass by value-result or in-out mode parameter passing semantic model through pass by reference in which none of the pointer variables are involved in the codes. The following figure 4, shows the logical state diagram for the program as shown in figure 3.

```
//int x = 5, y = 10;
```



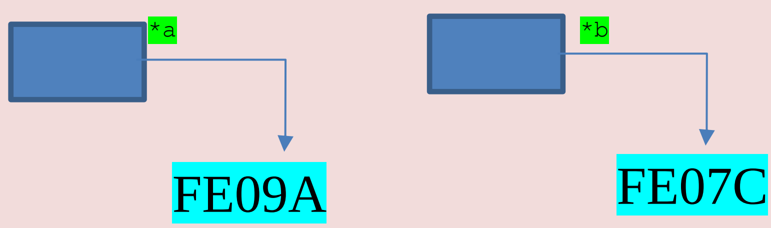
Variable x holds the value 5 and is located at the address FE09A.

Variable y holds the value 10 and is located at the address FE07C.

```
//swap (%a, &y);
```

Main program sends FE09A and FE07C to `swap(…)` function through its parameters.

```
//void swap(int* a, int* b)
```



The pointer variable `a is pointing` to the address of x and the pointer variable b is pointing to the address of y.

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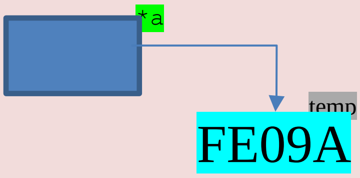
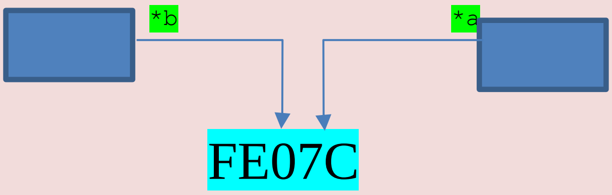
```
// temp = *a;
```



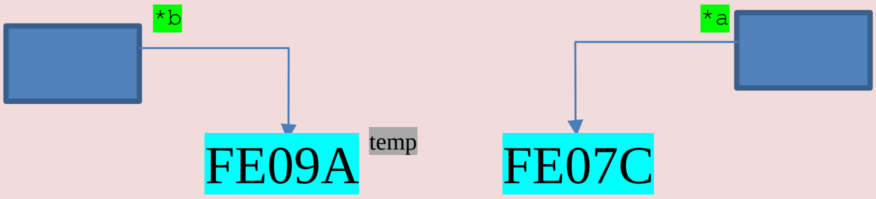
The variable temp has the same similar value of address as pointed by the pointer variable a.

```
//*a = *b;
```



The pointer variables a and b are pointing to the same address.

```
//*b = temp;
```

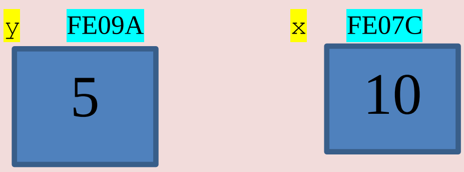


Now, the final state is the pointer variable b is pointing to the address held by the variable temp and the pointer variable a is pointing to the address as previously pointed by the pointer variable b.

Later, when the formal parameters at the header returns the result, it will be returning the exchanged address to the main program.

The main program will be receiving address **FE07C** by the variable x and the address **FE09A** by the variable y. At the location **FE07C**, the memory address holds the value 10 and **FE09A** holds the value 5, which now both variables received the exchanged numbers.

The following is the final memory state of the value held by variable x and y.



Variable x holds the value 10 and is located at the address FE07C.

Variable y holds the value 5 and located at the address FE09A.

Figure 4: Logical state diagram of in-out mode parameter passing semantic model

The third type of the parameter passing semantic model in imperative programming paradigm using C is the out mode as shown in the following figure 5.

```
#include <stdio.h>
int input();//prototype function
int main()
{
        int number = input();//calling function
        printf("\n The number entered in the function is %d",number);
        return 0;
}

int input()//definition function
{
        int x;
        printf("\n Enter a number : ");
        scanf("%d",&x);
        return x;
}
```

Figure 5: C Program with the out-mode parameter passing

The above code as shown in figure 5 illustrates that the input is performed in the function. None of the values are passed from the main program to the subroutine. Once the value is entered in the function, it will be returned to the main program and assigned to a variable for further actions. The out mode parameter passing is also called as pass by result. The following figure 6 shows the structured chart of the parameter passing flows from the subroutine to the main program.

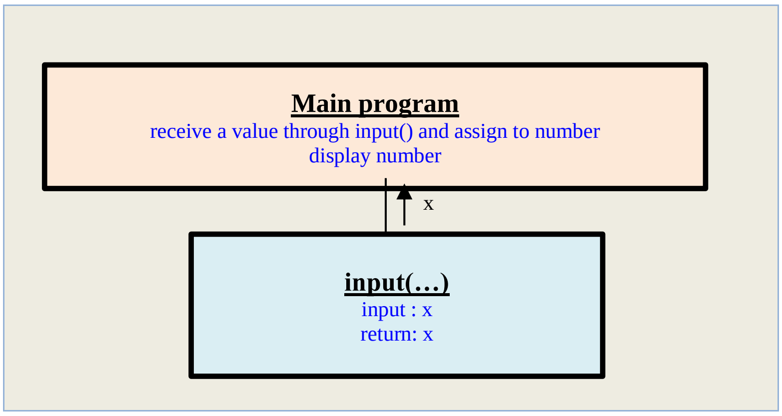


Figure 6: Structured chart that shows the parameter passing flows, out mode semantic model

The three types of parameters passing semantics model as discussed before are the pass by value (in mode), pass by value-result (in-out mode) and pass by result (out mode). The next type of parameter passing is sending the arrays. This type of parameter passing will pass the arrays to the function, and the affected subscript of an array will be updated and the result will be returned to the main program. The following figure 7 shows the implementation of passing the array as parameter.

```
#include <stdio.h>

void process(int a[], const int S) //definition function
{
       for (int i=0;i<S;i++)
       {
              a[i]= a[i] * 2;
       }
       return;
}

int main()
{
       const int SIZE = 5;
       int x[5]={1,2,3,4,5};

       printf("\n Array contents before processing ");
       for (int i=0;i<SIZE;i++)
       {             printf("%d ",x[i]);        }

       process(x,SIZE); //calling function
       printf("\n Array contents after processing ");
       for (int i=0;i<SIZE;i++)
       {             printf("%d ",x[i]);        }

}
```

Figure 7: C Program with array parameter passing

The contents of array variable `x` before it is sent to the function are `{1,2,3,4,5}`. The function `process(…)` receives the array and multiplies each of the array subscripts by 2 and results `{2,4,6,8,10}`. The output as shown below, depicts that the original contents can be changed if the parameter sent is an array type. Sending an array as part of the parameter to the function is categorized as pass by value-result and the semantic model is the in-out mode.

```
Array contents before processing 1 2 3 4 5
Array contents after processing 2 4 6 8 10
```

Figure 8: Comparison of array contents, before and after processing

Conclusively, the parameter passing types and its semantic model can be summarized as shown in the following table.

Table 1: Parameter passing type and semantic model

Parameter Passing Type	Semantic Model
Pass by value	In mode
Pass by value-result	In-out mode
Pass by Pointer or Reference	In-out mode
Pass by result	Out mode
Pass array	In-out mode

Conclusion

In programming, parameter passing plays a crucial role in passing data between different parts of a program, such as functions or subroutines. The method of passing parameters can significantly impact the efficiency and behavior of a program. By understanding the different methods of parameter passing - including pass-by-value, pass-by-reference and pass-by-pointer, the developers can make informed decisions about which approach to use based on factors such as performance requirements, memory management, and the desired behavior of the program. Each method has its advantages and limitations. Ultimately, the choice of parameter passing method depends on the specific requirements of the program and the trade-offs between performance, memory usage, and data integrity. By carefully considering these factors, developers can design robust and efficient software systems.

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MIND MAPPING: A VISUAL TOOL FOR ENHANCED TEACHING AND LEARNING IN MATHEMATICS

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ABSTRACT

In the realm of mathematics education, finding innovative methods to enhance teaching and learning is essential for fostering student engagement and comprehension. Mind mapping stands out as a powerful visual tool that can significantly improve the way mathematical concepts are taught and understood. Mind mapping makes complex mathematical concepts easier to understand and retain by using the brain's innate capacity for pattern recognition and connection to arrange information in a creative yet organized way. Mind mapping also helps students of all ages retain information better, be more creative, and develop their critical thinking abilities. Furthermore, mind maps can be used to introduce new mathematical concepts, review learned material, and encourage collaborative problem-solving among students. For educators, it provides a versatile approach to curriculum design and lesson planning, enabling the creation of more dynamic and interactive classroom environments. This abstract examines the potential of mind mapping as an educational tool, discussing its benefits, practical applications, and the scientific foundations that support its role in improving learning outcomes. Through a detailed exploration, it becomes evident that mind mapping not only aids in the comprehension and retention of mathematical concepts but also a catalyst for fostering a more engaging and inclusive educational experience.

Keywords: mind mapping, teaching and learning, education tool

Introduction

Mind mapping is a visual thinking tool that helps in structuring information, enabling better analysis, comprehension, and recall. It involves creating diagrams that represent ideas, tasks, or concepts, typically radiating from a central node or theme. These diagrams are structured in a hierarchical or tree-like format, with branches connecting related ideas or subtopics to the central theme. In addition, the text can be accompanied by images, and color can be used for emphasis or to facilitate organization (Jones et al., 2012). Mind mapping is a versatile and powerful tool that can be applied in various fields to enhance learning, creativity, and productivity.

Mathematics, often perceived as a challenging subject, requires innovative teaching methods to facilitate student understanding and engagement. Traditional approaches, while foundational, sometimes fall short in addressing the diverse learning needs and styles of students. Enter mind mapping, a powerful visual tool that redefines the way mathematical concepts are taught and learned.

By presenting information in a visually appealing and logically structured format, mind maps help students grasp abstract mathematical concepts more intuitively. They aid in breaking down complex problems into manageable parts, fostering deeper comprehension and long-term retention. According to (Edwards and Cooper, 2010), mind mapping can be used as an effective way of getting information in and out of your brain. It is a creative and logical means of note-taking and note-making that literally ‘maps out’ your ideas.

(Loc and Loc, 2020) found that teaching mathematics with the help of mind maps will be a teaching method that contributes to improving the effectiveness of mathematics education in schools. In addition, the make of mind mapping also supports students’ development of conceptual understanding since it requires students to summarize and connect what they have learnt visually (Tiani, Johar and Bahrun, 2019). Besides that, (Buran and Filyukov, 2015) studied and showed that mind maps are useful for solving problems, brainstorming ideas, taking notes, improving reading skills, and preparing presentations. Hence, mind mapping may transform the learning process of mathematics by giving abstract ideas greater substance and connectivity.

How to use mind mapping effectively for Mathematics?

1. Central Concept
   Start by understanding the main idea or subject you wish to learn more about. This could be as general as “Calculus” or as specific as “Quadratic Equations”.
2. Main Branches
   Create main branches from the main idea. These branches represent key subtopics or major ideas related to the central concept. For example, for "Calculus," the main branches might include "Limits," "Derivatives," "Integrals," and "Applications."
3. Sub-Branches
   Make sub-branch representations of more detailed ideas, equations, theorems, or instances from each major branch. It is possible to have sub-branches under "Derivatives," such as "Definition," "Rules of Differentiation," "Chain Rule," "Product Rule," and "Applications of Derivatives."
4. Use Visuals and Colours
   To improve comprehension, provide visual aids such as graphs, drawings, and diagrams. To make the map more visually appealing and to help identify distinct areas, use different colours for different branches.
5. Connect Related Concepts

Draw bridges between related ideas in many disciplines. This helps in recognising the relationships and interdependence between various mathematical concepts.

6. Include Examples and Practice Problems

   Put practice questions and examples within the applicable branches. By addressing these cases, it will help reinforce the concepts and provide practical application.

7. Review and Update

   Review and update your mind map frequently as you get new insights and as relevant details come to mind. The mind map becomes a dynamic tool as a result, expanding with your knowledge.

Benefit of mind mapping in Mathematics

Mind mapping offers numerous benefits for mastering mathematical concepts by enhancing comprehension, memory retention, and problem-solving skills. There are several criteria to show the benefits of mind mapping.

1. Enhanced Comprehension

   Visual Learning: Mathematics often involves abstract concepts that can be better understood through visual representation. Mind maps help visualize relationships between ideas, making complex concepts easier to grasp.

   Holistic View: Provides a thorough summary of a subject, demonstrating the connections between many ideas and equations.

2. Improve Memory Retention

   Active Engagement: Creating a mind map requires active information processing, which improves recall.

   Visual Cues: Colours, images, and spatial organisation in mind maps serve as visual cues that aid recall.

3. Better Organisation

   Structured Information: Helps organise information logically, breaking down complex topics into manageable chunks.

   Clear Hierarchies: Establishes clear hierarchies and relationships between main topics and subtopics.

4. Enhanced Problem-Solving Skills

Analytical Thinking: Encourages breaking down problems into smaller parts, fostering analytical thinking.

Connections and Patterns: Helps identify connections and patterns that might not be immediately obvious, leading to deeper insights.

5. Boosted Creativity

   Flexible Thinking: Encourages creative and flexible thinking by allowing free-form association of ideas.

   Innovative Solutions: Facilitates brainstorming and the exploration of multiple solutions to a problem.

6. Effective Study and Revision Tool

   Condensed Information: Provides a brief overview of a lot of material, making it simpler to go over.

   Dynamic Updates: Easy to update and expand as new information is learned, making it a living document.

Thus, applying mind mapping to a student's study routine can greatly improve their comprehension, memorization, creative thinking, and application of mathematical topics. In addition, according to (Karo-Karo, Restuati, and Silaban, 2017) also conclude that creative thinking skills possibly mean that they have an ability to seek for solution or problem-solving to their own problems.

Example of mind mapping

1.

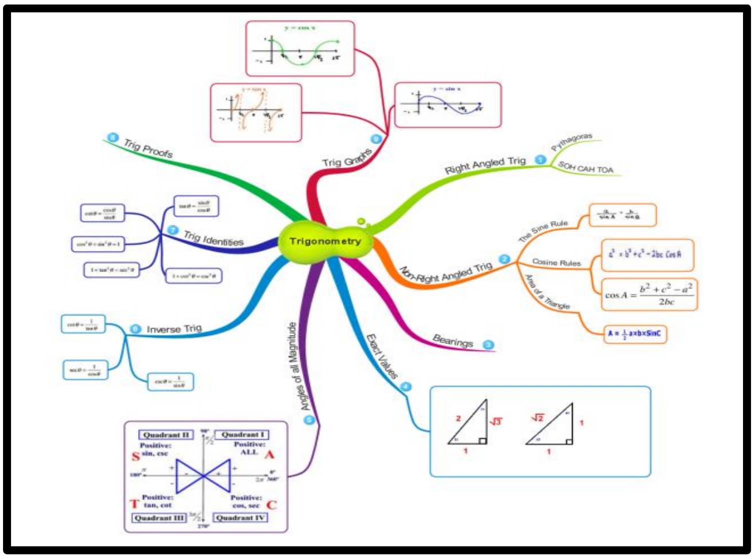

Figure 1: Example of mind mapping 1

2.

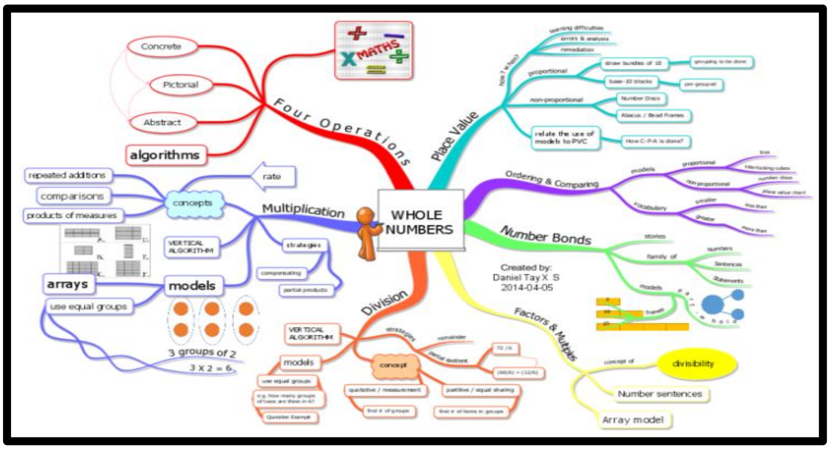

Figure 2: Example of mind mapping 2

3.

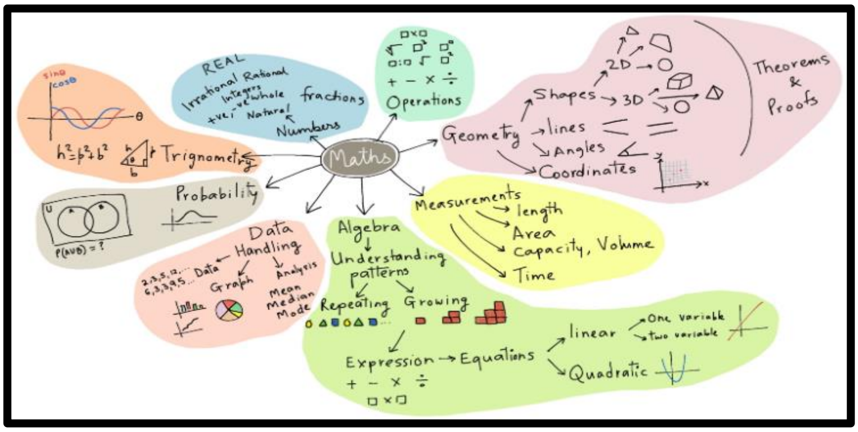

Figure 3: Example of mind mapping 3

Conclusion

In conclusion, mind mapping shows potential as a powerful teaching aid in mathematics, with numerous advantages and real-world uses backed by solid scientific research. Through the use of structured representations, mind maps help students better understand and retain complicated mathematical topics by graphically organising information and also stimulating both creative and analytical thinking, which leads to creative problem-solving and novel ideas. Scientifically, mind mapping is backed by cognitive theories that emphasise the importance of visual learning and active engagement in enhancing cognitive processes. Therefore, incorporating mind mapping into mathematics education not only simplifies learning but also boosts motivation and confidence, ultimately fostering a deeper and more lasting understanding of mathematical principles.

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THE IMPORTANCE OF MINITAB SOFTWARE IN THE SUBJECT OF STATISTICS (STA408) AMONG ENGINEERING STUDENTS

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ABSTRACT

Engineering students often find statistical analysis, including data collection, methodology, and preparation, to be challenging aspects of their academic projects. This study explains the importance of integrating Minitab software into the STA408 Statistics course for student performance and comprehension. This study also aimed to describe how Minitab's user-friendly interface and advanced analytical capabilities enhance the learning experience by providing practical, hands-on opportunities to engage with complex statistical concepts. Students using Minitab can understand and apply statistical methods such as correlation, regression, hypothesis testing, and confidence intervals. Additionally, the software fosters self-regulated learning and prepares students for data-driven decision-making in professional settings. The value of incorporating advanced statistical software into educational programmes is to improve learning outcomes and equip students with essential analytical skills.

Keywords: Statistics, Minitab Software, Engineering Education

Introduction

Science Improving a country's human resource base is mostly dependent on scientific and technological advancements. One approach to human resource management involves enhancing the quality of education (Suharti et al., 2020). One of the courses that is crucial to a well-rounded education is statistics. According to Oldknow et al. (2010), lecturers should make sure that their undergraduate students have enough chances to learn and grow in class. So that students can relate to and utilise any technology for any topic, it is the responsibility of all lecturers, not just those teaching computers.

Students must possess the basic ability to analyse data through the use of real-world problems in statistical learning. Students should learn this skill to enhance their creative problem-solving abilities during the learning process. As outlined by Mairing (2020), Statistics courses encompass the comprehensive processes of data collection, representation, summarization, analysis, and drawing conclusions. These procedures involve intricate computations utilizing various formulas, which become more complex with larger datasets, diverse types of analyses, and additional variables under study.

When considering the use of software as an educational tool, it is crucial to assess the necessity of using the programme. The development of Minitab software-based statistical teaching materials is designed to cater to the needs and advancements of technology (De Muth, 2019). The creation of statistical teaching materials using Minitab software is anticipated to foster a favourable environment for students to engage in self-regulated learning. Effective self-regulated learning significantly influences students' attitudes following the completion of the recovery period. The researcher formulated the problem statement as follows: "How can statistical teaching materials be designed using Minitab software to facilitate self-regulated learning among engineering students?" Therefore, the aim of this study is to describe the effect of using Minitab with teaching teams on the undergraduates' achievements in the Statistics course (STA408).

Statistical Analysis Using MINITAB

STA408 is a statistics course specifically designed for students in the fields of science and engineering. This course familiarises students with fundamental and advanced techniques of data analysis. The focus will be on utilising descriptive and inferential statistics, which encompass measures of central tendency, measures of dispersion, correlation, regression, hypothesis testing, and analysis of variance. Students will have the capacity to analyse and understand the computer-generated results produced by the statistical software MINITAB.

In the STA408 course, engineering students are introduced to the versatile capabilities of Minitab software for statistical analysis. One of the fundamental topics covered is correlation, where students utilise Minitab to calculate and interpret the strength and direction of relationships between variables. By inputting their data and selecting appropriate statistical tests within Minitab, students gain practical insights into how correlation coefficients are computed and how to interpret their significance in real-world applications.

In STA408, students also utilize Minitab to construct confidence intervals for both population mean and variance. Minitab simplifies the calculation process by allowing students to input sample data and specify the desired confidence level. For estimating population mean, students use Minitab to compute confidence intervals based on sample statistics such as mean, standard deviation, and sample size. Similarly, for variance, students apply Minitab to calculate confidence intervals using sample variance and sample size. This hands-on approach not only reinforces the concept of confidence intervals but also enhances students' ability to interpret and communicate statistical results effectively in engineering and scientific contexts.

Hypothesis testing is a critical component of statistical analysis covered in STA408, facilitated by the robust capabilities of Minitab software. Students learn to formulate and test hypotheses regarding one population mean, two population means, one population variance or standard deviation, and two population variances or standard deviations. Through Minitab, students can conduct t-tests and as well as chi-square tests for comparing categorical data proportions. This practical application of hypothesis testing using Minitab allows students to not only understand the theoretical foundations of statistical inference but also gain proficiency in executing and interpreting tests to make informed decisions based on data-driven insights.

Regression analysis is another crucial area where Minitab plays a pivotal role in STA408. Students learn to perform both linear and logistic regressions using the software, enabling them to model and predict relationships between variables. Through interactive sessions with Minitab, students not only observe how regression equations are formulated but also grasp the underlying statistical principles and assumptions that govern regression analysis.

Analysis of variance (ANOVA) represent advanced statistical techniques covered in STA408, supported by Minitab's robust analytical tools. Students learn to formulate hypotheses, select appropriate test procedures in Minitab, and interpret results to draw meaningful conclusions. Beyond simply executing tests, students deepen their understanding of statistical inference by exploring the formulas and statistical assumptions underpinning hypothesis tests and ANOVA, thereby enhancing their analytical and critical thinking skills.

In STA408, students engage with Minitab not only as a learning tool but also as an integral part of their assessment strategy, encompassing both individual tests and collaborative group assignments. Individual assessments often involve students applying Minitab to conduct statistical tests, such as hypothesis testing or regression analysis, on given datasets. Through these assessments, students demonstrate their proficiency in using Minitab to analyze data, interpret results, and draw valid conclusions based on statistical principles.

Moreover, group assignments in STA408 provide students with opportunities to leverage Minitab's collaborative features for more complex statistical analyses. Groups may be tasked with designing experiments, collecting data, and using Minitab to perform comprehensive analyses that involve multiple variables or experimental conditions. This collaborative approach not only fosters teamwork and communication skills but also reinforces students' understanding of statistical concepts as they apply Minitab to solve real-world problems collectively.

By incorporating Minitab into both individual assessments and group assignments, STA408 ensures that students not only gain theoretical knowledge but also develop practical skills in statistical analysis using industry-standard software (Allen, 2019). This approach equips engineering students with the competencies necessary to excel in data-driven decision-making and research within their academic and professional careers (Ghavifekr & Rosdy, 2015).

Exploring Minitab's Interface for Statistical Analysis

When launching Minitab, users are typically presented with a visual representation resembling Figure 1. The interface is divided into several key sections: the menu bar at the top provides access to various functions and statistical tools; the session window displays commands and results, facilitating user interaction and output review; and the worksheet area is where data is inputted and managed, allowing for efficient organization and analysis. This intuitive layout enables users to easily navigate and utilize Minitab's powerful statistical capabilities, streamlining the process of data analysis and hypothesis testing.

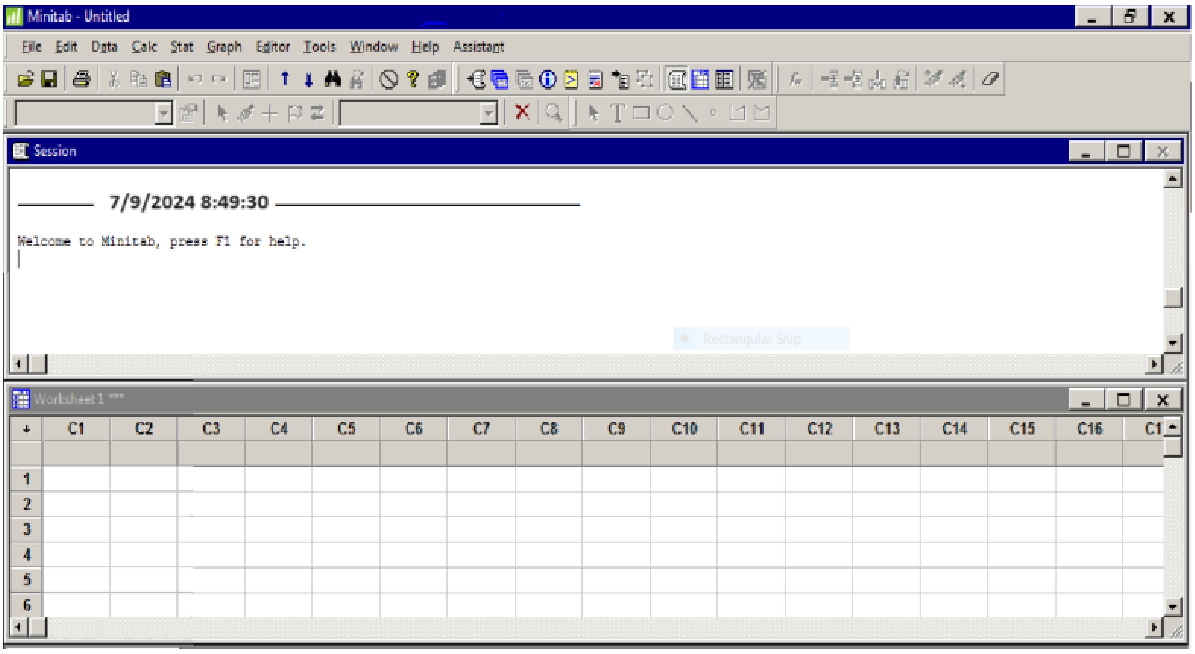

Figure 1: Minitab-Integrated Session and Worksheet Windows

Figure 2 illustrates the steps in Minitab to compute and interpret the confidence interval for one population mean. Users navigate to the 'Stat' menu, select 'Basic Statistics,' and then '1-Sample t...' to input data and specify the desired confidence level. The output window displays the computed confidence interval, providing insights into population parameter estimation using Minitab's statistical tools.

Figure 3 illustrates the steps in Minitab to conduct hypothesis testing for one population mean. Users navigate to the 'Stat' menu, select 'Basic Statistics,' and then '1-Sample t...' to input data and specify the hypothesized mean. In the dialog box, users can check the 'Perform hypothesis test' box and enter the hypothesized mean value. The output window displays the test results, including the sample mean, standard deviation, standard error of the mean, confidence interval, t-value, and p-value. This process enables users to determine if there is a significant difference between the sample mean and the hypothesized mean, providing insights into population parameter testing using Minitab's statistical tools.

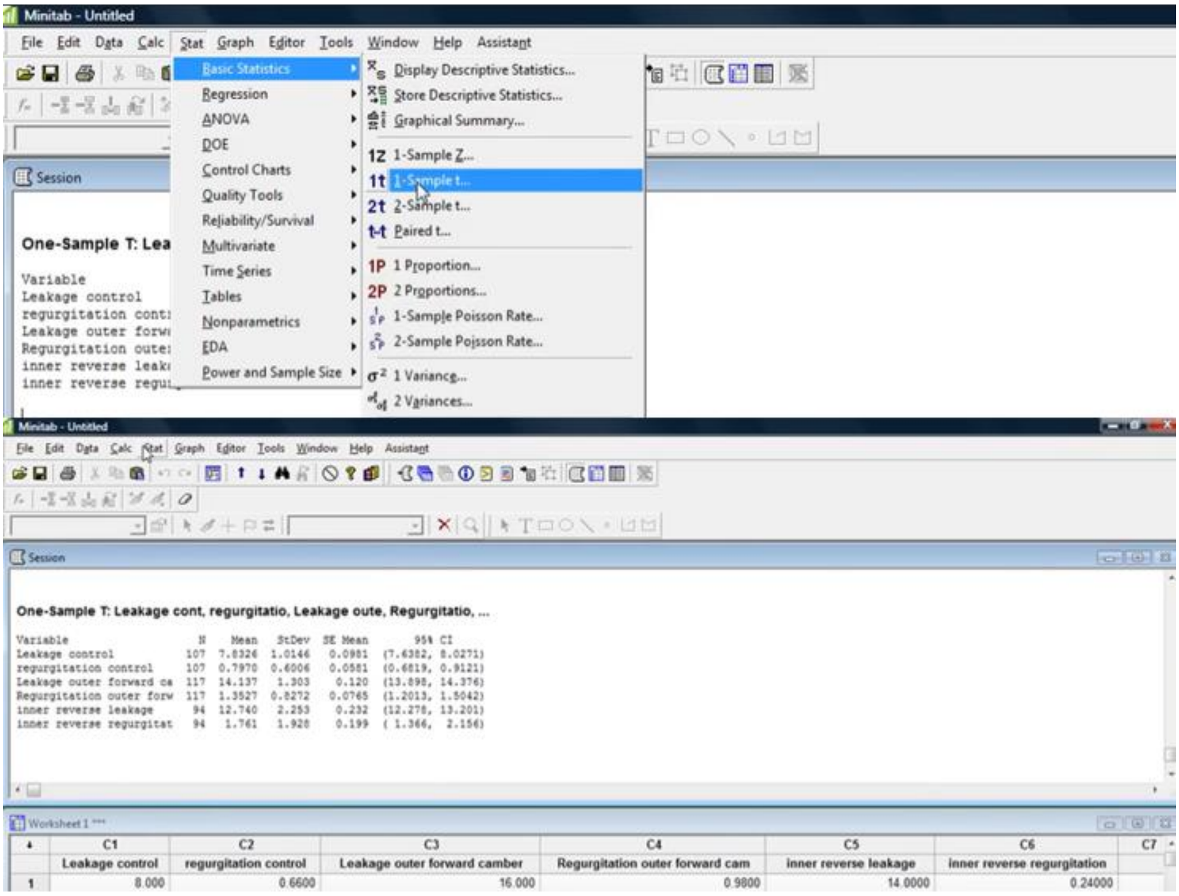

Figure 2: Locating Confidence Interval for One Population Mean in Minitab

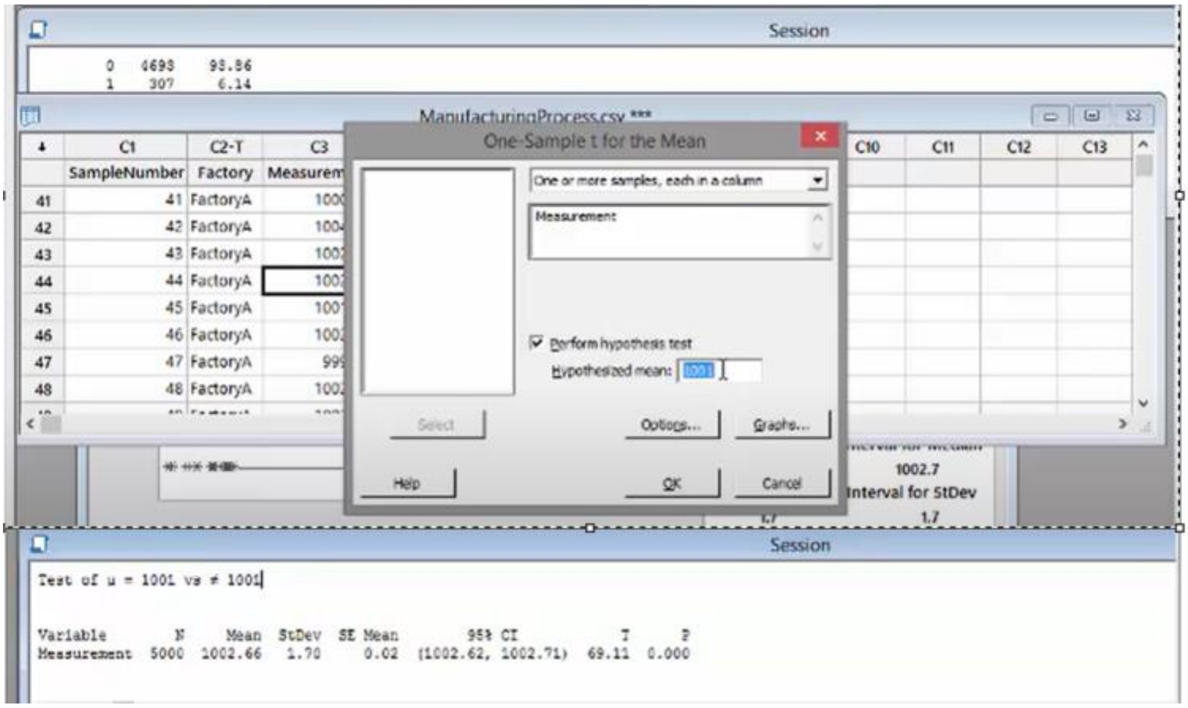

Figure 3: Locating Hypothesis Testing for One Population Mean in Minitab

Figures 4 and 5 illustrate performing correlation and regression analysis using Minitab. In Figure 3, users navigate to the 'Stat' menu, select 'Basic Statistics,' and then 'Correlation...' to input the variables for which they want to compute the correlation coefficient. The output window displays the correlation matrix, providing insights into the strength and direction of the linear relationship between the variables. In Figure 4, users navigate to the 'Stat' menu, select 'Regression,' and then 'Regression...' to specify the dependent and independent variables. The output window presents the regression equation, coefficients, and various diagnostic statistics, offering a comprehensive understanding of the predictive relationship between the variables.

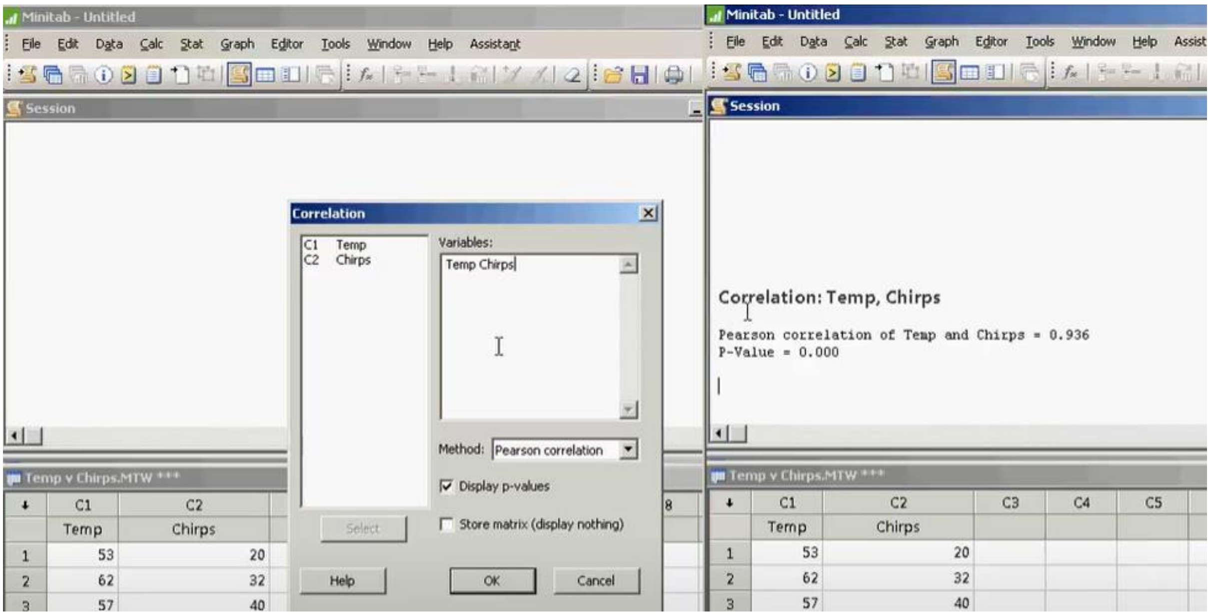

Figure 4: Locating Correlation in Minitab

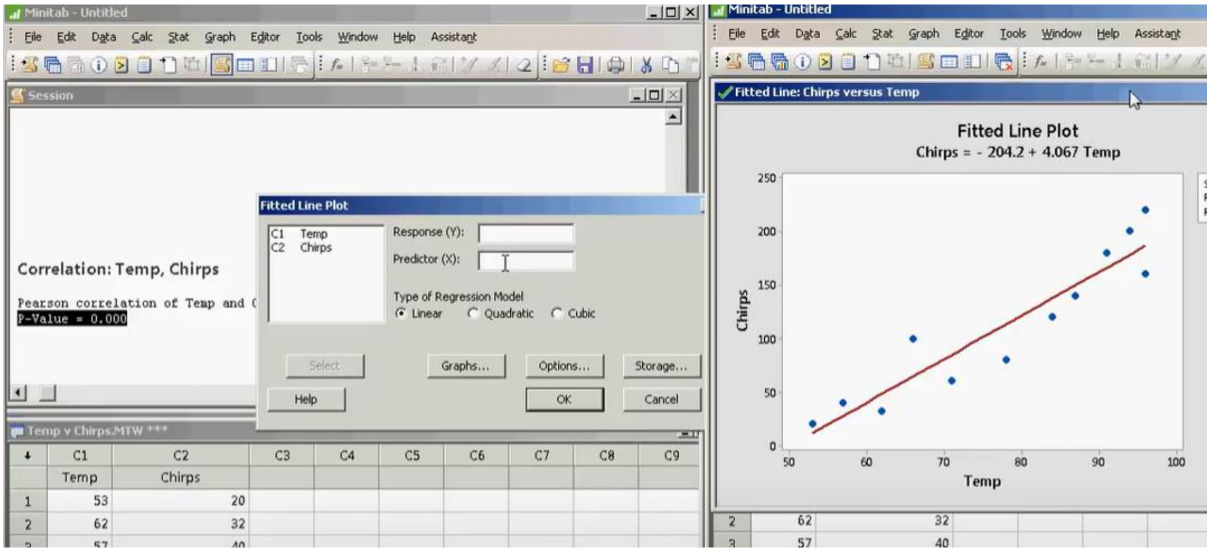

Figure 5: Locating Regression in Minitab

Conclusion

The integration of Minitab software into the Statistics course (STA408) for engineering students has demonstrated significant benefits in enhancing their learning experiences and outcomes. Minitab's user-friendly interface and robust analytical capabilities enable students to engage with complex statistical concepts through practical, hands-on application. By navigating through various statistical analyses such as correlation, regression, hypothesis testing, and confidence intervals, students not only grasp theoretical foundations but also develop essential skills in data analysis and interpretation. This study underscores the importance of incorporating advanced software tools like Minitab in educational curricula to foster self-regulated learning, improve analytical proficiency, and prepare students for data-driven decision-making in their future careers. As engineering education continues to evolve, the use of Minitab in teaching statistics will undoubtedly play a crucial role in shaping competent and confident professionals in the field.

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EVOLVING PRESENTATION DYNAMICS: THE SYNERGY OF POWERPOINT AND AI-POWERED TOOLS

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ABSTRACT

PowerPoint remains the leading presentation tool due to its integration with Microsoft Office, extensive features, and user-friendly interface, despite competition from Google Slides and Prezi. The rise of AI in higher education and other fields has introduced AI-powered presentation tools that enhance productivity, creativity, and customization through automation of tasks like design layout and data visualization. These AI tools offer advanced features such as smart templates and real-time content generation, which improve audience engagement and simplify complex data. The future will likely see a hybrid approach combining traditional tools like PowerPoint with AI technologies, offering a comprehensive toolset for creating impactful presentations. The integration of AI tools with PowerPoint can streamline workflows, enhance design capabilities, and provide tailored content, catering to diverse user needs and preferences.

Keywords: PowerPoint, Artificial Intelligence, higher education, presentation, features

Introduction

The presentation production environment is dominated by PowerPoint because of its widespread use, smooth integration with Microsoft Office, vast feature set, adaptability, device compatibility, frequent improvements, ease of use, collaborative capabilities, and substantial market dominance. It is still a top choice because of its established reputation and large user base, even in the face of competition from Google Slides and Prezi. Nowadays, the use of artificial intelligence (AI) in higher education (HE) has increased dramatically over the last five years (Chu et al., 2022), as has the availability of new AI technologies. Researchers (Crompton et al., 2021) have investigated the benefits of artificial intelligence for both educators and students in higher education. Advantages of using technology in education include tailoring instruction to meet varied student requirements (Verdú et al., 2017). These papers provide insight into how educators might effectively use artificial intelligence in higher education.

AI powered presentation tools are emerging as significant players in the presentation creation landscape due to their ability to enhance productivity, creativity, and customization. These tools leverage AI to automate tasks such as design layout, content suggestions, and data visualization. Therefore, AI powered presentation tools are transforming the way presentations are generated by providing intelligent automation, increased design capabilities, and tailored content, making them attractive additions to the traditional presentation software ecosystem. The future presentations will most likely involve a combination of existing tools, such as PowerPoint, and upcoming AI powered technologies. AI solutions provide automation, efficiency, sophisticated functionality, and personalization, yet PowerPoint remains prominent because of its long history, extensive capabilities, integration with other Microsoft Office applications, and vast user base. A hybrid approach could evolve, with AI improving PowerPoint's skills. Ultimately, both sorts of tools will coexist, catering to a variety of user needs and preferences.

Revolution presentation between AI tools and PowerPoint

PowerPoint's widespread use, seamless integration with Microsoft Office, versatile features, and user-friendly interface makes it a dominant tool in presentation creation. Traditional methods are often time-consuming due to manual design, limited templates, and lengthy revisions, highlighting the need for more efficient tools. They also struggle with audience engagement and effective storytelling, emphasizing the need for dynamic and interactive approaches. Additionally, traditional methods lack advanced data visualization tools, underscoring the need for tools that enhance clarity and interactivity in presentations.

According to Górriz et al. (2020), AI is now widely used to improve and advance various aspects of modern life. AI is becoming increasingly popular in higher education, which is significantly influenced by technology improvements (Alajmi et al., 2020). AI is utilized in various fields, including language education (Liang et al., 2021), engineering education (Shukla et al., 2019), mathematics education (Hwang & Tu, 2021), and medical education (Winkler-Schwartz et al., 2019).

AI presentation tools streamline and enhance presentations with advanced features such as smart templates, auto-design, real-time content generation, and slide suggestions. They support real-time collaboration, personalize content, and provide data-driven insights. With capabilities like dynamic visualizations, interactive elements, personalized storytelling, and adaptive presentations, these tools simplify complex data, forecast trends, and improve audience engagement and understanding. Overall, AI tools boost productivity, creativity, and presentation effectiveness, making them essential for modern presentations. The comparison between AI tools and PowerPoint in the different aspects is displayed in Table 1 below.

Table 1: The comparison between AI tools and PowerPoint

Aspect	AI tools	PowerPoint	Combined Strengths
Collaboration	Enhances with design automation, data analysis, and interactive elements	Provides a user-friendly interface and extensive features	Improved productivity, creativity, and audience engagement
Strengths	Innovation in automation and data-driven insights	Familiar and user-friendly, with robust features	A comprehensive toolset for creating impactful presentations
Synergy	Automates and personalizes content creation	Extensive customization and template options	Streamlined presentation creation with advanced functionalities
Future Outlook	Continues to evolve with advanced AI capabilities	Ongoing updates and integration with Microsoft Office Suite	Enhanced tools and capabilities for modern, dynamic presentations

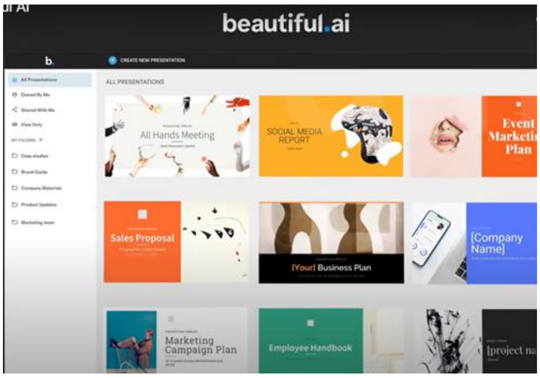
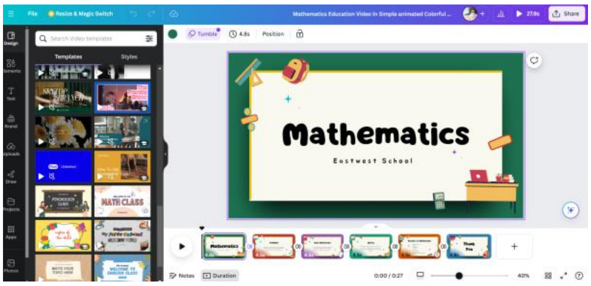
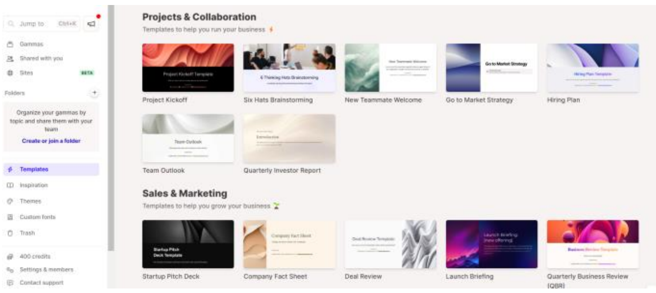
AI tools in presentation creation could potentially improve or replace PowerPoint by automating design, generating content, integrating real-time updates, and creating sophisticated data visualizations. These tools increase productivity by eliminating manual tasks and personalizing presentations. However, challenges include overcoming user preference for familiar programs like PowerPoint and adjusting the user interface. The adoption of AI tools will depend on their ability to meet users' needs for adaptability, personalization, and ease of use in creating impactful presentations.

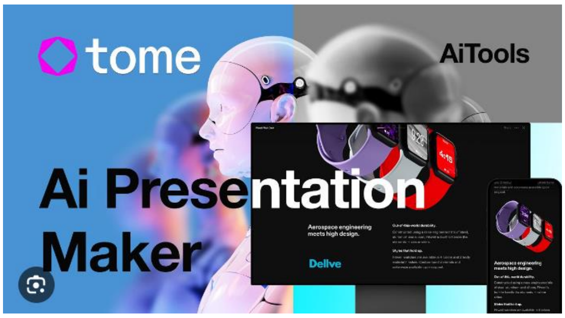
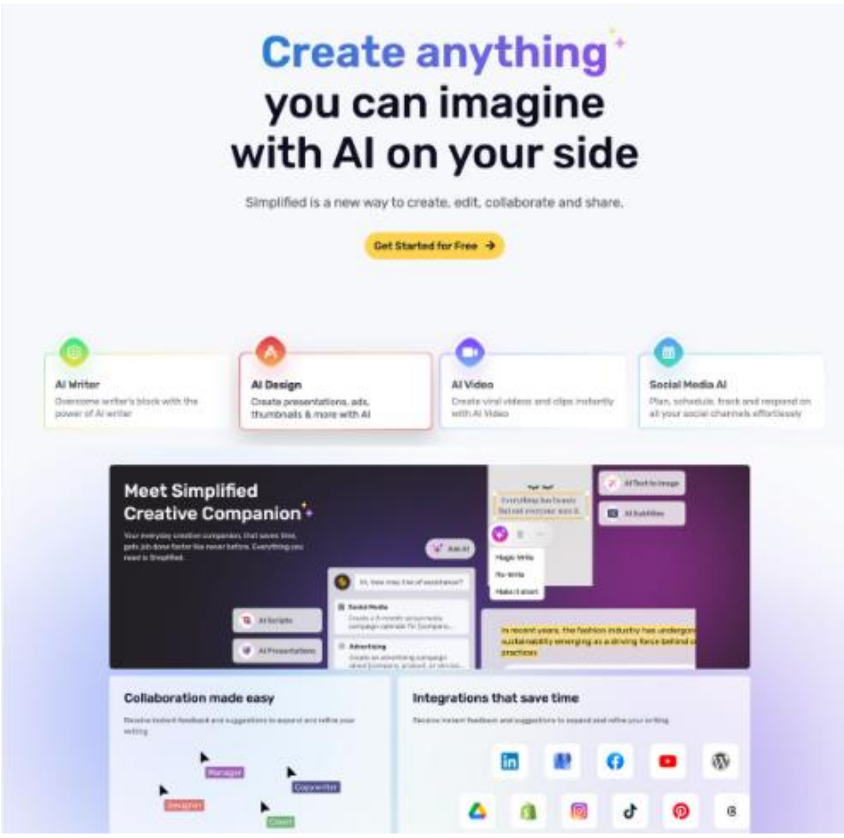
The AI tools for Presentation

Technology is advancing at the same rate as presentation tools used in higher education. An increasing number of people are using AI presentation builders like Canva instead of traditional presentation tools are shown in Table 2.

Table 2: The AI tools for presentation

	Best for
1. Beautiful.ai	● One-Click Presentations: Generate presentations instantly with AI technology ● AI Design: AI-powered design elements ● AI Text Generator: Rewrite and improve text with AI ● Extensive Template Library: Access over 110 pre-designed templates.

	● Seamless PowerPoint Integration: Easily import and export with PowerPoint compatibility. 
2. Canva	● Multi-platform support: Create graphics for multiple platforms ● Extensive Options: Canva provides a wide array of ready-to-use templates. ● AI tools: Canva provides several AI design tools to make creating quick and easy ● Simple interface: Utilize a user-friendly drag-and-drop visual editor. 
3. Gamma.ai	● Analytics Tracking ● Web Sharing: Easily share online and gather feedback through comments. ● Simple Interface: Drag-and-drop visual editor ● Export Options: Export to PowerPoint or PDF formats. 

4. Tome	● Interactive: Creates live, interactive presentations ● Responsive Design: Ensures layouts adapt to any screen size or device. ● Multiple AI Tools: Generates text, images, graphs, 3D models, and more ● Multi-Language Support: Supports multiple languages seamlessly. 
5. Simplified	● Multimedia: Generate presentations and other forms of media ● AI-Powered Editing: Enhance images and text using advanced AI tools. ● Branding: Create logos and design elements with AI ● Simple to Use: One-click editing tools for image editing 

Conclusion

PowerPoint provides essential user control and customization, with a familiar interface and flexible design options. AI tools complement PowerPoint by automating tasks, enhancing impact and engagement, and handling data analysis. PowerPoint excels in complex customization, while AI streamlines workflows and adds advanced insights. Together, they support seamless adoption, merging familiar foundations with AI-driven enhancements.

PowerPoint and AI tools effectively integrate existing presentation assets. PowerPoint supports diverse file formats and media libraries, while AI automates asset management and enriches presentations with advanced data visualizations. The user-friendly interface facilitates seamless integration, optimizing workflows, supporting collaborative editing, and enabling continuous improvement.

AI presentation technologies have improved greatly by combining audience data and real-time feedback. AI changes presentations depending on feedback, delivers audience insights, and boosts involvement with interactive elements. It personalizes content, optimizes communication, and enhances strategy using performance measurements, all while maintaining data privacy. AI automates processes and provides enhanced insights, which improves productivity, engagement, and effectiveness. Despite the benefits of artificial intelligence, human creativity and presentation skills are still required for captivating tales, dramatic images, effective delivery, and audience engagement, resulting in memorable and persuasive presentations.

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THE IMPACT OF THE ON-DEMAND ECONOMY ON MALAYSIAN LOGISTICS

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ABSTRACT

The on-demand economy has reshaped the logistics landscape, particularly in last-mile delivery and warehouse management. The rise of e-commerce has driven significant changes in the sector, necessitating innovative approaches to optimize operations and meet increasing customer expectations. The study explores the challenges and opportunities presented by the on-demand economy, including the role of technology, satellite depots, and emerging trends like crowd logistics. By analyzing the interplay between these factors, the paper highlights the critical role of balancing efficiency, cost-effectiveness, and customer satisfaction in shaping the future of logistics.

Keywords: on-demand economy, logistics, last-mile delivery, warehouse management, e-commerce.

Introduction

The sharing economy, gig economy, or on-demand economy are other terms for the same business model that uses technology to link companies or individuals looking for particular services with service providers who can meet their needs. The on-demand economy has significantly impacted the logistics sector. Allied Industry Research (2022) projects that between 2022 and 2031, the on-demand logistics industry will expand at a compound annual growth rate (CAGR) of 20.8%, reaching USD 80.6 billion. The on-demand economy's growth has changed several industries, including logistics, and encouraged the creation of creative ways to boost last-mile delivery effectiveness. Consequently, a paradigm shift in supply chain management has resulted from the on-demand economy, with an emphasis on customer satisfaction, transparency, and creative logistics techniques.

The on-demand economy, defined by platforms that facilitate exchanges between service providers and consumers, has completely transformed the distribution of goods and services. Through contract or freelance labor arrangements, technology platforms connect people looking for services with providers. While it is different from traditional markets, Benjaafar (2021) and Song (2022) point out that it has the ability to transform these markets into entrepreneurial ecosystems by implementing information and communication technology (ICT). However, Duch-Brown (2021) disagrees that online markets are currently more integrated than traditional markets, despite their innovative nature. Waluyo (2021) discusses how the coronavirus pandemic has affected conventional markets and caused a move towards digital marketing applications. The study also illustrates how external factors have caused the landscape to change.

Warehouse Management

There are several different aspects of logistics and supply chain optimization that are involved in the management of warehouses and satellite depots. A warehouse serves as a facility for inventory management and storage. According to Geoff (2023), warehouse management involves organizing for the purpose of achieving maximum pick and pack efficiency, implementing rigorous stock tracking, ensuring security, and guaranteeing that the working environment is clean and well-organized. Traditional warehouses, being centralized facilities, typically store large quantities of merchandise. Satellite depots, on the other hand, are mini-warehouses that are strategically positioned and located closer to consumers (Lark, 2023). Satellite depots might help minimize transportation costs, improve delivery times, and free up warehouse space (CRS Cold Storage, 2019). Time-sensitive shipments, like temperature-controlled products, necessitate a specific duration for successful delivery, making this particularly crucial.

The best practices for managing warehouses in an economy that operates on demand include prioritizing demand-supply matching, taking into account the mutual impact that exists between tactical and operational planning, developing hybrid network architectures, and making use of mobile satellites to ensure that delivery routes are as efficient as possible. Unnu (2022) observed on-demand warehousing by utilizing dynamic facility location models in his research. According to his findings, the power of on-demand storage comes from its ability to create hybrid network architectures that make use of self-distribution facilities in a more efficient manner by utilizing their capacity. The two-echelon city dispatching model with mobile satellites (2ECD-MS) is a model that Lan (2020) proposes. In this model, the locations of mobile satellites change according to the demands of customers in order to ensure the efficiency of delivery routes every day. Additionally, the study proposes a cluster-based variable neighborhood search scheduling algorithm to determine the locations of mobile satellites and the dispatch routes of trucks and tricycles.

Last-Mile Delivery

The term "last-mile delivery" refers to the final leg of a product's journey, which includes the transport of the product from a distribution center or warehouse to the doorstep of the consumer. Even though it is the most costly and time-consuming stage in the shipping process, this essential stage is crucial since it plays a significant role in determining the overall level of customer satisfaction (Alexandra, 2003). In the on-demand economy, it is crucial to effectively manage operational expenses in last-mile delivery and satellite depot management in order to maintain competitiveness and ensure customer satisfaction.

Effective management of last-mile delivery and satellite depots is the main factor that determines the effectiveness of the supply chain and logistics business, particularly in the context of e-commerce and the on-demand economy specifically. When it comes to satisfying the requirements of consumers, making the most of available resources, and ensuring sustainability, these components are absolutely necessary. Bruni et al. (2023) look into drone-assisted last-mile delivery with shared depot resources. They also come up with a mixed-integer program with linear restrictions to account for how tactical and operational plans affect each other. The ability to provide timely and efficient last-mile delivery has a direct impact on customer satisfaction, which in turn helps to develop brand loyalty in an environment that is extremely competitive. The pooling of orders is an essential source of efficiency, and efficient last-mile delivery methods include initiatives such as collaborative logistics, urban consolidation centers, and multimodal transport. Additional sources of efficiency include multimodal transport. Zhang (2022) suggests a paradigm for quantifying the efficiency loss that occurs in urban last-mile delivery systems. He also discovers that time frames have the potential to dramatically exacerbate the problem of efficiency loss. Lyons (2023), conducting a comprehensive assessment of the existing literature and identifying 22 different strategies, has examined urban consolidation centers, freight bicycles, and collaborative logistics as the most examined last-mile delivery solutions. Kou (2022) proposes a multimodal transport design to facilitate last-mile delivery in rural areas. The study realizes that multimodal transport has the potential to successfully minimize the distribution costs associated with last-mile delivery in rural areas.

Last-Mile Delivery and Warehouse Management in Malaysia

The on-demand economy has transformed last-mile delivery in Malaysia, leading to the expansion of on-demand delivery services that prioritize efficient last-mile delivery. The effective use of these services, which include efficient routing, real-time tracking, and extensive data analytics, helps to reduce the amount of time and resources required for delivery, hence improving the efficiency of the last mile. (TruxCargo, 2023). According to Luwjistik (2024), a few examples of companies in Malaysia that provide last-mile services include Pos Malaysia, GDEX, and City Link Express. Last-mile delivery has become an essential component of the logistics industry in Malaysia due to the surge of e-commerce entities. Projections indicate that Malaysia's e-commerce sales will grow from US$7.1 billion in 2021 to US$13.8 billion in 2025 (Kosmo, 2023).

Last-mile delivery services and satellite depots in Malaysia are now facing a variety of challenges, and satellite depots present a potentially useful solution to these problems. These smaller facilities serve as distribution points, which enables faster delivery and a more flexible customer experience due to their increased response. Companies have the ability to significantly reduce delivery times and improve customer satisfaction by pre-stocking high-demand commodities in satellite depots (Lark, 2023). This could result in a higher standard of satisfaction among customers.

According to the findings of several studies, the logistics and courier services business in Malaysia faces several potential opportunities and significant problems. There is a significant relationship between client preferences and factors such as cost optimization, service quality, express alternatives, and overall service excellence. One of the most important factors that customers consider when choosing a courier service is the pricing range that is offered by different firms. Haron (2023) emphasized crowd logistics as an innovative frontier in the Malaysian logistics business, highlighting its potential for improving efficiency and sustainability. The study also highlighted the point that crowd logistics represents new horizons.

However, the study indicated that there are issues in the management of resources, technology, and operations. In order to deliver effective solutions, it is necessary to make investments in technology and standardize processes. Zainuddin (2022) provided evidence that customer-related factors have a major impact on the effectiveness of last-mile delivery in Malaysia following the COVID-19 outbreak. This study underlines the significance of aspects such as meeting delivery time, delivery volume, effective route planning, and infrastructure in influencing the efficiency of logistics service providers (LSPs). Also included in this study is the importance of infrastructure.

Krishnan (2019) emphasizes that Malaysian warehouses recognize the importance of technology in determining their ability to adopt new smart warehouse technologies. He specifically pointed out that managerial influence and expenses are two of the most important variables. As an alternative, Vatumalae (2020) demonstrated increases in efficiency with the use of warehouse management systems, while Ghapar (2023) addressed operational difficulties through the implementation of real-time inventory management solutions. The study's findings recommend addressing these problems by implementing current software solutions and real-time inventory management systems. Rahman (2023) emphasized the importance of optimizing labor, equipment, and technological integration in order to increase operational efficiency in Malaysian warehouses. Collectively, these findings enhance our understanding of the sector's complexity, thereby offering valuable insights for strategic decision-making.

Conclusion

The on-demand economy has revolutionized the logistics industry, particularly in last-mile delivery and warehouse management. By leveraging technology and innovative strategies, businesses can optimize operations, enhance customer satisfaction, and gain a competitive edge. However, challenges such as cost optimization, service quality, and resource management still remain. The successful integration of technology, the strategic deployment of satellite depots, and the exploration of emerging concepts like crowd logistics are crucial for navigating the complexities of the on-demand economy. As e-commerce continues to grow, the logistics sector must adapt and evolve to meet the increasing demands of consumers while ensuring sustainability and profitability. Eventually, the future of logistics lies in its ability to balance efficiency, cost-effectiveness, and customer experience. By adopting a holistic approach that involves last-mile delivery, warehouse management, and technological advancements, the industry can unlock new opportunities and thrive in the dynamic on-demand landscape.

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THE PERCEPTIONS OF ARTIFICIAL INTELLIGENCE AMONG MATHEMATICS LECTURERS IN UiTM CAWANGAN PULAU PINANG

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ABSTRACT

This study explores the perceptions of artificial intelligence (AI) among mathematics lecturers at Universiti Teknologi MARA Cawangan Pulau Pinang (UiTMCPP). Given AI's potential to revolutionize education by enhancing teaching, learning, and administrative processes, understanding lecturers' viewpoints is crucial for effective integration. Data were collected through a structured questionnaire distributed to mathematics lecturers, focusing on their familiarity with AI, perceptions of its application in mathematics education, and its practical usage. The findings reveal that while most lecturers acknowledge the benefits of AI in providing personalized learning experiences and assisting with grading, there are concerns about data privacy, job security, and the effort required to learn AI technologies. Despite these concerns, most lecturers actively use AI tools, with ChatGPT being the most popular. The study underscores the importance of addressing these concerns to facilitate the successful adoption of AI in mathematics education.

Keywords: AI, Mathematics lecturers, education, perceptions

Introduction

Artificial intelligence (AI) has the potential to revolutionize industries and improve efficiency in various fields. It has the ability to automate tasks, analyse data at large scales, and make predictions based on patterns. AI can also enhance decision-making processes by providing valuable insights and recommendations. Its capabilities continue to progress, thus making it a valuable tool for those looking to stay competitive in the digital age.

Nowadays, AI has been widely integrated into education for its advantages and potential. The application of AI in education has evolved to various aspects, including AI tools designed to support learning and assessment, aid in teaching, and manage educational institutions. AI technologies in Science, Technology and Mathematics (STEM) education have transformed instructional and learning design processes, enhancing educational experiences (Xu & Ouyang, 2022). In addition, AI in education aims to improve student learning outcomes, support teachers, and provide personalized educational experiences (Alkan, 2024).

AI has been increasingly integrated into a lot of educational fields including mathematics. Studies have shown that utilizing Information and Communication Technology (ICT) tools in mathematics education can enhance practice problems and provide tailored feedback thus enable lecturers to monitor students' progress and address individual needs effectively (Katakara, 2024). Stefanova (2024) stated that AI systems in mathematics education are typically categorized into AI-based calculators and Intelligent Tutoring Systems (ITS). These systems aim to personalize learning experiences, adapt instruction to students' requirements, and enhance the quantitative competence of learners (Remoto, 2023).

In the context of mathematics education, the implementation of AI is another approach to improve teaching quality, effectiveness, and student outcomes. According to Imran (2023), the use of AI in mathematics education is perceived as a long-term investment that contributes to continuous improvement in educational quality for both lecturers and students. Although there are significant benefits to incorporating AI in mathematics education, there are also challenges such as the need for lecturers to adapt to modern teaching strategies that use AI techniques.

The perceptions of mathematic lecturers regarding artificial intelligence (AI) are essential for guiding the effective integration of AI technologies into mathematics education. While AI has the potential to revolutionize instructional methods and offer innovative educational tools, the specific viewpoints of mathematics lecturers on these technologies are not fully understood. Mathematics lecturers might have varying opinions on AI, with some perceiving it as a beneficial tool that can improve teaching and increase student engagement (Xie, 2023), while others may have concerns about its effectiveness, its potential to disrupt established teaching practices, or its impact on their professional responsibilities (Weidener & Fisher, 2023). Understanding these perceptions is essential for developing effective strategies for AI adoption and ensuring that AI tools are implemented in ways that align with lecturers' needs and expectations.

The aim of this study is to understand the adoption of AI among mathematics lecturers at Universiti Teknologi MARA Cawangan Pulau Pinang (UiTMCPP) through questionnaires. Next is to gain insight into the lecturer's perception of the utilisation of AI in education. This study will be beneficial to observe the usage of AI among mathematics lecturers and how they perceive the adoption of this new technology in education.

Methodology

The important part of this research is data collection. A set of questionnaires was adopted based on the research questions from Chounta et al., (2022). The questionnaire was distributed online by emailing all mathematic lecturers in the Department of Computer and Mathematical Sciences, UiTM Pulau Pinang.

The questionnaires were divided into four sections: respondents' demographic information, respondents' familiarity about AI, perceptions of AI in mathematics education and AI in practice among lecturers. The quantitative data were analysed to determine the frequencies and percentages.

Results and Discussion

Demographic

This research involved 16 mathematics lecturers in UiTMCPP who taught mathematics for diploma and degree levels. Table 1 illustrates that 37.5% are from the 30 – 39-year-old group, 43.8% from the 40 – 49-year-old group and lecturers aged 50 and above constitute the remaining 18.8%. Among the lecturers, 12 are females, and the remaining are males. In relation to teaching experience, most lecturers fall within the 11 – 20 years of teaching experience range, comprising 56.3%, while 25% have 5 – 10 years of teaching experience, 12.5% have more than 20 years of teaching experience, and only 6.3% have less than 5 years experience. Of the total respondents, 87.5% have a master's degree as their highest academic qualification, while only 12.5% have a PhD.

Table 1: Demographics profile

Details		Frequency
Age	Under 30	-
	30 -39	6
	40 – 49	7
	50 - 59	3
Gender	Male	4
	Female	12
Teaching experience	Less than 5 years	1
	5 – 10 years	4
	11 – 20 years	9
	More than 20 years	2
Highest degree obtained	Bachelor's Degree	-
	Master's Degree	14
	Doctor of Philosophy (PhD)	2

Perception of AI among mathematics lecturers

Three sections of the questionnaire regarding the perception of AI among mathematics lecturers were analysed.

Familiarity of AI

Two questions were asked in this section of the questionnaire.

1. What do you know about Artificial Intelligence?
2. 80% of the respondents know what AI is and another 20% have limited knowledge about AI.
3. Have you ever used an AI application?
4. All of the respondents answered "Yes".

Perceptions of AI in Mathematics Education

In this section, three questions were asked in the questionnaire. Respondents can select multiple choice as their answer.

Table 2: Statements about AI in mathematics education

Mark the statements you think are true about AI in mathematics education	
a. AI can enhance the teaching and learning of mathematics	100%
b. AI can assist in grading and providing feedback on student assignments	53.3%
c. AI can identify and address individual student learning needs	60%
d. AI poses a threat to the job security of mathematics lecturers.	20%

From Table 2, All respondents believe that AI can enhance the teaching and learning of mathematics. This unanimous agreement highlights the potential of AI to revolutionize educational practices by providing personalized learning experiences, adaptive learning platforms, and intelligent tutoring systems. A significant majority of respondents (53.3%) agree that AI can assist in grading and providing feedback on student assignments. AI-powered grading systems can save time for educators by automating the assessment process, ensuring consistency and objectivity. 60% of respondents believe that AI can identify and address individual student learning needs. Only 20% of respondents feel that AI poses a threat to the job security of mathematics lecturers. This lower percentage suggests that while there are some concerns about AI replacing human educators, the majority believe that AI will augment rather than replace their roles.

In our next step, we aimed to understand mathematics lecturers' views on using AI in education. To achieve this, we asked participants to identify the positive and negative aspects of integrating AI in education using multiple-choice inputs. The results can be found in Table 3. Additionally, we allowed them to provide their input.

Table 3: Participants' perceptions regarding positive and negative aspects of AI use in education

Positive aspects	**Negative aspects**
It could help me to save time when creating a time plan for my lesson (75%)	It would require effort to learn how to use it (31.3%)
It could help me to save time when looking for materials/content for my lesson (81.3%)	I'm scared it could take someone else's job (37.5%)
It could help me to save time when reviewing homework (75%)	I don't trust it to carry out tasks without error (75%)
It could help me make less errors (50%)	My work requires human involvement and i don't think AI can do what is needed (56.3%)
It could help me to create interactive and adaptive learning tools (6.3%)	I'm concerned about the privacy and data security issues (68.8%)
	Derivations done by AI must be double-checked (6.3%)
	AI may not provide the same personal interaction and empathy that human can offer (6.3%)

According to their responses regarding the positive aspects, participants stated that AI could save them time doing lecturers' tasks and also help them make fewer errors. Concerning the negative aspects of AI, even though they use AI, most of them (75%) do not trust AI to carry out tasks without error. The majority are also concerned about privacy and data security issues. From the findings, some participants (31.3%) also see the negative aspect of AI as it would require effort to learn how to use AI.

AI in Practice

Figure 1 shows that 75% of the participants have participated in professional development or training related to AI. According to their answer, most of the training or workshops they have participated in are general workshops about AI, such as "Introduction to ChatGPT" and "Applications of AI for research".

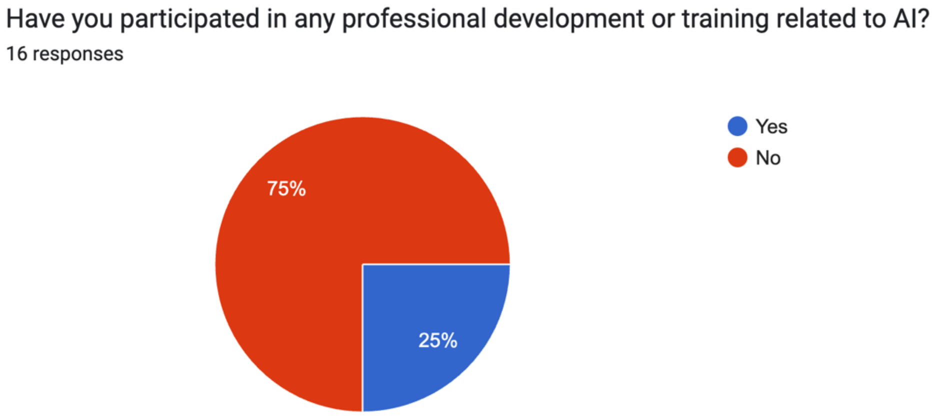

Figure 1. Pie chart of participants who participated in training related to AI.

Figure 2 shows that most participants use AI for administrative tasks. The majority also use AI to help them plan the lesson in terms of content (66.7%) and in terms of time (60%). This shows that the participants really use AI to assist their tasks in administration and teaching and learning.

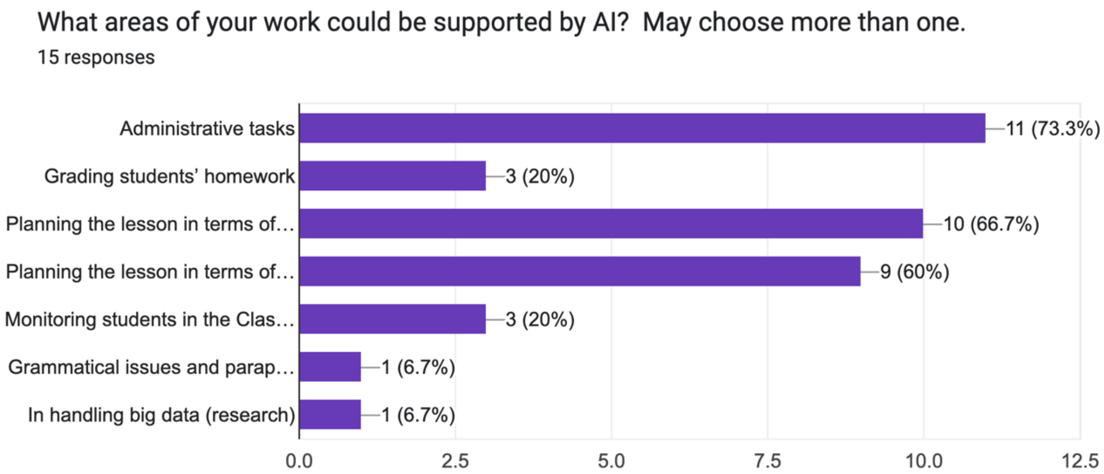

Figure 2. Areas supported by AI.

Figure 3 shows that only two mathematical applications have been used by the lecturers in their classrooms. 57.1% use GeoGebra while the other remaining use Wolfram Alpha. These two applications are the most popular among lecturers because they have been included in the syllabus.

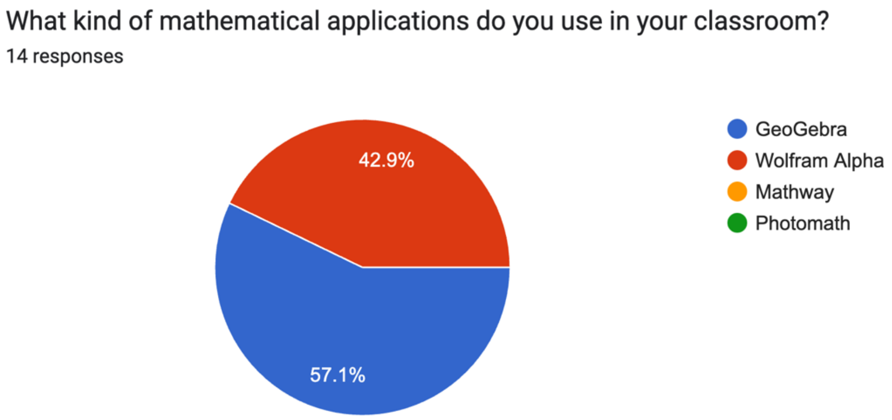

Figure 3. Mathematical applications use in the classroom

As expected, ChatGPT is the most popular AI program used by the lecturers (93.8%). The second most used is Co-pilot (43.8%) and the third is the Gemini by Google (12.5%). The last question in the questionnaire is whether the respondents subscribed to the premium version of the AI program they used. 87.5% do not subscribe to any premium version, while only 6.3% subscribed to the premium version, and another 6.3% are still considering subscribing. The lecturer who subscribed to the premium version paid RM200/year.

Conclusion

In conclusion, all mathematics lecturers in UiTMCPP use AI in their administrative work and lectures to enhance student learning and engagement. Integration of AI in mathematics education can improve teaching practices, personalize learning, and improve student outcomes. It is crucial for lecturers to adopt this technology to enhance the overall learning experience for students. Failing to do so may result in falling behind in providing students with the most effective and engaging educational opportunities. Lecturers and students may optimize the use of AI in teaching and learning by incorporating it in various educational activities and assessments.

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PERBANDINGAN PRESTASI PELAJAR SECARA BERSEMUKA DAN ATAS TALIAN BAGI TOPIK KEBARANGKALIAN

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ABSTRACT

Kajian ini bertujuan untuk menilai prestasi pelajar dalam pembelajaran topik taburan kebarangkalian melalui kaedah bersemuka dan atas talian. Ini kerana terdapat kebimbangan berkaitan prestasi pelajar yang belajar secara atas talian. Pelajar kurang memberi tumpuan ketika kelas berlangsung berbanding pembelajaran secara bersemuka. Analisa secara inferensi statistik iaitu ujian-t digunakan terhadap 54 sampel pelajar Kejuruteraan Mekanikal semester 1 (October 2023 hingga Februari 2024) iaitu secara bersemuka dan semester 2 (Mac hingga Ogos 2024) secara atas talian selama 3 bulan. Keputusan kajian menunjukkan bahawa tidak terdapat perbezaan yang ketara antara kedua-dua kaedah iaitu mencadangkan bahawa kedua-dua kaedah bersemuka dan atas talian adalah sama berkesan. Terdapat bebErapa sebab telah dikenalpasti termasuk kandungan pembelajaran yang konsisten, fleksibiliti dan aksesibiliti kepada sumber pembelajaran, serta penyesuaian pelajar dengan teknologi. Berdasarkan dapatan ini, beberapa langkah dicadangkan untuk terus meningkatkan prestasi pelajar dalam topik ini, termasuk peningkatan interaktiviti dalam pengajaran, penyediaan sokongan akademik tambahan, pemantauan dan maklum balas berterusan, serta penggunaan pendekatan berpusatkan pelajar. Dengan menggabungkan langkah-langkah ini, diharapkan prestasi pelajar dalam pembelajaran topik taburan kebarangkalian akan terus meningkat bagi memastikan keberkesanan yang konsisten terhadap kedua-dua kaedah pengajaran.

Keywords: taburan kebarangkalian, inferensi, ujian-t, atas talian, bersemuka

Pengenalan

Dalam statistik, taburan kebarangkalian adalah konsep penting untuk memahami bagaimana data atau kejadian tertentu berlaku dalam populasi. Tiga taburan kebarangkalian yang sering digunakan adalah binomial, Poisson, dan normal. Taburan binomial menggambarkan bilangan kejayaan dalam satu set percubaan bebas, taburan Poisson memodelkan kejadian yang jarang berlaku dalam selang masa tertentu, dan taburan normal menggambarkan data yang cenderung berkumpul di sekitar purata dengan bentuk loceng yang simetri. Pensampelan pula adalah proses memilih sebahagian kecil daripada populasi untuk membuat kesimpulan tentang keseluruhan populasi. Setiap taburan ini mempunyai ciri-ciri tersendiri dan digunakan dalam pelbagai situasi bergantung kepada sifat data yang dianalisis.

Taburan kebarangkalian juga adalah salah satu topik dalam kursus statistik yang wajib di pelajari dan lulus di kebanyakkan institusi pengajian tinggi. Di UiTM Permatang Pauh, pelajar dalam bidang kejuruteraan juga perlu mengambil kursus statistik sebagai asas kepada analisa data. Selaras dengan beberapa kajian yang telah diterokai iaitu yang berkaitan dengan pengajaran dan aplikasi taburan binomial dan Poisson dalam pendidikan kejuruteraan dan matematik sarjana muda. Capilla (2016) dan Malakar (2020) kedua-duanya membincangkan aspek teori dan praktikal pengagihan ini, dengan Capilla memfokuskan pada penggunaannya dalam latihan kawalan kualiti atribut dan Malakar memberikan gambaran keseluruhan yang lebih luas tentang aplikasinya dalam statistik. Fuad (2023) dan Fernández (2022) menyelidiki cabaran dan penyelesaian yang berpotensi dalam mengajar dan memahami pengagihan ini. Fuad (2023) menekankan kepentingan pemikiran kebarangkalian dalam menyelesaikan masalah taburan binomial, manakala Fernández (2022) menyerlahkan keperluan untuk pemahaman yang lebih mendalam tentang unsur sejarah dan epistemologi taburan binomial.

Namun, kebanyakkan pelajar merasa sukar untuk mempelajarinya dan terdapat banyak kesalahan mudah yang mereka lakukan. Pelbagai kajian juga telah dijalankan oleh ahli pengkaji bagi mengenal pasti salah tanggapan dan kesilapan biasa dalam pemahaman pelajar mengenai kebarangkalian. Huang (2021) dan Astuti (2020) kedua-duanya mengenal pasti kelaziman tinggi masalah salah faham dan kesilapan pengiraan, dengan Astuti turut menyatakan kesilapan dalam mentafsir soalan, membuktikan teorem, dan menggunakan peraturan Bayes. Yensy (2018) menyoroti lagi kesilapan dalam menggunakan data, konsep, dan pengiraan, yang sering disebabkan oleh kekurangan ketelitian dan pemahaman. Kajian-kajian ini secara kolektif menekankan keperluan intervensi yang disasarkan untuk menangani salah tanggapan dan kesilapan dalam pemahaman kebarangkalian.

Faktor lain yang mempengaruhi pemahaman dan prestasi pelajar dalam pembelajaran kebarangkalian juga telah dikaji. Raya (2020) mendapati bahawa pelajar lelaki cenderung menggunakan respons statistik dan pembentukan perwakilan dalam menyelesaikan masalah kebarangkalian, manakala pelajar perempuan menggunakan pelbagai strategi. Suwarto (2024) mengenal pasti korelasi antara sikap, kemahiran, dan refleksi pelajar terhadap pembelajaran kebarangkalian dan pemahaman mereka tentang konsep tersebut. Bagi Suwarto (2024) dan Gerald (2018) pula, mereka menekankan kepentingan sikap pelajar dan strategi pembelajaran dalam konteks pembelajaran kebarangkalian.

Selain itu, kaedah pembelajaran juga penting bagi menentukan prestasi pelajar. Pembelajaran secara bersemuka telah lama menjadi kaedah tradisional dalam sistem pendidikan. Kajian menunjukkan bahawa interaksi langsung antara pelajar dan pengajar dalam bilik darjah dapat meningkatkan pemahaman pelajar terhadap subjek yang diajarkan. Menurut Biggs dan Tang (2011), pembelajaran bersemuka membolehkan pengajar menggunakan pelbagai strategi pengajaran seperti demonstrasi langsung, diskusi kelas, dan sesi soal jawab yang memperkayakan proses pembelajaran. Selain itu, hubungan interpersonal yang terjalin dalam bilik darjah membantu meningkatkan motivasi dan komitmen pelajar terhadap pembelajaran mereka (Tinto, 1993). Pembelajaran atas talian pula telah berkembang pesat terutama dengan kemajuan teknologi dan keperluan pembelajaran jarak jauh. Kajian oleh Means et al. (2010) mendapati bahawa pembelajaran atas talian boleh sama efektif atau lebih efektif daripada pembelajaran bersemuka apabila dirancang dengan baik. Pembelajaran atas talian menawarkan fleksibiliti masa dan tempat, yang membolehkan pelajar belajar mengikut keselesaan mereka sendiri. Namun, kekurangan interaksi langsung dan sokongan segera dari pengajar boleh menjadi cabaran bagi sesetengah pelajar (Anderson, 2008). Beberapa kajian telah membandingkan prestasi pelajar dalam kedua-dua kaedah pembelajaran ini. Sebagai contoh, kajian oleh Xu dan Jaggars (2014) menunjukkan bahawa pelajar yang belajar secara bersemuka cenderung memperoleh markah yang lebih tinggi berbanding pelajar yang belajar secara atas talian. Namun, kajian lain oleh Bernard et al. (2014) mendapati bahawa perbezaan prestasi ini bergantung kepada subjek yang diajar dan cara kursus atas talian itu direka. Pembelajaran bersemuka memberikan lebih banyak peluang untuk interaksi langsung, bimbingan segera, dan pengalaman pembelajaran yang lebih kaya, manakala pembelajaran atas talian memerlukan pelajar lebih berdikari dan mempunyai kemahiran pengurusan masa yang baik.

Justeru itu, kajian ini dijalankan bagi melihat prestasi pelajar bagi dua kaedah pengajaran dan pembelajaran (PdP) iaitu secara bersemuka dengan atas talian. Kajian ini dijalankan kerana terdapat kebimbangan bahawa pelajar tidak dapat memahami keseluruhan topik tersebut kerana sikap dan strategi pembelajaran pelajar itu sendiri. Andaian pengkaji adalah pengajaran secara atas talian mungkin kurang efektif berbanding dengan pengajaran secara bersemuka, dan ini mungkin menyumbang kepada pencapaian yang lebih rendah dalam kalangan pelajar dengan kaedah PdP secara atas talian. Dengan membandingkan markah kuiz antara dua kumpulan pelajar ini, kajian ini bertujuan menentukan sama ada terdapat perbezaan signifikan dalam pencapaian mereka. Hasil kajian ini diharapkan dapat mencadangkan langkah-langkah untuk memperbaiki kaedah pengajaran, sama ada bersemuka atau atas talian, bagi memastikan pemahaman yang lebih baik dalam kalangan pelajar.

Metodologi

Kajian yang dijalankan melibatkan seramai 54 orang sampel pelajar yang mengambil kursus Statistik untuk kejuruteraan daripada Fakulti Kejuruteraan Mekanikal, UiTM Pulau Pinang. Seramai 27 orang pelajar daripada semester 1 (October 2023 hingga Februari 2024) mengikuti PdP secara bersemuka dan 27 orang pelajar daripada semester 2 (Mac hingga Ogos 2024) yang menjalankan PdP selama 3 bulan secara atas talian. Markah kuiz yang meliputi topik taburan kebarangkalian (binomial, Poisson, normal, dan persampelan) telah di analisa menggunakan inferensi Statistik. Ujian sampel tak bersandar atau ujian-t dan ujian Levene's telah dijalankan bagi melihat perbandingan min markah bagi kedua-dua semester. Ujian Levene's dijalankan terlebih dahulu bagi melihat kesamaan varians sebelum ujian-t dijalankan. Sekiranya nilai $p<\alpha=0.05$, maka H_o akan di tolak dan menunjukkan bahawa terdapat perbezaan yang signifikan. Berikut merupakan penyataan hipotesis yang digunakan untuk kedua-dua ujian tersebut:

Ujian Levene’s:

H_o: Variansi markah bagi kedua-dua semester adalah sama

H_1:Variansi markah bagi kedua-dua semester adalah tidak sama

Ujian-t:

H_o: Tiada perbezaan yang signifikan antara min markah bagi semester 1 dan semester 2

H_1: Terdapat perbezaan yang signifikan antara min markah bagi semester 1 dan semester 2

Analisa Data

Jadual 1 dibawah menunjukkan hasil daripada ujian Levene’s dan Ujian-t. Dapatan kajian menerangkan bahawa nilai p bagi ujian Levene’s adalah 0.892 (> α=0.05). Ini menunjukkan bahawa Ho tidak ditolak dan variasi markah bagi kedua-dua semester adalah sama. Oleh itu nilai p bagi ujian -t yang dikaji adalah 0.638 (>0.05). Maka Ho juga tidak ditolak dan ini menunjukkan bahawa tiada perbezaan yang signifikan antara min markah bagi semester 1 (secara bersemuka) dan semester 2 (atas talian).

Jadual 1: Ujian sampel tak bersandar

		Ujian Levene's Test untuk varians sama		**Ujian - t untuk kesamaan min**		
		F	**Sig.**	**t**	**df**	**Nilai signifikan**
Markah	**Varians sama**	0.019	0.892	-0.473	52	0.638
	Varians tidak sama			-0.473	51.86	0.638

Berdasarkan hasil yang diperolehi, prestasi pelajar yang belajar secara bersemuka dan atas talian adalah sama. Mereka dapat mempelajari topik statistik melalui kedua-dua kaedah. Ini berkemungkinan disebabkan oleh beberapa faktor iaitu kandungan yang konsisten, fleksibiliti dan aksesibiliti serta penyesuaian dengan teknologi. Kedua-dua kaedah menyediakan kandungan pembelajaran yang sama, dan pensyarah juga telah menggunakan bahan pengajaran yang serupa dalam kedua-dua platform. Pelajar juga mempunyai akses yang sama kepada sumber pembelajaran sama ada melalui kaedah bersemuka atau atas talian, yang membolehkan mereka belajar mengikut keselesaan dan keperluan masing-masing. Peningkatan penggunaan teknologi dalam pendidikan juga telah membolehkan kaedah atas talian menjadi lebih interaktif dan setara dengan pengalaman kelas bersemuka.

Walaubagaimanapun prestasi mereka masih dianggap kurang memuaskan kerana markah yang diperolehi adalah paling minimum. Keadaan ini berlaku mungkin disebabkan oleh faktor-faktor lain yang boleh diketengahkan lagi bagi meningkatkan prestasi pelajar dalam topik taburan kebarangkalian. Contohnya seperti kajian yang dijalankan oleh Suwarto(2024) iaitu menekankan keperluan strategi pengajaran berfokus untuk meningkatkan kemahiran menyelesaikan masalah kebarangkalian pelajar, dengan tumpuan khusus pada memahami bahan, melibatkan diri dalam aktiviti, menggunakan teknologi, mengambil bahagian dalam perbincangan, dan menerima maklum balas. Kajian Gerald (2018) pula menyokong bahawa pembelajaran koperatif boleh meningkatkan prestasi akademik dan sikap pelajar terhadap statistik, yang mungkin juga mempengaruhi pembelajaran kebarangkalian. Dapatan ini menggariskan kepentingan penglibatan pelajar dan pembelajaran kolaboratif dalam meningkatkan hasil pembelajaran topik taburan kebarangkalian.

Kesimpulan

Kesimpulannya, prestasi pelajar dalam pembelajaran topik taburan kebarangkalian tidak menunjukkan perbezaan yang ketara antara kaedah bersemuka dan atas talian. Keputusan kajian ini mencadangkan bahawa kedua-dua kaedah adalah sama berkesan dalam menyampaikan topik tersebut. Walaubagaimanapun, kedua-dua kaedah pembelajaran ini mempunyai kelebihan dan kekurangan masing-masing. Keberkesanan setiap kaedah bergantung kepada banyak faktor termasuk subjek yang diajar, reka bentuk kursus, dan profil pelajar. Beberapa langkah perlu diambil perhatian untuk terus meningkatkan prestasi pelajar dalam topik kebarangkalian. Antaranya adalah menggunakan alat pembelajaran interaktif seperti simulasi, permainan pendidikan, dan perisian analisis data untuk menjadikan pembelajaran lebih menarik dan mendalam. Menyediakan sesi sokongan tambahan, seperti bengkel, sesi ulang kaji, dan bimbingan peribadi untuk membantu pelajar yang menghadapi kesulitan. Mengambil kira keperluan dan gaya pembelajaran individu pelajar dalam merancang dan melaksanakan aktiviti pengajaran, sama ada bersemuka atau atas talian. Kajian lanjut dan pendekatan yang fleksibel mungkin diperlukan untuk menggabungkan elemen terbaik dari kedua-dua kaedah ini bagi meningkatkan prestasi pelajar secara keseluruhan.

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ERRORS IN HYPOTHESIS TESTING FOR MEAN AND VARIANCE

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ABSTRACT

This paper examines common errors encountered in hypothesis testing for mean and variance. Despite the foundational nature of these statistical methods, many practitioners and researchers frequently make errors that compromise the validity of their analyses. This study categorizes and elucidates typical mistakes, including misformulation of null and alternative hypotheses, inappropriate test selection, calculation errors, and misinterpretation of results. Additionally, the paper addresses specific issues that arise with small sample sizes, such as in the case of a study with 17 electrical engineering students, highlighting the common misuse of z-tests instead of t-tests and incorrect degrees of freedom calculations. The data used in this study is derived from assessments of students in class. Through detailed examples and corrective explanations, the paper aims to enhance understanding and application of hypothesis testing procedures. The findings underscore the importance of meticulousness in statistical testing to ensure reliable and accurate conclusions in research.

Keywords: hypothesis testing, mean, variance, null hypothesis, alternative hypothesis

Introduction

Hypothesis testing is a fundamental aspect of statistical analysis, crucial for making inferences about population parameters based on sample data. Despite its importance, errors in applying hypothesis testing methods are pervasive, often leading to incorrect conclusions and flawed research outcomes. This issue is particularly pronounced in the context of educational assessments, where the correct application of statistical tests is vital for evaluating student performance and educational interventions.

This paper focuses on the common errors made in hypothesis testing for mean and variance, using a case study of 17 electrical engineering students' class assessments. By identifying and analyzing these errors, this study aims to provide a comprehensive understanding of the pitfalls in hypothesis testing and offer practical solutions to avoid them. The findings are intended to aid researchers and practitioners in conducting more accurate and reliable statistical analyses, thereby improving the quality of their research and its implications.

For instance, Smith et al. (2015) found that a significant number of researchers misformulated null and alternative hypotheses, leading to incorrect conclusions. Similarly, Johnson and Wu (2017) identified the misuse of z-tests instead of t-tests, particularly in small sample sizes, as a prevalent issue. Nguyen and Thompson (2018) investigated the impact of data handling and test selection errors on the validity of conclusions drawn from educational assessments. They emphasized the importance of rigorous statistical procedures to ensure accurate interpretation of assessment data.

Patel and Rivera (2019) reviewed various errors in hypothesis testing methodologies, noting a prevalent issue of using inappropriate test statistics, such as z-tests instead of t-tests, particularly in studies with small sample sizes. Their study underscored the necessity for researchers to understand and apply correct statistical techniques to avoid misleading results.

Kim and Lee (2019) examined statistical errors commonly encountered in educational research, highlighting misinterpretations of statistical significance and errors in test selection. Their findings emphasized the need for improved statistical literacy among educators and researchers to enhance the reliability and validity of research findings. Brown et al. (2020) explored the misuse of statistical tests in studies with small sample sizes, identifying common pitfalls such as improper assumptions about data distribution and incorrect application of hypothesis testing procedures. Their research called for more robust statistical training and adherence to best practices in data analysis

Wilson and Martinez (2021) investigated errors in hypothesis testing among both students and educators, highlighting misunderstandings of statistical concepts and inadequate application of statistical tests. Their study emphasized the importance of enhancing statistical literacy and providing comprehensive training in statistical methods to improve research quality.

These studies collectively underscore the persistent challenges and errors in hypothesis testing for mean and variance, particularly in educational contexts. They highlight the critical need for researchers and educators to acquire robust statistical skills and apply correct methodologies to ensure accurate and meaningful interpretation of research findings. This literature review sets the stage for addressing these challenges and offers insights into improving the reliability and validity of statistical analyses in educational and research settings.

Methodology

The sample data for this research was collected from a cohort of 17 electrical engineering students. This study employs a descriptive observational research design to identify common errors made by students in hypothesis testing. The primary data source is the students' answers from a series of classroom assessments to evaluate their understanding and application of hypothesis testing concepts. These assessments included both theoretical questions and practical problems requiring students to perform hypothesis tests on given datasets.

The assessments covered various aspects of hypothesis testing, including formulating null and alternative hypotheses, selecting appropriate test statistics (e.g., z-test, t-test), calculating test statistics and p-values, determining critical values, making decisions based on test results (rejecting or failing to reject the null hypothesis), and interpreting the results in the context of the problem. Each student's assessment was carefully reviewed to identify errors at each step of the hypothesis testing process. The errors were categorized and recorded systematically into main categories, such as misformulation of null and alternative hypotheses, inappropriate selection of test statistics, incorrect calculation of test statistics and p-values, incorrect determination of critical values, misinterpretation of test results, and overall misunderstanding of hypothesis testing concepts. The frequency and nature of errors were analyzed to determine the most common mistakes made by students. The analysis focused on identifying patterns and recurring issues that could be addressed through targeted educational interventions. The findings were documented to provide a clear understanding of the specific areas where students struggle with hypothesis testing. Recommendations for improving instruction and assessment techniques were proposed based on the observed errors.

The primary objective of this methodology is to systematically identify and analyze the common errors made by electrical engineering students in hypothesis testing for mean and variance. By understanding these errors, educators can develop more effective teaching strategies to enhance students' comprehension and application of statistical methods. This study is limited to a small sample size of 17 students from a single academic program, which may not represent the broader student population. Additionally, the observational nature of the research means that it relies on the accuracy and completeness of the classroom assessments. Further studies with more diverse samples are recommended to validate the findings and extend their generalizability.

Result and Discussion

The analysis of the classroom assessments from the 17 electrical engineering students revealed several common errors in hypothesis testing for mean and variance. These errors were categorized and discussed as follows:

1. Misformulation of Null and Alternative Hypotheses

A significant number of students (65%) incorrectly formulated the null and alternative hypotheses. This error often stemmed from a misunderstanding of the problem context and the hypotheses' roles in hypothesis testing. For example, students frequently reversed the null and alternative hypotheses, leading to incorrect conclusions.

2. Inappropriate Selection of Test Statistics

Around 70% of the students incorrectly selected the test statistic. Many students used z-tests instead of t-tests, particularly in cases with small sample sizes. This error indicates a lack of understanding of when to apply each test, which is crucial for accurate hypothesis testing. Some students use the t-test instead of hypothesis testing for variance when they should use the chi-square for one variance and the F distribution for two variances.

3. Incorrect Calculation of Test Statistics

Approximately 55% of the students made errors in calculating the test statistics. These calculation errors often resulted from arithmetic mistakes or incorrect use of statistical formulas. Such errors directly affect the accuracy of the hypothesis test results.

4. Incorrect Determination of Critical Values

About 50% of the students incorrectly determined the critical values, which are essential for decision-making in hypothesis testing. This error often occurs due to misreading statistical tables or misunderstanding the significance level and degrees of freedom.

5. Misinterpretation of Test Results

A notable 60% of students misinterpreted the results of their hypothesis tests. Even when the calculations were correct, many students incorrectly concluded whether to reject or fail to reject the null hypothesis. This misinterpretation highlights the importance of proper training in understanding and explaining statistical results.

6. Overall Misunderstanding of Hypothesis Testing Concepts

Overall, 75% of the students demonstrated a general misunderstanding of hypothesis testing concepts. This was evident in their inability to correctly follow the steps of hypothesis testing consistently. These misunderstandings underscore the need for more comprehensive instruction on the fundamental principles of hypothesis testing.

The results of this study highlight several critical areas where electrical engineering students commonly make errors in hypothesis testing. The high frequency of misformulated hypotheses, inappropriate test selection, and calculation mistakes indicate a need for improved educational strategies. Firstly, educators should emphasize the importance of correctly formulating null and alternative hypotheses, as this step is foundational to hypothesis testing. Interactive problem-solving sessions and clear, context-based examples can help students better understand this concept. Secondly, proper selection of test statistics should be reinforced through practice problems that differentiate between scenarios requiring z-tests and t-tests. Providing students with a decision-making framework or flowchart could aid in this understanding.

Thirdly, calculation errors can be mitigated by encouraging students to double-check their work and by providing more practice with statistical formulas. Introducing tools and software for statistical calculations might also help students avoid arithmetic mistakes. Furthermore, accurate determination of critical values can be improved through better instruction on using statistical tables and understanding significance levels and degrees of freedom. Practice exercises focused specifically on this step can help solidify students' skills.

Lastly, improving students' overall understanding of hypothesis testing concepts requires a comprehensive approach. Incorporating more detailed explanations, hands-on activities, and real-world examples into the curriculum can help students grasp the full process of hypothesis testing. In conclusion, addressing these common errors through targeted educational interventions can significantly enhance students' competency in hypothesis testing.

Conclusion

This study has identified and analyzed common errors made by electrical engineering students in hypothesis testing for mean and variance. The results indicate that students frequently misformulate null and alternative hypotheses, select inappropriate test statistics, make calculation errors, incorrectly determine critical values, and misinterpret test results. These errors stem from a general misunderstanding of hypothesis testing concepts and highlight the need for improved educational strategies. To address these issues, educators need to emphasize the correct formulation of hypotheses, the appropriate selection of test statistics, and the accurate calculation of test statistics and p-values. Providing clear, context-based examples and interactive problem-solving sessions can help students better understand these concepts. Additionally, incorporating practice exercises and real-world examples into the curriculum can enhance students' overall competency in hypothesis testing. By addressing these common errors through targeted educational interventions, we can significantly improve students' understanding and application of statistical methods. This, in turn, will lead to more accurate and reliable statistical analyses in their future academic, ultimately contributing to the quality and validity of research in various fields.

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CHAIN RULE ERRORS IN COMPOSITE FUNCTION DIFFERENTIATION

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ABSTRACT

Examining mathematical errors in the application of the chain rule highlights specific areas of student difficulty, such as improper differentiation of composite functions and inconsistent application of the rule. This study investigates the common errors students make in applying the chain rule in calculus. Using a sample of 22 students, the researcher employs an observation to explore the mistakes observed in classroom assessments. The findings reveal that a significant number of students continue to make fundamental errors when performing chain rule calculations. These errors include misidentifying the outer and inner functions, incorrect differentiation of these functions, and mishandling the multiplication of derivatives. The study highlights the need for targeted instructional strategies to address these misconceptions and improve students' proficiency in applying the chain rule. Recommendations for teaching practices and further research are also discussed to mitigate these persistent issues.

Keywords: errors, chain rule, calculus, descriptive analysis, misconceptions

Introduction

The chain rule is a fundamental concept in calculus, used to find the derivative of a composition of functions. Despite its importance, many students and professionals often encounter difficulties and errors when applying this rule. Understanding the types of errors and their sources is crucial for improving mathematical instruction and learning outcomes. Over the past few years, research has focused on identifying common mistakes and misconceptions associated with the chain rule. For example, studies have highlighted that students frequently struggle with recognizing when to apply the chain rule and how to decompose a composite function into its constituent parts correctly. These errors can stem from a lack of conceptual understanding or procedural knowledge, indicating a need for better instructional strategies and tools. In 2019, a study by Tall and Watson explored how cognitive load impacts students' ability to apply the chain rule correctly. They found that high cognitive load can lead to increased errors, suggesting that instructional methods should aim to reduce unnecessary complexity when teaching the chain rule (Tall & Watson, 2019).

Subsequent research by Martinez and Torres (2020) examined the effectiveness of visual aids in teaching the chain rule. Their findings indicated that students who used visual representations, such as function diagrams, made fewer errors compared to those who relied solely on algebraic manipulation.

This highlights the potential benefits of incorporating diverse teaching methods to enhance comprehension (Martinez & Torres, 2020). Further investigations by Nguyen and Park (2021) identified students' misconceptions about the chain rule. They found that many students mistakenly believe that the chain rule is a simple multiplication of derivatives without understanding the need for function composition. This study underscores the importance of addressing fundamental misconceptions in mathematical education (Nguyen & Park, 2021).

A more recent study by Smith and Lee (2022) analysed the impact of digital tools on learning the chain rule. They discovered that interactive software and online resources can significantly reduce errors by providing immediate feedback and allowing students to practice independently. This research suggests that integrating technology into the curriculum could improve mathematical proficiency (Smith & Lee, 2022).

Additionally, Brown and Evans (2021) conducted a meta-analysis of various teaching interventions aimed at reducing errors in calculus. The study synthesizes data from multiple sources to evaluate the effectiveness of different instructional strategies, focusing on both conceptual understanding and procedural proficiency. Key findings suggest that targeted interventions, including explicit instruction, formative assessment, and feedback mechanisms, significantly improve student performance and reduce errors in calculus applications. They concluded that a combination of visual, interactive, and traditional teaching methods was the most effective in minimizing mistakes and enhancing students' understanding of the chain rule.

Chen and Liu (2021) advocate for the use of visual aids, such as function trees and diagrams, to help students better understand the relationship between outer and inner functions. By visually mapping out the differentiation process, students can more easily grasp the need to differentiate each component correctly. Additionally, the study highlights the importance of fostering a deep conceptual understanding of why the chain rule works, rather than just memorizing steps.

Johnson and Taylor (2023) suggest incorporating active learning techniques, such as group problem-solving and peer teaching, to engage students in learning. These methods encourage students to articulate their understanding and correct each other’s mistakes, leading to a deeper comprehension of the chain rule. They also recommend providing timely and specific feedback on assignments and quizzes to address errors promptly and guide students toward the correct methods.

Overall, these studies highlight the persistent challenges students face when learning the chain rule and suggest various strategies for mitigating these difficulties. By understanding the sources of errors and implementing targeted instructional techniques, educators can enhance students' comprehension and application of this essential mathematical concept. Future research should continue to explore innovative teaching methods and tools to further reduce errors and improve learning outcomes in calculus.

Methodology

There were 22 students involved in this study in all. It focuses on students' frequent mathematical errors on assessment (tests). Students were required to answer five questions. According to the observation of each question, the chain rule is one of the topics that obtained a higher mathematical error. Among the mistakes in solving the chain rule discussed in this study are improper differentiation of composite functions., inconsistency in applying the chain rule, and mishandling the multiplication of derivatives.

Here are some of the chain rule questions that have been tested on assessment to the students:

1. $\frac{d}{dx} sin3$x
2. $\frac{d}{dy} cos3y$
3. $\frac{d}{dx} e^{2x}$
4. $\frac{d}{dt} \sqrt{1-t}$

This question will help the researcher identify common mistakes students make when solving the chain rule.

Result and Discussion

Based on observation, most students make mistakes when solving the differentiation of composite functions. Differentiating composite functions is a fundamental skill in calculus, crucial for accurately solving problems in various fields of science and engineering. However, improper application of the chain rule, essential for differentiating composite functions, often leads to significant errors. In the questions tested on the students, it was found that 3 types of composite functions usually make mistakes, namely Trigonometric Composite Function, Exponential Composite Function, and Polynomial Composite Function.

Table 1 shows the trigonometric error of the composite function. When differentiating sin[g(x)] the chain rule requires that you first take the derivative of sin (which is cos) and then multiply it by the derivative of the inner function g(x). The derivative of cos x is - sin x. When dealing with composite functions, this negative sign must be included and multiplied by the inner function's derivative.

Table 1: Trigonometric Composite Function

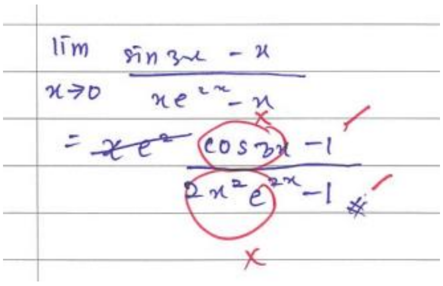
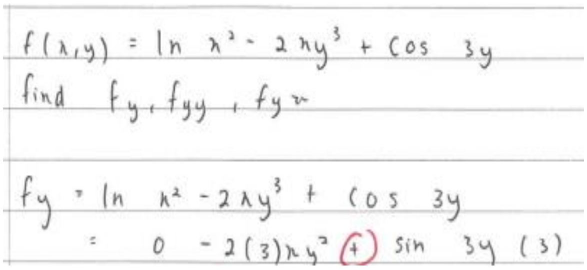
Common Errors	Correct approached
1. Forgetting to apply the chain rule to the inner function 	$\frac{d}{dx}sin3x = cos3x\left(\frac{d}{dx}3x\right) = 3cos3x$
2. Mistaking the derivative of cos x and sin x and vice versa. 	$\frac{d}{dy}cos3y = -sin3y\left(\frac{d}{dy}3y\right)$ $= -3sin3y$

Table 2 shows the error of the exponential composite function. For $e^{g(x)}$, the derivative involves $e^{g(x)}$ itself multiplied by the derivative of the exponent g(x). When differentiating an exponential function like $e^{g(x)}$, students sometimes forget to apply the chain rule to the inner function g(x). They might incorrectly think that the derivative is $e^{g(x)}$.

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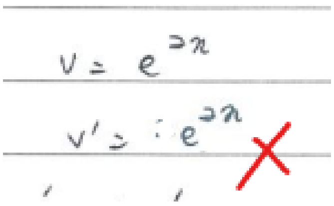
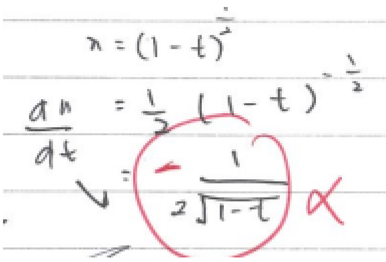
Table 2: Exponential Composite Function

Common Errors	Correct approached
1. Neglecting to multiply by the derivative of the exponent. 	$\frac{d}{dx}e^{2x} = e^{2x}\left(\frac{d}{dx}2x\right) = 2e^{2x}$

Based on Table 3, mistakes are also often made for the Polynomial Composite Function. When differentiating $[g(x)]^n$, apply the power rule and then multiply by the derivative of the inner function g(x). When dealing with composite polynomials, students might differentiate each term without considering the chain rule for inner functions. For example, in a function like $(3x^2 + 1)^5$, they might ignore the inner polynomial $3x^2 + 1$.

Table 3: Polynomial Composite Function

Common Errors	Correct approached
1. Incorrectly applying power rule without considering the inner function. 	$\frac{d}{dt}\sqrt{1-t} = \frac{d}{dt}(1-t)^{\frac{1}{2}}$ $= \frac{1}{2}(1-t)^{-\frac{1}{2}}\left(\frac{d}{dt}(1-t)\right)$ $= -\frac{1}{2\sqrt{1-t}}$

Conclusion

The recurring errors in applying the chain rule to composite functions highlight a need for improved instructional strategies. By addressing these errors through structured practice, visual aids, and active learning techniques, students can develop a stronger grasp of the chain rule. Understanding and implementing the chain rule is crucial for determining composite functions. Common errors, such as neglecting the derivative of the inner function, can be mitigated through targeted practice and reinforcement of concepts. Implementing the suggested solutions can enhance students' comprehension and application of the chain rule, leading to better outcomes in calculus. Educators can better prepare students to tackle complex differentiation problems by focusing on these common issues and their solutions, strengthening their overall mathematical proficiency.

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THE IMPACT OF TECHNOLOGY ON NOTE TAKING: A REVIEW

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ABSTRACT

This research explores the transformative effects of technology on note-taking methods. It investigates the transition from traditional pen-and-paper procedures to the inclusion of digital tools such as laptops, tablets, and smartphones. The advantages of technological note-taking, including increased efficiency, organization, accessibility, and multimedia integration, are discussed. Conversely, challenges such as distractions, potential impacts on learning and retention, dependency on technology, and privacy concerns are highlighted. The future of note-taking is discussed, taking into account rising technologies like AI and the significance of balancing traditional and digital ways. The study continues by emphasising the importance of critically evaluating technology's role in improving learning and productivity while minimising potential disadvantages.

Keywords: note-taking, technology, digital tools, challenges, benefits

Introduction

For centuries, pen and paper have been the primary tools for capturing information and ideas. However, the advent of technology has revolutionized the way we take notes. Laptops, tablets, and smartphones have become indispensable companions, offering a myriad of digital tools for recording, organizing, and accessing information. Learning methodologies have evolved over the decades, with many students and teachers swapping their notebooks and pens for tools such as laptops, mobile devices, and software applications (EdTech, 2018). This change to digital note-taking has definitely transformed the process, providing both important benefits and concerns, which will be discussed in this article.

Note-taking methods have evolved along technology throughout the years. Handwritten notes were augmented, if not replaced, by word processing software, personal digital assistants, digital notebooks, note-taking apps, audio recorders, voice-to-text systems, and other technologies. However, not all these pen-and-paper alternatives, especially computers, are seen as highly advantageous. The digital age ushered in word processors, transforming written documents into editable files (Bouchrika,2024). Subsequently, dedicated note-taking apps emerged, offering specialized tools for capturing, organizing, and searching information. Note-taking has been further enhanced by the incorporation of cloud synchronisation and storage, which allows for easy access and collaboration across various devices. Findings, however, indicate that while gadgets like laptops might help students take better notes, they might also reduce the effectiveness of their education (Stacy & Cain, 2015).

The Evolution of Note-Taking

Since we were born and raised in the era of digital technology, we have witnessed a great deal of change in the world, including how children choose to learn in the classroom. Although it looks like an increasing number of students are choosing to take their notes on a laptop, tablet, or smartphone, it also seems like an equal number of students are sticking with the more conventional method of taking notes with a pen and paper (Berkovatz & Guzman, 2011).

Advantages of Technological Note-Taking

According to Beck (2014), taking notes with technology greatly increases speed and efficiency. Quick notes can be taken, frequently using real-time transcription, and it's simple to look for specific information in these digital documents. Claassen (2023) in his article, discovered that, organizing notes becomes a breeze with features like tagging and searching, ensuring easy accessibility. Collaboration is also streamlined, allowing multiple individuals to work on a single document simultaneously and provide real-time feedback. Multimedia integration is frequently supported by digital note-taking platforms, allowing users to add images, videos, and audio for a more engaging educational experience. Finally, because digital notes are available from any device with an internet connection, their portability and accessibility are unmatched.

Challenges of Technological Note-Taking

While technological note-taking offers numerous benefits, it also presents several challenges. Distractions from social media and other applications can hinder focus and productivity. According to Ronningsbakk (2022), the shift from handwriting to typing may impact learning and retention, as some studies suggest handwriting reinforces information processing. Dependence excessively on devices and internet connectivity can expose vulnerabilities, especially when access is limited. Furthermore, cloud storage raises privacy concerns because sensitive information may be vulnerable to unauthorized access or breaches.

The Future of Note Taking

Future developments in note-taking are expected due to the introduction of innovative technologies like augmented reality, virtual reality, and AI-powered note-taking. These developments could completely alter the way that we gather, arrange, and use information (Saini, et.al.,2023). However, it's essential to strike a balance between technological advancements and traditional methods, as hybrid approaches may offer optimal learning and information retention. The way that note-taking is used in the digital age will change significantly, with consequences for work, education, and personal life. To fully utilise this crucial talent, one must be adaptable and a critical thinker. (Stacy & Cain, 2015).

The Impact of Technology on Student Learning and Academic Performance

Technology has had a dramatic impact on the educational landscape, affecting how students learn and how academic performance is evaluated. On the one hand, it provides unprecedented access to information, encouraging autonomous learning and critical thinking. According to Rafique (2022), digital tools and platforms have the potential to improve engagement by offering interactive and multimedia learning experiences that accommodate a variety of learning styles. Moreover, technology facilitates collaboration, enabling students to work together on projects and share knowledge, thus developing essential 21st-century skills.

On the other hand, too much screen time and technological distractions can make it difficult to concentrate and be productive (Nakshine, et.al.,2022). Unequal access to technology, known as the "digital divide," can make educational gaps worse. Furthermore, critical thinking abilities are necessary for the validity and dependability of online material, and not every student fully possess these abilities. Optimising student learning and academic achievement has the potential to have undesirable consequences.

The Role of AI in Education

Artificial intelligence (AI) is changing education quickly and presents both benefits and difficulties (Almasri, 2024). AI-powered technologies can personalise learning experiences by adapting to each student's needs and speed. Intelligent tutoring systems can provide tailored instruction, while automated grading can free up teachers' time for more in-depth student interactions. Khan et. al (2023) find that AI also capable of analysing enormous volumes of data to spot trends in student performance, which aids educators in anticipating and addressing possible learning challenges. Educators can equip students for an era driven by artificial intelligence (AI) by emphasising the development of critical thinking, creativity, and problem-solving abilities. They should also make sure that technology supports education rather than interferes with it.

The Impact of Technology on Higher Education

Technology has significantly altered the environment of higher education. Online learning platforms, digital libraries, and virtual classrooms have made education more accessible to a global audience. Students can now pursue degrees and certifications flexibly, accommodating diverse learning styles and schedules. Technology also improves research capacity by allowing academics and students to work together on challenging topics and access enormous volumes of data (Balalle,2024). However, challenges persist. The digital divide can create inequities, with students from disadvantaged backgrounds facing barriers to accessing technology and online resources.

The quality of online education varies widely, raising concerns about the overall value of online degrees. Furthermore, an excessive dependence on technology might impede the growth of crucial soft skills like critical thinking and communication.

The Challenges of the Digital Divide in Higher Education

The digital divide, the gap between those with access to technology and those without, is a significant challenge in higher education. Students from disadvantaged socioeconomic backgrounds often lack the necessary devices, internet connectivity, or digital literacy skills to fully participate in online learning. This inequity can lead to academic disparities, as students without adequate technology resources may struggle to keep up with coursework, access online resources, and collaborate with peers.

Moreover, the digital divide can also impact students' mental health and well-being. Isolation from peers and limited access to social and academic support networks can exacerbate feelings of loneliness and stress. To address the digital divide, institutions must provide equitable access to technology, offer digital literacy training, and develop hybrid learning models that accommodate students with varying levels of technological proficiency.

Conclusion

The world of taking notes has changed dramatically because of technology. Even if pen and paper methods are still useful, digital tools have significantly increased efficiency and opened new possibilities. Technology has made note-taking a dynamic and flexible process, from quick information organization and capture to easy accessibility and interaction with other digital resources. But switching to digital note-taking comes with drawbacks as well, such as dependence on technology, eye strain, and possible distractions. A balanced strategy that combines digital and traditional methods is frequently advised in order to optimize the advantages of digital note-taking while minimizing its disadvantages.
The best way to take notes ultimately depends on personal tastes, preferred methods of learning, and the specific task at hand. Technology will probably become more and more important in determining how people take notes and study in the future.

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INVESTIGATING THE CORRELATION BETWEEN MOOC PARTICIPATION IN FURTHER DIFFERENTIAL EQUATIONS AND STUDENTS' FINAL GRADES

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ABSTRACT

The increasing prevalence of Massive Open Online Courses (MOOCs) in higher education makes it crucial to understand their impact on students' academic performance. This study examines the relationship between participation in MOOCs on Further Differential Equations and students' final grades across several semesters. Focusing on undergraduate engineering students enrolled in the Further Differential Equations (MAT480) course as part of the Civil Engineering degree program at UiTM Cawangan Pulau Pinang, data were collected from the academic years 2023 and 2024. The comparison was made between students who completed the MOOC and those who did not, as well as between students who passed or failed their final exams. The results show a Pearson's correlation coefficient of 0.998, indicating a very strong positive correlation between MOOC completion and higher passing rates. This suggests that students who complete more MOOCs tend to have higher passing rates in their final grades. However, more research is needed to understand other factors affecting student success.

Keywords: MOOCs, academic performance, Further Differential Equations, civil engineering education, undergraduate students.

Introduction

In recent years, MOOCs have gained significant traction in higher education as a flexible and accessible method for students to enhance their learning. MOOCs also have become more popular worldwide especially after the outbreak of COVID-19 (Liu et al., 2021; Alamri 2022). Many researchers believe that MOOCs are important in educating more people (Gallego-Romero et al, 2020). These courses provide valuable opportunities for students to gain knowledge beyond the traditional classroom setting, offering a range of subjects, including advanced topics like Further Differential Equations. This study focuses on understanding the impact of MOOC on academic performance, specifically examining its influence on students enrolled in the MAT480 course as part of the Civil Engineering degree program at UiTM Cawangan Pulau Pinang.

Differential equations are a critical component of engineering education, forming the foundation for various applications in civil engineering and related fields. Mastering these concepts are essential for students to succeed in this course and future professional practice. Despite the potential benefits of MOOCs in supplementing traditional learning, the relationship between MOOC's participation and student outcomes remains underexplored. This study aims to fill this gap by investigating whether participation in Further Differential Equations MOOC positively correlates with students' final grades.

The increasing integration of online learning platforms in academia necessitates a thorough understanding of their effectiveness. Previous research has highlighted mixed outcomes regarding the impact of MOOCs on students' performances, with some studies indicated improvements in grades and others showed negligible effects. By analyzing data from semesters spanning from 2023 to 2024, this study seeks to provide empirical evidence on the relationship between MOOC's participation and academic success, thereby offering insights into how online education can be leveraged to enhance learning outcomes in engineering programs.

Understanding the effectiveness of MOOCs in this context is crucial for educators and institutions that aim to optimize educational strategies and support student success. This research will contribute to the broader discussion on online education's role in higher learning and provide actionable recommendations for integrating MOOCs into engineering curricula.

Literature Review

MOOCs have revolutionized higher education by providing accessible, flexible learning opportunities to students worldwide. Compared to traditional classroom teaching, MOOCs provide "any-time" learning and the potential to enrol diverse groups of international learners (Lazarus and Suryasen, 2022). Furthermore, MOOCs provide a diverse array of subjects and frequently serve as a supplement to traditional classroom instruction. MOOCs expand educational access, encourage lifelong learning, and equip learners to adapt to technological advancements (Rulinawaty, et al., 2023). It has been praised for their potential to democratize education and offer supplementary learning resources (Yuan & Powell, 2013). However, their effectiveness in improving academic performance remains a subject of ongoing research.

MOOCs have had varying effects on students' academic performance. Several studies suggest that MOOCs can positively influence learning outcomes by providing additional resources and practice opportunities. High-quality, well-structured online content is essential for student satisfaction. When students are satisfied with the content, they are more likely to engage deeply with the material, leading to better academic outcomes (Taip, et al., 2023). In addition, a study by Kizilcec et al. (2013) found that students who engaged with supplementary online resources demonstrated improved performance in their traditional courses. Similarly, a study by Chen et al. (2018) reported that students who completed MOOCs scored higher grades in related subjects, indicating a positive correlation between MOOC participation and academic success. According to Pérez-Sanagustín et al. (2021), students who obtained moderate grade point averages (GPAs) demonstrated greater engagement with the course curriculum in comparison to those who had relatively high or low GPAs. Thai, et al. (2020) stated that there is a significantly positive impact on learning performance when studying in a flipped classroom (FC) and blended learning (BL) environment compared to face-to-face learning (F2F) or fully e-learning (EL). However, in a study conducted in a business school in northern India, there is a significant number of candidates dropped out of these MOOC courses due to various barriers, such as usage barriers, value barriers, tradition barriers, and image barriers (Dang, et al., 2022).

While there is substantial literature on MOOCs and their general impact on education, there is limited research specifically focus on the correlation between MOOC participation and final grades in specialized courses like Further Differential Equations. Existing studies often address MOOCs' broader impacts without delving into specific subject areas. This study aims to address this gap by investigating the relationship between MOOC participation and final grades in the MAT480 course, providing valuable insights for educators and institutions seeking to enhance educational outcomes through online learning resources.

Methodology

This study employs a quantitative research design to investigate the relationship between participation in the Further Differential Equations MOOC and students' final grades. This research focused on undergraduate students enrolled in the MAT480 course under the Civil Engineering degree program at UiTM Cawangan Pulau Pinang. Data from academic records for the years 2023 and 2024 were analyzed in this study.

This study included all students who were enrolled in the course and had the opportunity to participate in the associated MOOC. The samples consist of students who completed the MOOC and those who did not, providing a comprehensive view of the impact of MOOC participation on academic performance. Correlation analysis was conducted to assess the relationship between MOOC completion and final grades. This includes calculating Pearson's correlation coefficient to determine the strength and direction of the relationship.

Several limitations are acknowledged in this study, such as other external factors influencing academic performance, such as teaching quality and student engagement. These factors were not included in this study and the findings are specific to the MAT480 course and may not be generalizable to other courses or institutions.

Results

Data collected from undergraduate students enrolled in the MAT480 course during the academic years 2023 and 2024 were analysed. Table 1 shows the participation in the Further Differential Equations MOOC and students' final grades. Pearson's correlation coefficient was calculated to assess the relationship between MOOC completion and final grades. The Pearson's correlation coefficient value of 0.998 indicates a very strong positive correlation between the number of completed MOOC and the number of students who passed the MAT480 course. This suggests that students who completed more MOOCs tend to achieve higher passing rates in their final grades.

Table 1: Participation In MOOCs on Further Differential Equations and Students' Final Grades

	MOOC				Final Grade			
	Completed		Uncompleted		Passed		Failed	
Semester	Number of students	%	Number of students	%	Number of students	%	Number of students	%
20232	114	89	14	11	124	95	6	5
20234	17	89	2	11	18	86	3	14
20242	106	90	12	10	109	90	12	10

Figure 1 shows the scatter plot of the relationship between the percentage of students who completed the MOOC and the percentage of students who passed the final examinations. The completion rates for this MOOC are very high (around 89-90%) and the passing rates are also high (86-95%) throughout the three semesters. This suggests a strong commitment to completing MOOC and a high success rate in final grades. The percentages of students who completed the MOOC and passed students are quite consistent across the semesters, indicating a stable pattern in both MOOC completion and academic performance.

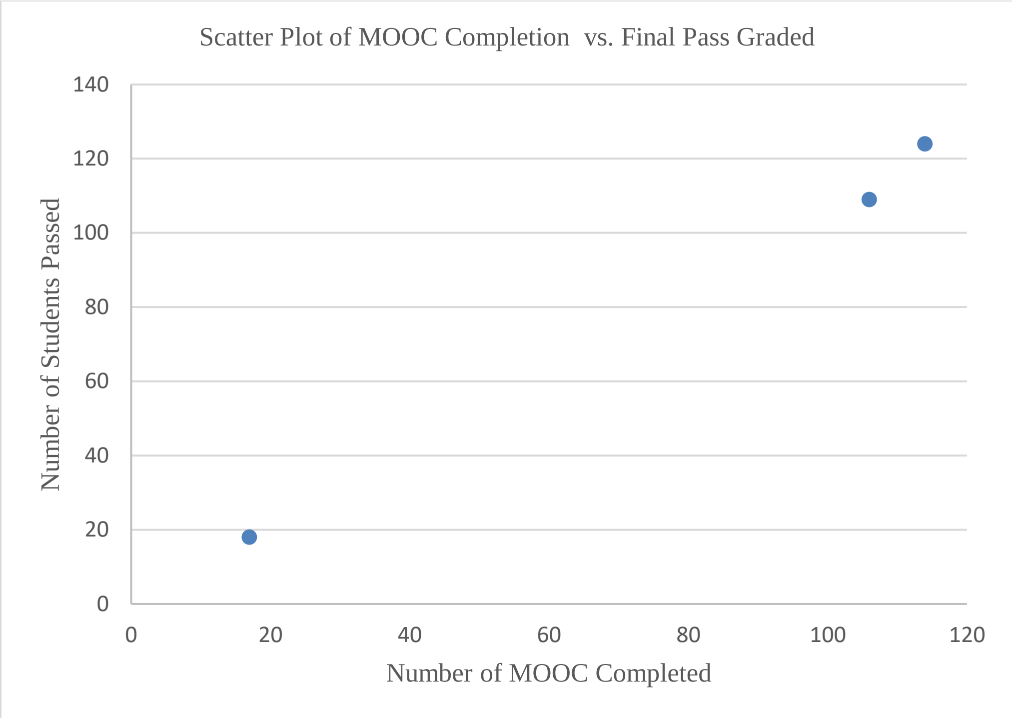

Figure 1: The relationship between the number of students who completed the MOOC and the number of students who passed the final examinations

Discussion

Across three semesters, both MOOC completion rates and passing rates were consistently high, with completion rates around 89-90% and passing rates between 86-95%. This consistency indicates a strong commitment to complete MOOCs and correspond to high success rate in final grades (Taip, et al., 2023). The strong positive correlation observed suggests that the Further Differential Equations MOOC can enhance students' understanding of the subject, potentially leading to improved academic outcomes. This finding aligns with previous research indicating that supplementary online resources can positively influence learning and performance (Chen et al., 2018).

Incorporating MOOCs into the curriculum can provide additional learning resources and support for students. Given the positive impact observed, integrating MOOCs as a supplementary tool for complex subjects like Further Differential Equations may help students better grasp challenging concepts and improve their performance. While MOOCs can enhance learning, they should be thoughtfully integrated with traditional teaching methods. The effectiveness of MOOCs in improving academic performance is maximized when used alongside conventional instruction, as suggested by studies highlighting the importance of a blended learning approach (Luo et al., 2014, Thai, et al., 2020).

Several limitations of this study should be considered. This study focuses on a specific course and institution, which may limit the generalizability of the findings. Results may differ in other subjects or educational settings. While prior academic performance and attendance are controlled in this study, other factors such as student motivation, study habits, and external support were not taken into consideration. These variables may also influence academic performance and should be explored in future research.

Further research is needed to build on these findings and address existing limitations. Expanding the study to include multiple courses, institutions, and disciplines could provide a more comprehensive understanding of MOOCs' impact on academic performance. Incorporating qualitative methods such as surveys or interviews with students could offer insights into their experiences with MOOCs and identify factors influencing their effectiveness. Longitudinal studies could examine the long-term effects of MOOC participation on students' academic and professional outcomes, providing a deeper understanding of their overall impact.

Conclusion

The results indicate a strong positive correlation between MOOC participation and improved final grades, suggesting that MOOCs can be an effective supplementary tool for enhancing students' understanding and performance in complex subjects. In conclusion, MOOCs hold considerable potential to improve academic outcomes in higher education, particularly when used as part of a blended learning approach. By leveraging MOOCs effectively and addressing challenges related to student engagement and completion, educators can enhance the learning experience and support students in achieving their academic goals. Continuous exploration and refinement of online learning resources will contribute to optimizing educational practices and fostering student success.

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SOLVING HEAT EQUATION USING FINITE VOLUME METHOD AND CRANK-NICOLSON METHOD

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ABSTRACT

The heat equation which is a significant partial differential equation depicting temperature distribution of a given domain at a given time is used in several engineering and scientific problems. This research rises in the context of the heat equation solving, based on the Finite Volume Method and the Crank-Nicolson Method with the purpose to enhance the numerical stability, accuracy, and computational cost reduction. The usage of maple tools to calculate temperature distributions through time with different step sizes is demonstrated in this research. The main goals include evaluating the performance of these methods in terms of accuracy and convergence, and assessing their capabilities in dealing with nonlinearity and heterogeneity of the material. The study then uses these numerical techniques to get its solutions that are then compared with those of analytical solutions. Some new insight called into question indicate that the Crank-Nicolson method is more accurate and stable when in relation to complicated shapes while the Finite Volume Method is more effective in terms of conservative quantity like heat over finite volumes. Such outcomes suggest the applicability of these methods in the development of heat transfer research, stating the ways of utilizing it in practical engineering problems regarding the disposal of computational time and increasing the precision of calculations.

Keywords: Finite Volume Method, Crank-Nicolson, Heat Equation

Introduction

The heat equation, a partial differential equation describing temperature distribution in a heat-conducting body, is crucial in many fields such as physics, engineering, and materials science. Analytical solutions are often impractical for complex geometries and boundary conditions, necessitating numerical methods like the Finite Difference Method (FDM) and Finite Volume Method (FVM). This research aims to solve the heat equation using the Crank-Nicolson method within FDM and the FVM, comparing their accuracy and stability. FDM, particularly the Crank-Nicolson approach, is known for its stability and second-order accuracy, making it suitable for complex geometries (Mojumder, 2023). FVM, adept at handling irregular shapes, integrates over control volumes and is precise with minimal error (Saptaningtyas, 2018). The study focuses on identifying efficient methods that balance computational resources and accuracy, especially for non-linear and heterogeneous material properties (Xiang, 2018). Using numerical computing environments like Maple, this research evaluates these methods under various step sizes and boundary conditions, aiming to determine the most suitable approach for solving heat equations in practical scenarios. However, limitations include challenges in achieving stability and accurate results with the Crank-Nicolson method and the impact of boundary and initial condition assumptions (Zhu, 2021). Further research may explore using different boundary conditions to enhance the reliability and applicability of these numerical techniques in real-life situations.

Methodology

Finite Volume Method using Explicit Method

Heat or thermal energy is a form of energy found in solids, liquids, and gases. Its units can be converted to joules or calories, with 1 cal = 4.184 J. The heat equation governs the transfer of thermal energy in solid and liquid phases, focusing on isolated points (Herbin, 2023).

The metal rod of length *l* is divided into small control volumes, were heat travels from hotter to cooler regions under constant conduction through insulation.

The heat equation is defined as:

$$\frac{\partial}{\partial t}(e(x,t)) = \frac{w}{A \Delta x}$$

where e(x,t) is thermal energy density, *w* is heat flow per unit area, *A* is area, and Δx is rod length.

Numerical Solution of One-Dimensional Heat Equation by Crank-Nicolson Method

We solve the one-dimensional heat equation using the Crank-Nicolson method, essential for homogeneous boundary-value problems with Dirichlet conditions (Islam, 2018).
The heat equation is:

$$\frac{\partial u(x,t)}{\partial t} = \beta \frac{\partial^2 u(x,t)}{\partial x^2}$$

with initial condition u(x,0) = f(x) and boundary conditions u(0,t) = T_0, u(l,t)=T_1.
The Crank-Nicolson finite difference method is given by:

$$\delta\left(u_{j+1}^{i+1} + u_{j+1}^{i-1}\right) - \left((2\delta+2)\cdot u_{j+1}^{i}\right) = (2\delta+2)\cdot u_j^i - \delta\left(u_j^{i+1} - u_j^{i-1}\right)$$

Where $\delta = \frac{kh^2}{\beta}$

Unsteady State Problem of Explicit Method

Solve the heat equation using an explicit method:

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}, \quad 0 \le x \le 1, \quad t \ge 0$$

with initial condition u(x,0) = x (1 − x) and boundary conditions u(0,t) = u(1,t) = 0.

Unsteady State Problem of Implicit Method

Solve the heat equation using an implicit method:

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}, \quad 0 \le x \le 1, \quad t \ge 0$$

with initial condition u(x, 0) = x(2 − x) and boundary conditions u(0, t) = u(2, t) = 0.

Results

Finite Volume Method

Although explicit methods require small time steps to maintain numerical stability typically governed by the (Courants-Friedrichs-Lewy (CFL) condition), this constraint can be managed in many practical applications where high temporal resolution is acceptable.

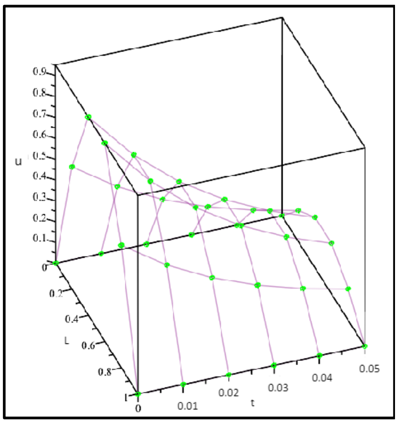

Figure 1: The grid function of Finite Volume Method simulation with spatial step size (h) = 0.2 and number of spatial divisions (NX) = 5.

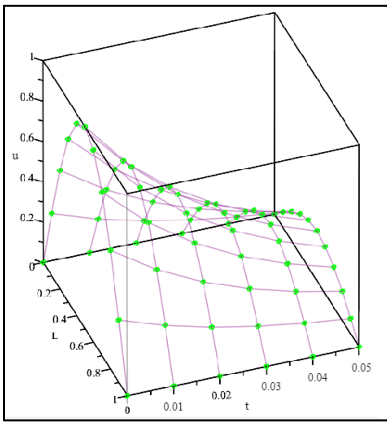

Figure 2: The grid function of Finite Volume Method simulation with spatial step size (h) = 0.1 and number of spatial divisions (NX) = 10.

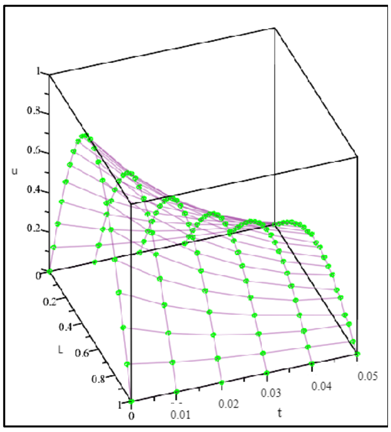

Figure 3: The grid function of Finite Volume Method simulation with spatial step size (h) = 0.05 and number of spatial divisions (NX) = 20.

Explicit Crank-Nicolson Method

The highly known explicit Crank-Nicolson method is preferred widely for its simplicity both in terms of understanding and implementation, calculating the temperatures at the grid points depending on the temperature there in the previous time step, with maximum time of **0.05 seconds.**

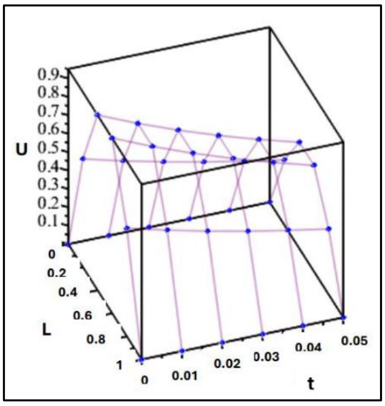

Figure 4: Crank-Nicolson with spatial step size, h = 0.2 and number of spatial divisions, NX = 5

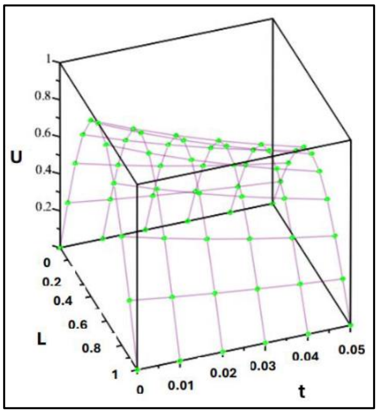

Figure 5: Crank-Nicolson with spatial step size, h = 0.1 and number of spatial divisions, NX = 10

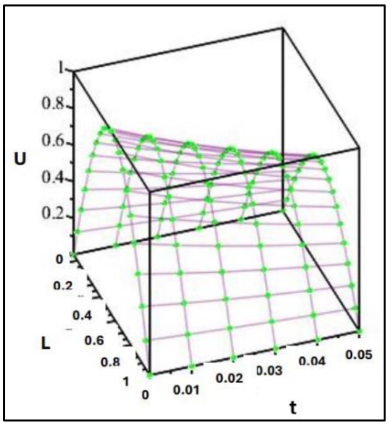

Figure 6: Crank-Nicolson with spatial step size, h = 0.05 and number of spatial divisions, NX = 20

Discussion

The finite volume method is often solved using the explicit method due to its straightforward implementation, involving simple algebraic updates at each time step (Stabile, 2018). Despite requiring small time steps to maintain numerical stability governed by the Courant-Friedrichs-Lewy (CFL) condition, this constraint can be managed in many practical applications where high temporal resolution is acceptable. Figures 1 to 3 illustrate the grid functions of finite volume method simulations with spatial step sizes (h) of 0.2, 0.1, and 0.05, respectively (Barth, 2018). As the spatial step size decreases, the temperature distribution becomes more accurate, capturing finer details and reducing numerical errors. However, increased precision also leads to higher computational demands.

The Crank-Nicolson method, known for its second-order accuracy in both space and time, can be used explicitly or implicitly. Figures 4 to 6 show explicit Crank-Nicolson simulations with spatial step sizes of 0.2, 0.1, and 0.05. The smallest step size (h = 0.05) provides the highest accuracy for the heat equation solution, though at a higher computational cost (Du, 2018). The implicit Crank-Nicolson method is preferred for its stability over longer time periods, as shown in Figures 10 to 12 for a maximum time of 0.05 seconds. The implicit method with a spatial step size of 0.05 is the most accurate, capturing finer fluctuations in temperature distribution.

Conclusion

The study achieved its objectives by solving the heat equation using numerical methods and compare the most suitable method between the Finite Volume Method (FVM) and the Crank-Nicolson method. Through extensive tests and simulations, it was found that the implicit Crank-Nicolson method provided more stability and better results over long intervals compared to FVM. The results showed that while the Crank-Nicolson method enhances accuracy and stability in thermal modelling, FVM produced unstable results over longer intervals. Consequently, the research concluded that the Crank-Nicolson method is superior for detailed thermal analysis and long-term simulations. To achieve more accurate and stable solutions for the heat equation, using mixed (Robin) boundary conditions is recommended for better modelling of heat interactions at boundaries compared to Dirichlet and Neumann conditions (Bollati, 2018). Additionally, employing standard finite difference methods, including forward, backward, central, and fourth-order schemes, ensures higher accuracy and stability, especially for nonuniform gradients and spatial variations. Implementing adaptive mesh refinement (AMR) locally refines the mesh in areas with high temperature gradients, enhancing solution accuracy and stability without significantly increasing computational costs (Dunning, 2020).

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TAHFIZ LEARNING TECHNIQUES AMONG STUDENTS

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ABSTRACT

This study examines the methods used in learning Tahfiz among students. It aims to explore the diversity of approaches used to facilitate memorization and understanding of the Qur'an. Through the analysis of traditional or contemporary methodologies, this study wants to see the effectiveness of Tahfiz pads education today. By examining the techniques used for tahfiz learning, this study strives to contribute for improving the practice and learning outcomes of tahfiz. Finally, this finding will provide valuable insight for educators and students involved in improving memorization guided by the correct technique in order to dignify al-Quran education.

Keywords: Tahfiz, Quran memorization, learning methods, education, Islamic studies.

Introduction

The memorization of the Quran, known as Tahfiz, is the cornerstone of Islamic education. This study examines the methods used to facilitate the learning of Tahfiz among students. It aims to explore the various approaches used to foster both memorization and understanding of the Qur'anic text. By examining teaching methods, this research aims to identify effective practices and contribute to the improvement of Tahfiz education. Al-Quran has great importance for Muslims all over the world. Tahfiz is learning by memorizing the Qur'an is a noble endeavor done by many people. This study focuses on understanding the approach used to cultivate Tahfiz among students and to identify the techniques used for the learning of tahfiz students nowadays that affect the effectiveness of tahfiz learning.

The development of Tahfiz education in Malaysia varies throughout the state, with the rise of private Tahfiz schools staying with the government. Each state or school can choose any curriculum and teaching method from a different country, and it is often based on the teacher's personal background. This means that teachers often teach from their own experience without following certain organized methods (Azmil, 2010).

The development of tahfiz education in Malaysia has shown rapid growth in line with the progress of the country's education sector. The establishment of tahfiz schools whether government or private reflects a positive trend in this field. The main factor driving this growth is the high demand from the community who prioritize tahfiz education for their children. This is proven by the very high number of applications to tahfiz schools and institutions, whether run by the private sector or under government management (Ahmad, 2015; Mustafa & Md Sawari, 2018).

One of the weaknesses of Tahfiz teaching is that teachers still use traditional methods, even though they agree that technology can help improve the memorization of the Quran (M. Marzuqi, 2008). In addition, students struggle with memorization because they do not have the right strategies, techniques, and motivation (Misnan & A. Sadadi, 2003). An organized Tahfiz teaching system has not yet been fully implemented because the training provided by educational institutions does not contribute much to the skills required to teach Tahfiz (Azmil et al., 2013). This study looks at how students learn to memorize the Quran in addition to knowing the best way to teach and learn the Quran so that more people can memorize it.

Memorization Techniques Among Students (Specifically for the Quran)

Tahfiz is an Arabic term that specifically refers to the memorization of the Quran. It's a significant practice in Islamic education. Here are some common techniques used for Quran memorization:

Repetition (Muraja'ah) for memorizing the Quran

Repetition is the basis of memorizing the Qur'an. Muraja'ah, the Arabic term for repetition, emphasizes the importance of consistent repetition. To memorize the Qur'an effectively, it is important to re-read previously learned verses regularly, either daily or weekly. This consistent repetition helps cement the verses in one's memory. To improve the memorization process, diversifying reading methods can be beneficial. For example, reading a sentence aloud, softly or while doing physical activity such as walking can stimulate different neural pathways and increase the level of memory From each of those memorizations. This multifaceted approach to repetition ensures a deeper understanding and stronger memory of the memorized text of the Qur'an. Zakaria and Samah (2022), stated that the strength of a person's memorization can be seen from the person's ability to repeat the memorization first and rewrite the verse of the Qur'an without looking at the mushaf.

Understanding the Meaning (Tadabbur)

To truly internalize the Quran, comprehending its meaning is essential. Tadabbur involves delving deeper into the Quran's message. Translating verses into one's native language can provide a foundational understanding. For complex verses, seeking concise commentaries can offer valuable insights. However, the true essence of tadabbur lies in connecting the Quran's wisdom to everyday life. By reflecting on how Quranic verses relate to personal experiences, challenges, and aspirations, individuals can develop a profound and personal connection to the divine message, making it a living and guiding force in their lives.

Writing (Imla' or Khat)

Engaging multiple senses can significantly enhance memory, and writing is a powerful tool in this regard. Imla' or khat, the practice of handwriting, is a valuable technique in Quran memorization. By physically writing out the memorized verses, learners reinforce the neural pathways associated with memory. This kinesthetic process helps to solidify the verses in the mind. Additionally, writing translations alongside the verses can deepen understanding and create a stronger connection between the Arabic text and its meaning. This combined approach not only strengthens memory but also cultivates a deeper appreciation for the language and content of the Quran.

Mastering Tajweed

Tajweed is the science of proper Quranic recitation, encompassing rules for pronunciation, articulation, and intonation. To master Tajweed, one must first diligently study its rules. This involves understanding the Arabic alphabet, phonetics, and the specific regulations governing Quranic recitation. However, mere knowledge is insufficient without consistent practice. Regular Tajweed practice is essential to internalize the rules and develop the skill to apply them accurately while reciting the Quran. Through dedicated study and practice, individuals can achieve a level of proficiency that allows them to recite the Quran with beauty, precision, and reverence.

Time Management to Memorize the Quran

Effective time management is essential to achieve consistent progress in memorizing the Qur'an. A well-organized study schedule provides a road map, allocating specific time slots for Quranic study. This routine helps establish a consistent rhythm and avoid procrastination. To optimize learning, breaking study sessions into shorter, focused periods is beneficial. This technique allows attention to be focused, improves comprehension and speed. By alternating periods of concentrated study with short breaks, students can maintain optimal mental health and prevent burnout. This strategic approach to time management contributes significantly to efficient and effective memorization of the Qur'an.

A Conducive Learning Environment

Creating an optimal study environment is essential for effective Quran memorization. A quiet space free from distractions allows for focused attention, enabling deeper concentration on the Quranic text. Noise interruptions can disrupt the flow of thought and hinder memorization. Additionally, a comfortable atmosphere is crucial for maintaining motivation and reducing fatigue. A well-lit, organized, and aesthetically pleasing study area can enhance the overall learning experience. By prioritizing a peaceful and comfortable setting, individuals can create an environment that is conducive to optimal Quran memorization and spiritual growth.

Guidance from a Teacher

Having a qualified and experienced Quran teacher is invaluable in the memorization journey. A competent teacher possesses the knowledge and skills to guide students effectively, correcting mistakes, explaining complex concepts, and offering personalized support. Building a strong teacher-student relationship fosters a conducive learning environment. Moreover, asking questions is crucial for clarifying doubts and misconceptions. A good teacher encourages a questioning attitude, creating an atmosphere where students feel comfortable seeking clarification. By actively engaging with the teacher and asking questions, learners can deepen their understanding of the Quran and accelerate their memorization progress.

Self-Motivation

Self-motivation is a crucial component of successful Quran memorization. Setting clear and achievable goals provides a sense of direction and purpose. Breaking down the memorization process into smaller, manageable targets can help maintain momentum and prevent overwhelm. Rewarding oneself upon reaching milestones is a powerful motivator, reinforcing positive behavior and celebrating achievements. Additionally, seeking support from loved ones, such as parents, can significantly boost morale. Encouragement and understanding from those who care can create a supportive environment that fosters resilience and perseverance, ultimately contributing to overall success in Quran memorization.

Prayer and trust in God

A deep spiritual connection is essential for successful memorization of the Qur'an. Prayer is the foundation of this relationship, allowing individuals to seek guidance, comfort, and strength from God. With prayer, students only rely on divine help and trust in God. This involves surrendering one's efforts and results to God's will, recognizing His ultimate power and wisdom. With a heart full of faith and dependence, students can approach the memorization process with calmness and confidence, knowing that divine support is always present.

Conclusion

Memorizing the Quran requires patience, persistence, and effective strategies. Techniques such as repetition, understanding the meaning, writing, mastering Tajweed, time management, and creating a conducive learning environment are essential. Additionally, guidance from a teacher, self-motivation, and reliance on God are crucial supporting factors. A combination of personal effort and divine assistance is key to successful Quran memorization. With strong commitment and a balanced approach, individuals can achieve their Quran memorization goals with blessings.

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A STIGMA: IS AUTISM SPECTRUM DISORDER (ASD), A DISABILITY OR MERELY A DIFFERENT ABILITY

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ABSTRACT

Social media frequently misrepresents autism spectrum disorder (ASD) as a disability. The shift in mentality is necessary for creating a more tolerant and understanding atmosphere. Dispelling the idea that our diverse abilities preclude us from performing particular activities is critical. By emphasizing persons with autism's unique abilities as accomplishments, the idea that autism is a "different ability" shifts the emphasis from flaws to strengths. They contribute and improve to our communities and develop various fields with their exceptional cognitive abilities, great attention, originality, honesty, passion, and reliability. Fostering a more accepting and understanding environment requires this change of attitude. Additionally, autism is not a disability to be fixed, but a different ability that should be embraced. Recognizing the strengths and potential of individuals with autism can foster a more inclusive and supportive society. By celebrating their unique abilities, we can uplift them and appreciate their unique perspectives, helping to build a world where everyone can thrive. Finally, from the Islamic perspectives, autism is viewed as a different ability bestowed by Allah, not a disability. By embracing and supporting individuals with autism, we fulfill our duty to show compassion, respect, and understanding to all of Allah's creations.

Keywords: autism spectrum disorder (ASD), social awareness, disability, special ability, neurodiversity

Introduction

Autism Spectrum Disorder (ASD) is often misunderstood and misrepresented in society. While it is commonly labelled as a disability, many advocates and individuals with autism prefer to view it as a different ability. This perspective shift is crucial in fostering a more inclusive and understanding world. We need to break the stigma, that there are things we cannot do just because of our diverse abilities. Viewing autism as a ‘different ability’ shifts the focus from deficits to strengths, highlighting the unique abilities and contributions of individuals with autism. Their exceptional cognitive abilities, intense focus, creativity, honesty, passion, and reliability enrich our communities and drive progress in numerous fields. ASD also includes conditions that were historically treated as separate disorders. For example, someone with Asperger syndrome, autistic disorder, childhood disintegrative disorder, or pervasive developmental disorder would all fall on the autism spectrum (Jakab, 2024). How to comprehend the nature of AUTISM? Autism is a neurodevelopmental condition characterized by social interaction, communication, and behaviour. These differences can manifest in a variety of ways, making each individual’s experience with autism unique, refer Figure 1 and Figure 2. Some may have exceptional skills in areas such as mathematics, music, or art, while others might excel in logical thinking and problem-solving (Assistant, 2024).

Figure 1 : Taken from https://www.livingholistichealth.com/natural-medicine-news/autism-from-a-nautropathic-perspective

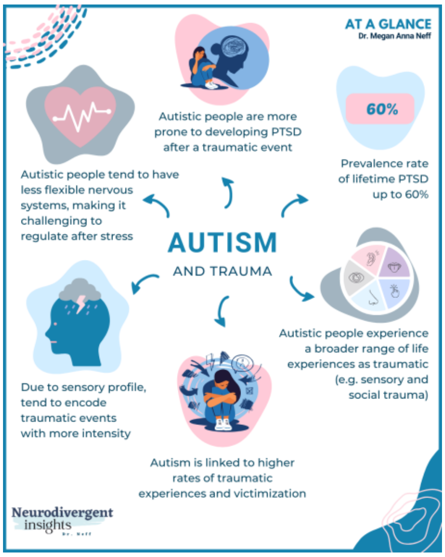

Figure 2: Taken from https://neurodivergentinsights.com/autism-infographics/autismandtrauma

The Strength of Autism

Among the strengths of autistic people are (Assistant, 2024):

i. Attention to Detail: Many individuals with autism have an extraordinary ability to notice details that others might overlook. This skill can be particularly valuable in fields such as data analysis, quality control, and research.

ii. Honesty and Integrity: People with autism often exhibit a high level of honesty and integrity. They tend to be straightforward and transparent, which can be a refreshing and valuable trait in personal and professional relationships.

iii. **Unique Perspectives:** The different ways in which individuals with autism perceive the world can lead to innovative solutions and creative ideas. Their unique perspectives can drive progress and inspire new ways of thinking.

iv. **Specialized Interests:** Many individuals with autism develop deep, specialized interests in specific subjects. This passion can lead to expertise and significant contributions in their chosen fields.

v. **Challenges and Misconceptions**

While it is important to recognize the strengths associated with autism, it is also crucial to acknowledge the challenges. Social interactions and communication can be difficult, and sensory sensitivities can be overwhelming. However, these challenges do not diminish the value and potential of individuals with autism. Misconceptions about autism often stem from a lack of understanding. Educating ourselves and others can break down stereotypes and promote acceptance. It is essential to listen to the voices of those with autism and to respect their experiences and perspectives.

vi. **Embracing Neurodiversity**

The concept of neurodiversity celebrates the variety of human brains and minds. It recognizes that neurological differences, including autism, are natural variations of human experience. Embracing neurodiversity means valuing and supporting individuals with autism, not despite their differences, but because of them.

Real-Life Examples

There are many real-life examples of excellent Autistic people who have made significant contributions and shared their experiences. Among the Muslims autistic amazing figures are:

i. ***Iqra Babar*:** Iqra Babar is an autistic woman, artist, and comic book creator. She uses her art to explore her identity as an autistic woman of colour and a Muslim. Iqra's work challenges stereotypes and promotes understanding of autism within the Muslim and broader communities (Babar, 2024).

ii. ***Kathryn Irrgang and her daughter Zainab*:** Kathryn Irrgang is a devoted mother who has adapted her Islamic lifestyle to support her autistic daughter, Zainab. Kathryn shares their experiences of celebrating Eid and other Islamic practices in ways that accommodate Zainab's needs, advocating for autistic-friendly spaces in mosques (Anjum, 2023).

iii. ***Brinda Jegatheesa*:** Educational anthropologist Brinda Jegatheesan conducted a study observing South Asian immigrant families with young boys with autism. These families are practising Muslims, and the research highlights how they navigate their faith and community interactions while supporting their autistic children (Hughes, 2010).

iv. ***Personal Story on Beliefnet:*** An article on Beliefnet shares the story of a Muslim family who found that having an autistic child reinvigorated their faith. They view their autistic child as a gift and have integrated their faith more deeply into their lives as a result (Beliefnet, 2024).

Other famous Autistic role-models are (Assistant, 2024):

i. ***Temple Grandin***: Temple Grandin is a renowned animal behaviour expert and professor of animal science at Colorado State University. Diagnosed with autism at a young age, she has used her unique perspective to revolutionize the livestock industry. Her designs for humane livestock handling facilities are used worldwide, and she has authored several books on autism and animal behaviour (Grandin & Barron, 2024).
ii. **Satoshi Tajiri:** Satoshi Tajiri, the creator of the globally popular Pokémon franchise, is another inspiring example. His intense focus and passion for collecting insects as a child, a common interest among individuals with autism, led to the creation of Pokémon. His ability to think differently and his attention to detail have made Pokémon a beloved and enduring phenomenon (Tajiri, S., n.d.)
iii. ***Greta Thunberg*:** Greta Thunberg, the Swedish environmental activist, has been open about her autism diagnosis. She describes it as her "superpower" that helps her see the climate crisis clearly and speak out with unwavering conviction. Her activism has sparked a global movement, inspiring millions to take action against climate change.
iv. ***Daniel Tammet*:** Daniel Tammet is a British author and savant with extraordinary mathematical and linguistic abilities. He has memorized and recited pi to 22,514 decimal places and learned Icelandic in just one week. Tammet's unique brain wiring allows him to visualize numbers as shapes and colours, which he describes in his book "Born on a Blue Day."
v. ***Stephen Wiltshire*:** Stephen Wiltshire is an artist known for his detailed cityscape drawings, often created from memory after a single viewing. Diagnosed with autism at the age of three, Wiltshire's exceptional memory and artistic talent have earned him international acclaim. His works are displayed in galleries and collections around the world.

These examples illustrate the diverse experiences of men/women with autism and how they navigate their faith and daily lives.

Promoting Autism Acceptance

Promoting autism acceptance involves a combination of education, advocacy, and creating inclusive environments. Here are some effective strategies (Assistant, 2024):

1. Education and Awareness

Public Campaigns: Launch public awareness campaigns to educate people about autism, its characteristics, and the strengths of individuals with autism.

School Programs: Implement educational programs in schools to teach students about neurodiversity and the importance of inclusion.

Workshops and Training: Offer workshops and training sessions for employers, educators, and community members to better understand and support individuals with autism.

2. Advocacy and Representation

Support Advocacy Groups: Support organizations and advocacy groups that work towards autism acceptance and provide resources for individuals with autism and their families.

Promote Self-Advocacy: Encourage and support individuals with autism to share their experiences and advocate for themselves.

Media Representation: Promote accurate and positive representation of individuals with autism in media, including movies, TV shows, and books.

3. Inclusive Environments

Accessible Spaces: Design public spaces, workplaces, and schools to be accessible and accommodating for individuals with autism, considering sensory sensitivities and communication needs.

Inclusive Policies: Implement policies that promote inclusion and prevent discrimination in schools, workplaces, and communities.

Supportive Services: Provide access to supportive services such as therapy, counselling, and social skills training to help individuals with autism thrive.

4. Community Engagement

Community Events: Organize community events that celebrate neurodiversity and provide opportunities for individuals with autism to connect and share their talents.

Peer Support Groups: Establish peer support groups where individuals with autism and their families can share experiences and offer mutual support.

Volunteer Opportunities: Encourage community members to volunteer with organizations that support individuals with autism.

5. Personal Actions

Listen and Learn: Take the time to listen to individuals with autism and learn from their experiences. Respect their perspectives and preferences.

Challenge Stereotypes: Actively challenge stereotypes and misconceptions about autism whenever you encounter them.

Be an Ally: Stand up for the rights and inclusion of individuals with autism in your community and advocate for their acceptance.

Promoting autism acceptance is a collective effort that requires education, advocacy, and the creation of inclusive environments. By taking these steps, we can build a society that values and supports individuals with autism, recognizing their unique abilities and contributions. Let's work together to foster understanding, acceptance, and inclusion for all.

Islamic Views on Autism As A Different

In Islam, every individual is seen as a unique creation of Allah, endowed with their own strengths and abilities. Autism, like other neurodiverse conditions, is viewed through this lens of divine wisdom and purpose (Assistant, 2024).

i. **Dignity and Respect for All**

Islam emphasizes the inherent dignity and worth of every human being. The Qur'an states, "We have certainly created man in the best of stature" (Qur'an 95:4). This verse underscores that all individuals, regardless of their abilities, are created perfectly by Allah. Autism is not seen as a flaw but as a different way of experiencing and interacting with the world.

ii. **Embracing Diversity**

The Qur'an acknowledges the diversity of human creation: "And of His signs is the creation of the heavens and the earth and the diversity of your languages and your colours. Indeed, in that are signs for those of knowledge" (Qur'an 30:22). This diversity includes neurological differences, which are part of Allah's grand design. Embracing neurodiversity means recognizing and valuing the unique contributions of individuals with autism.

iii. **Compassion and Support**

Islam teaches compassion and support for those who face challenges. The Prophet Muhammad (peace be upon him) showed great kindness and understanding towards individuals with disabilities. For example, he appointed a blind man, Abdullah ibn Umm Maktum, as the muezzin (caller to prayer) of Medina, highlighting that physical or cognitive differences do not diminish a person's value or capabilities.

iv. Special Abilities and Talents

Undoubtedly, many individuals with autism possess exceptional talents and abilities. Islam encourages the recognition and nurturing of these gifts. The Prophet Muhammad (peace be upon him) said, "Allah does not look at your appearance or your wealth but looks at your hearts and your deeds" (Sahih Muslim). This hadith emphasizes that what truly matters are one's intentions and actions, not their outward characteristics.

v. Patience and Gratitude

Families and individuals dealing with autism are encouraged to practice patience and gratitude. The Qur'an states, "And We will surely test you with something of fear and hunger and a loss of wealth and lives and fruits but give good tidings to the patient" (Qur'an 2:155). Patience in the face of challenges is highly valued, and gratitude for the unique abilities and perspectives that autism brings is encouraged.

vi. Seeking Knowledge and Understanding

Islam places a high value on seeking knowledge. Understanding autism and educating others about it can help reduce stigma and promote acceptance. The Prophet Muhammad (peace be upon him) said, "Seeking knowledge is an obligation upon every Muslim" (Sunan Ibn Majah). This includes knowledge about neurodiversity and how to support individuals with autism.

CONCLUSION

Autism is not a disability to be fixed but a different ability to be embraced. By shifting our perspective and recognizing the strengths and potential of individuals with autism, we can create a more inclusive and supportive society. Let us celebrate our unique abilities. These examples highlight the incredible abilities and contributions of individuals with autism. By recognizing and celebrating these different abilities, we can foster a more inclusive and supportive society. Let us continue to support and uplift those with autism, appreciating the unique perspectives and talents they bring to our world. that autism brings and works together to build a world where everyone can thrive. Furthermore, in Islam, autism is viewed as a different ability bestowed by Allah, not a disability. It is a reminder of the diversity and complexity of Allah's creation. By embracing and supporting individuals with autism, we fulfil our duty to show compassion, respect, and understanding to all of Allah's creations.

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EXAMINING KOLB'S LEARNING STYLE AMONG UNIVERSITI TEKNOLOGI MARA CAWANGAN PULAU PINANG (UiTMCPP) STUDENTS

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ABSTRACT

This study examines the learning style preferences of students at Universiti Teknologi MARA Cawangan Pulau Pinang (UiTMCPP) using Kolb's Learning Style Model, which categorizes learners into four types which are activists, theorists, reflectors, and pragmatists. The research involved 50 students from the Centre of Civil Engineering Studies, utilizing a questionnaire based on Kolb's framework to determine their preferred learning styles. The results reveal a strong preference for activist and reflector learning styles among the students, with activists showing a very strong inclination toward hands-on and dynamic learning experiences, while reflectors prefer to engage in thoughtful observation and analysis. Theorist and pragmatist styles were less favored, exhibiting a more moderate preference level among the students. Interestingly, no significant differences in learning style preferences were observed between diploma and bachelor's degree students, indicating a similar pattern of learning style distribution across educational levels. These findings highlight the need for educators to diversify their teaching methods to cater to the varied learning preferences of students. The study suggests that a more personalized approach to teaching could improve educational outcomes by aligning instructional strategies with students' learning preferences. Future research should consider exploring how these learning style preferences might evolve over time and how they influence students' academic performance.

Keywords: learning style, activist, theorist, reflector, pragmatist

Introduction

Students encounter a range of challenges in their learning journeys, which can significantly impact their academic success and overall well-being. Common difficulties include lack of motivation, poor time management, inadequate study skills, and insufficient support (Balduf, 2009). Among these, one critical challenge is the misalignment between teaching methods and students' preferred learning styles. When classroom instruction does not align with a student's learning style, the student may struggle to understand and engage with the material effectively (Biggs, 1999).

Understanding students' learning styles is essential for creating an effective and inclusive educational environment. Learning styles refer to the preferred ways individuals absorb, process, and remember information (Ray, 2024). Studying these styles means exploring into the cognitive, emotional, and environmental factors that shape how students engage with educational material. By identifying and adapting to these learning preferences, educators can tailor their approaches to meet the unique needs of each student.

Identifying student learning styles is crucial for several reasons. Firstly, it enhances learning efficiency. By understanding whether a student is a visual learner, who benefits from diagrams and charts, or an auditory learner, who prefers listening to explanations, educators and students can adapt their approaches accordingly (Claire,2024).Secondly, align the teaching strategies with learning styles increases focus and concentration. Creating a study environment that matches a student's preferred learning style helps minimize distractions and boosts concentration (LearnFree, 2024).Lastly, understanding learning styles improves communication and relationships. Educators who grasp their students' individual learning styles can engage in more effective communication and develop stronger connections (Fleming & Grace, 2023).

Kolb's learning style model, as discussed by Huang and Busby (2007), offers a framework for understanding how individuals approach learning. This model emphasizes experiential learning and the diverse ways learners engage with educational content. There are four basic learning styles that were suggested in Kolb's learning style model which are activist, reflector, theorist and pragmatist. By recognizing and accommodating these different styles, educators can tailor their teaching methods to better suit students' needs and preferences, thereby enhancing the learning experience and outcomes.

The objective of this paper is to examine students' preferred learning styles among diploma and bachelor's degree students at Universiti Teknologi MARA Cawangan Pulau Pinang. This paper aims to contribute to the development of more effective teaching strategies and improve educational outcomes by aligning instructional methods with students' individual learning needs.

Methodology

This study was conducted at Universiti Teknologi MARA Cawangan Pulau Pinang (UiTMCPP) and involved 50 students from the Centre of Civil Engineering Studies. The students were from two different educational levels, namely, diploma and bachelor's degree. This study adopted the questionnaire from Kolb D.'s (1984) which emphasizes learning as a process transforming experience into knowledge.

Kolb's learning styles theory is a well-known model in the field of experiential learning, identifies four distinct learning preferences: activists, theorists, reflectors, and pragmatists (Chan et al., 2021) (Yue & Mei-li, 2021). The questionnaire was created using Google Form and distributed to the students over WhatsApp. The four components of the survey correspond to the four student types identified by Kolb. The responses were evaluated based on the number of questions they answered yes to in every section.

Activists are individuals who prefer to engage in hands-on experiences and excel in dynamic, action-oriented environments where they can participate and experiment without limitations. These learners are open to new challenges and experiences and often tend to immerse themselves in activities that involve immediate engagement and interaction.

Theorists are people who would rather approach education logically, analytically, and methodically. The importance of abstract conceptualization within Kolb's model is illustrated by the fact that they prefer to understand the fundamental principles and theories that determine various events and try to make sense of their experiences by integrating them into a logical framework.

In contrast, reflectors prioritize taking a step back to thoughtfully evaluate their observations and analyse their experiences before making any conclusions. This allows a thoroughly reflective analysis that helps learners to understand their learning experiences and thus encourages them to review their experiences from multiple perspectives to gain deeper insights and improve future actions.

Lastly, pragmatists are learners who focus on applying their knowledge to real-world situations and prefer to implement concepts in practical ways in order to achieve concrete results. They are driven by the usefulness and practicality of ideas and hands-on experiments including trial-and-error approaches in learning. This approach emphasizes actionable outcomes and problem-solving through practical experience.

Result and Discussion

Data were collected through Kolb's Learning Style Questionnaires developed by Kolb (1984). The source of Kolb's Learning Style Questionnaire is based on David Kolb's Experiential Learning Theory, which he published in 1984.Thesimple analysis used Microsoft Excel to examine students' preferred learning styles.

Fifty students from Universiti Teknologi MARA Cawangan Pulau Pinang (UiTMCPP) were voluntarily involved in this study. The bar chart below illustrates the frequency of education level by gender. (Figure 1)

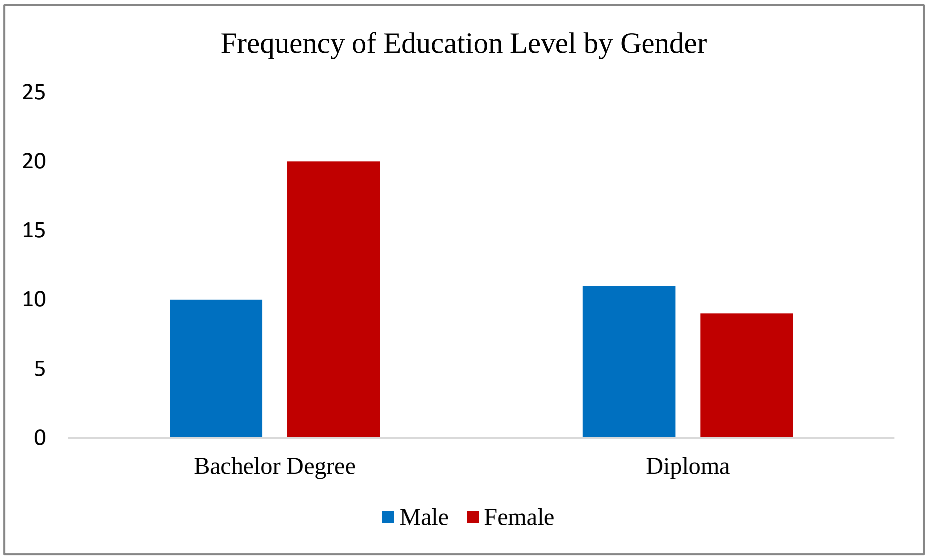

Figure 1: Frequency of education level by gender

Out of fifty students, sixty per cent (60%) had bachelor's degree, whereas forty per cent (40%) were diploma students.

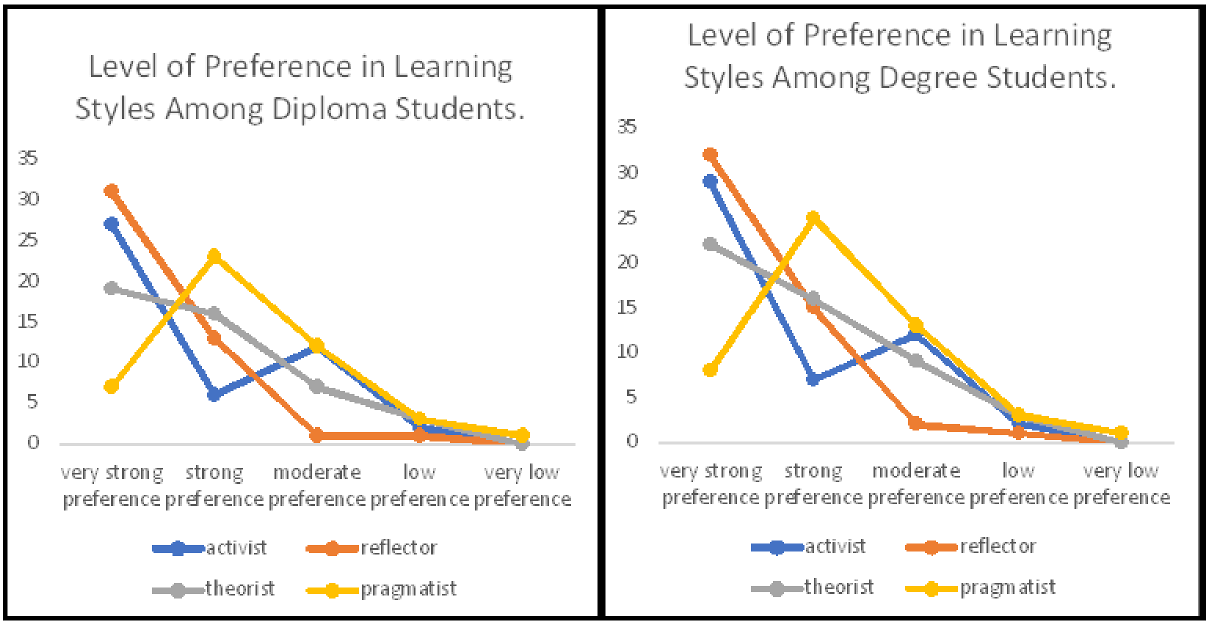

Figure 2: Level of preference in learning styles among diploma and bachelor’s degree students.

Table 1: Frequency table of students' preference level in learning style.

		Type of Learning Style			
Education Level	Preference Level	activis t	reflector	theorist	pragmatist
Diploma	very strong preference	27	31	19	7
	strong preference	6	13	16	23
	moderate preference	12	1	7	12
	low preference	2	1	3	3
	very low preference	0	0	0	1
Bachelor's Degree	very strong preference	29	32	22	8
	strong preference	7	15	16	25
	moderate preference	12	2	9	13
	low preference	2	1	3	3
	very low preference	0	0	0	1

Figure 2 shows the result of students' preferred learning styles for both bachelor's degree and diploma students. The x-axis represents the bachelor's degree of preference, ranging from 'very strong preference' to 'very low preference. The y-axis represents the number of students, ranging from 0 to 35. Each line represents a different learning style: activist, reflector, theorist, and pragmatist. For both groups, students who preferred the activist learning style start high at 'very strong preference' but drop significantly towards 'very low preference.' This suggests that a significant number of students have a very strong preference for an activist learning style.

On the other hand, students who preferred the reflector learning style showed a more balanced distribution, indicating a moderate preference among students. There is a peak at 'moderate preference,' suggesting that more students prefer this style moderately for students who preferred the theorist-leaning style. Finally, the pragmatist learning style shows a balanced trend, but fewer students have a very strong preference.

According to the line pattern, there is no difference in their preferred learning styles for both bachelor's degree and diploma students. However, more students strongly prefer the reflector and activist style compared to the theorist and pragmatist style. The graph indicates that while many students strongly prefer the activist style, the theorist style is more commonly preferred at a moderate level. This can inform educators about the diversity in learning preferences among students.

Conclusion and Recommendation

The study examined the learning style preferences among diploma and bachelor's degree students at Universiti Teknologi MARA Cawangan Pulau Pinang using Kolb's Learning Style Questionnaire. The results reveal that both diploma and bachelor's degree students exhibit a strong preference for the activist and reflector learning styles, with a significant number of students showing a very strong preference for the activist style. Theorist and pragmatist styles were less favoured, with a more balanced distribution across the different levels of preference. Importantly, the study found no significant difference in learning style preferences between diploma and bachelor's degree students. These findings highlight the diversity in learning preferences, suggesting that educational strategies should be tailored to accommodate the varied learning styles of students to enhance their learning experiences.

Based on the study's findings, it is suggested that educators take into consideration the various learning preferences that have been observed, implement a variety of instructional strategies, and incorporate techniques that accommodate all learning styles. Future research could also focus in examining how learning style preferences changes over time as students' progress through their study years, and assess how these changes impact their academic performances.

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PHYSICS ENERGIZER BRAIN BOOSTER: ENHANCING CONCENTRATION AND ENGAGEMENT IN EDUCATIONAL SETTINGS

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ABSTRACT

In contemporary educational and seminar settings, maintaining sustained concentration among participants remains a significant challenge. Despite diverse teaching methodologies and technological advancements, many students and seminar attendees struggle with prolonged focus and engagement. Innovative strategies are needed to capture and sustain attention. This paper introduces the Physics Energizer Brain Booster ($PE=B^2$), an innovative approach designed to combat fatigue, enhance concentration, and foster positive group dynamics through energizer activities. This study evaluates the effectiveness of $PE=B^2$ in improving student engagement, focus, and overall academic outcomes.

Keywords: Physics Energizer, Brain Booster, Student Engagement, Educational Innovation, Cognitive Performance

Introduction

Educational and seminar settings often face the challenge of maintaining sustained concentration among participants. The lack of concentration leads to diminished retention of information, reduced participation, and overall lower educational outcomes. In many educational environments, students and seminar attendees have trouble maintaining focus over extended periods. Traditional teaching methods and even advanced technological tools have not fully addressed this issue. As a result, participants often struggle with reduced concentration, leading to lower retention of information and decreased participation.

The landscape of education is constantly evolving, with educators seeking novel ways to enhance learning experiences and outcomes for students. The integration of innovative teaching methods has become crucial in keeping pace with the changing needs of learners in the 21st century (Manshad, 2022). Pedagogical innovation plays a vital role in not only engaging students but also in preparing them to tackle new challenges effectively (Manshad, 2022). By exploring new methodologies such as the Physics Energizer Brain Booster (PE=B^2), educators can create dynamic and interactive learning environments that promote active participation and cognitive development.

Research in educational sciences has shown that active methodologies, such as inquiry-based learning supported by formative assessment processes, can significantly impact academic achievement and the quality of the teaching-learning process (Tirado-Olivares, 2023). By incorporating innovative approaches like the PE=B^2 into educational settings, educators can potentially enhance student performance and perception of the learning experience. Moreover, studies have indicated that the use of innovative teaching methods can lead to improved student engagement and learning outcomes compared to traditional approaches (Lopez-Gazpio, 2023). This underscores the importance of exploring new strategies, such as the PE=B^2, to address challenges related to student focus and participation.

This paper introduces the Physics Energizer Brain Booster (PE=B^2), an innovative strategy that utilizes energizer activities to capture and sustain attention, thereby enhancing cognitive performance and engagement. The primary objective of the Physics Energizer Brain Booster (PE=B^2) is to address the persistent challenge of maintaining concentration and engagement in educational settings. By introducing a series of energizer activities specifically designed for the physics curriculum, PE=B^2 aims to combat the mental fatigue that students often experience during prolonged study sessions. These activities are crafted to refresh participants' minds, enhance their focus, and foster a more interactive and dynamic learning environment. The overarching goal is to create a positive group dynamic that not only improves cognitive performance and information retention but also encourages active participation and collaboration among students. By achieving these objectives, PE=B^2 seeks to significantly elevate the overall academic experience and outcomes for students in physics courses.

Methodology

The Physics Energizer Brain Booster (PE=B^2) employs a structured methodology integrating a series of specially designed energizer activities into the physics curriculum to enhance student engagement and cognitive performance. The implementation begins with identifying key areas where students commonly experience fatigue and loss of concentration. Four main activities were developed: PHY-Bing!, Matter Word Search, Momentum Word Scramble, and Rotational Motion Maze Puzzle as shown in Figure 1, each targeting different cognitive skills such as memory, problem-solving, and critical thinking.

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These activities are interspersed throughout the Fundamental Physics I (PHY130) course to provide periodic mental stimulation and refreshment. During collaborative teaching sessions with industry partners, such as KNAUF SDN BHD, these activities were tested and refined based on student feedback. This study focuses on evaluating the effectiveness of the Physics Energizer Brain Booster (PE=B^2) program within the context of the PHY130 course at UiTM Penang Campus. The study aims to assess the impact of PE=B^2 on various aspects of student learning and engagement. Data on student engagement, concentration levels, and academic performance were collected through surveys and observational studies. This iterative process ensures that the activities are both enjoyable and effective in enhancing learning outcomes. The methodology focuses on creating a cohesive learning environment that maintains high levels of student participation and cognitive alertness, thereby addressing the core challenges of traditional educational approaches.

Figure 1: PHY-Bing!, Matter Word Search, Momentum Word Scramble, and Rotational Motion Maze Puzzle

Results and Discussion

The analysis of feedback from the PHY130 Energizer Brain Booster survey demonstrates the program's significant positive impact on student engagement and learning outcomes. The survey results reveal that most students found the activities enjoyable, beneficial in familiarizing them with physics terms, and effective in improving concentration and confidence in the course. The results of the survey conducted to assess the effectiveness of the Physics Energizer Brain Booster (PE=B^2) are depicted in the graph titled "Survey Results for PHY130 Energizer Brain Booster" as shown in Figure 2. The survey questions focused on various aspects of the PE=B^2 activities, including their enjoyability, familiarity with physics terms, ability to sharpen concentration, improvement in confidence in the course, preparation for final examinations, and overall implementation in class. The responses were categorized into three levels of agreement: Strongly Agree, Agree, and Neutral.

The feedback was overwhelmingly positive, with 24 out of 30 respondents "Strongly Agreeing" that they found the PE=B^2 activities enjoyable, and an additional five students "Agreeing." This high level of enjoyment is crucial as it reflects the success of the activities in creating a stimulating and engaging learning environment. This demonstrates that the students found the activities to be engaging and enjoyable, an essential factor in maintaining sustained concentration and interest in the subject matter. Similarly, students reported that the activities helped familiarize them with physics terms, reinforcing key concepts and terminology crucial for understanding and retaining the subject matter (Arias et al., 2020).

The survey also showed that 22 students "Strongly Agreed" that the brain booster activities helped them become more familiar with physics terminology, with another seven students "Agreeing." This is an important outcome, as familiarity with key terms is essential for students to grasp complex concepts in physics. The effectiveness of PE=B^2 in reinforcing these terms suggests that the program is not only enjoyable but also educationally valuable.

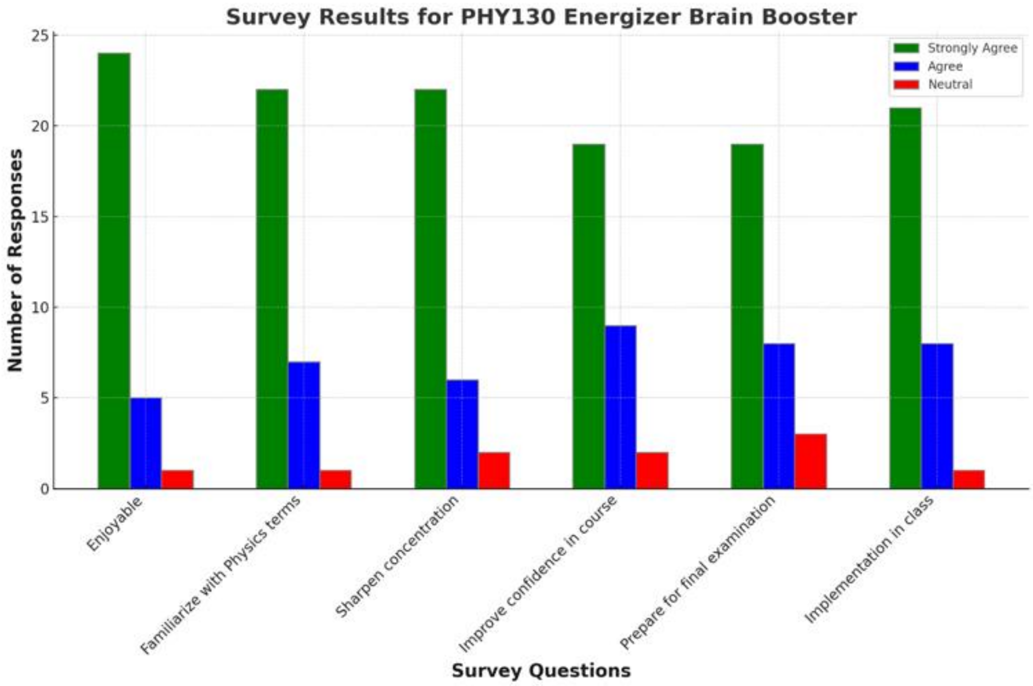

Figure 2: Survey Results for PHY130 Energizer Brain Booster

The PE=B^2 program significantly enhanced students' concentration and confidence in the course. Twenty-two students "Strongly Agreed" that the activities sharpened their concentration, and 19 students felt a boost in their confidence regarding the course material. These aspects are critical for academic success, especially in a subject as demanding as physics. The uniformity of these positive responses indicates that PE=B^2 effectively addresses one of the main challenges in education: maintaining student focus and self-assurance. This suggests that the PE=B^2 activities not only made the learning process more enjoyable but also effectively enhanced the students' focus, confidence, and preparedness for assessments. These findings underscore the positive impact of the PE=B^2 activities on student engagement and cognitive performance, aligning with the goal of enhancing the learning experience and outcomes for students (Lynch & Sargent, 2020).

Nineteen students "Strongly Agreed" that the brain booster activities helped them prepare for their final exams, with another eight students "Agreeing." This result is particularly important as it underscores the practical benefits of the program in helping students consolidate their knowledge and feel better prepared for assessments. Effective exam preparation is a key indicator of the success of any educational tool, and PE=B^2's positive impact in this area suggests that it plays a vital role in students' academic performance. The desire for regular implementation of the PE=B^2 activities in class was strongly expressed, with 21 students "Strongly Agreeing" and eight "Agreeing." This strong preference for continued use of the program highlights its perceived value among students and suggests that they see tangible benefits from its integration into their coursework.

The commercialization potential of PE=B^2 is also promising, indicating a broad scope for expansion and application. This innovation can be replicated across different physics courses and adapted for other subjects and educational levels, leveraging the same cognitive science techniques to improve learning outcomes. Collaborations with schools and educational institutions can facilitate broader implementation, while income generation avenues such as e-commerce platforms, educational conferences, and retail stores present viable pathways for commercial success. By promoting the widespread adoption of PE=B^2, educational institutions can significantly enhance student engagement, cognitive performance, and overall academic experience, thus addressing fundamental challenges in contemporary education (Dyson et al., 2020). Currently, PE=B^2 has been implemented in collaborative teaching sessions with industry partners, such as KNAUF SDN BHD, with ongoing developments to expand its application to other educational settings and explore further commercialization opportunities including collaborations with industry partners, indicate a proactive approach towards maximizing the impact of this innovative educational tool. By leveraging cognitive science techniques and industry partnerships, PE=B^2 has the potential to revolutionize teaching practices and improve learning outcomes for students (Herrero-González, 2023).

Conclusion

The Physics Energizer Brain Booster (PE=B^2) has proven to be an innovative and effective solution to the persistent challenge of maintaining concentration and engagement in educational settings. By integrating interactive and stimulating activities into the physics curriculum, PE=B^2 successfully enhances cognitive performance, focus, and overall academic outcomes. The originality and novelty of this approach are evident in the positive feedback received from students, who reported increased enjoyment, reduced stress, and improved retention of information.

Survey results from the PHY130 course underscore the significant impact of PE=B^2 on student engagement and learning. Most students found the activities enjoyable and agreed that they helped familiarize them with physics terms, sharpen concentration, improve confidence, and prepare for final examinations. This positive reception highlights the effectiveness of PE=B^2 in creating a dynamic and supportive learning environment.

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RELIABILITY ANALYSIS: APPLICATION OF CRONBACH'S ALPHA IN RESEARCH INSTRUMENTS

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ABSTRACT

Reliability is a critical aspect of evaluating research instruments, ensuring that the tools used to assess constructs such as attitudes, skills, and knowledge yield consistent and dependable outcomes. This paper investigates the use of Cronbach's Alpha, a widely accepted measure of internal consistency, through a case study that examines the perceptions of online Calculus learning among engineering students. A survey targeting two main dimensions, course content and instructor effectiveness, was administered to 25 students. The analysis reveals an overall reliability, indicated by a Cronbach's Alpha of 0.83, and identifies specific items that may require further refinement. The findings are discussed in light of Nunnally's recommendations for acceptable reliability levels, offering insights into the adequacy of the research instrument.

Keywords: Reliability Analysis, Cronbach's Alpha, Online Learning, research instrument, consistent measurements

Introduction

Reliability is essential for ensuring that data collected accurately reflect consistent measurements of the constructs under study. Whether the research focuses on student attitudes, course effectiveness, or educational technologies, the instruments used must reliably measure the intended constructs to provide valid and actionable insights. Reliability refers to the extent to which an instrument yields consistent results across different administrations or different sets of items purported to measure the same construct (Nunnally & Bernstein, 1994; DeVellis, 2016).

Cronbach's Alpha is one of the most widely used statistics for assessing the reliability of research instruments. This coefficient measures the internal consistency of a set of items, indicating how well they collectively capture the intended construct (Cronbach, 1951; Tavakol & Dennick, 2011). In cases where instruments include multiple items designed to measure complex constructs such as student attitudes, satisfaction, or perceptions, Cronbach's Alpha provides a crucial metric for evaluating the quality of these tools. This study explores the use of Cronbach's Alpha to assess the reliability of a survey examining engineering students' perceptions of online learning in Calculus. The survey, consisting of 10 items, was administered to 25 students and focused on two key dimensions: course content and instructor effectiveness. By calculating Cronbach's Alpha for the entire survey and for each individual item, this study provides insights into the survey's internal consistency and discusses implications for improving research instruments. The data analysis aimed to:

i. Determine the overall reliability of the survey on students' perceptions of online learning in Calculus.
ii. Evaluate the reliability of each dimension of students' perceptions.
iii. Identify specific items that may reduce the overall reliability of the survey.

Theoretical Framework

Reliability is critical for ensuring that instruments consistently measure latent constructs such as attitudes, beliefs, behaviors, or knowledge. Consistent measurements across different populations, settings, and times ensure that the data obtained are dependable and can inform decisions about practices and policies (Nunnally & Bernstein, 1994). Instruments typically consist of multiple items designed to capture various dimensions of a construct. For example, a survey measuring students' perceptions of online learning might include items related to course content and instructor effectiveness. For the instrument to be reliable, these items must consistently reflect the underlying construct of students' perceptions. Cronbach's Alpha assesses whether these items are sufficiently correlated to justify their use in measuring a single construct (Cronbach, 1951).

Cronbach's alpha, introduced by Lee Cronbach in 1951, is a coefficient of internal consistency that gauges the extent to which items in a test measure the same underlying construct (Cronbach, 1951). The statistic is computed based on the average inter-item correlation, where a higher alpha value indicates stronger correlations among the items. The formula for Cronbach's alpha is:

$$\alpha = \frac{N\bar{c}}{\bar{v} + (N-1)\bar{c}}$$

where:

N = number of items
$\bar{c}$ = mean covariance between items.
$\bar{v}$ = mean item variance.

Cronbach's Alpha is used to assess the internal consistency of instruments designed to measure constructs like student perceptions, satisfaction, or engagement. A high Cronbach's Alpha suggests that the items in the instrument are closely related and effectively measure the same construct, which is essential for the validity of the research findings (Nunnally & Bernstein, 1994).

However, it is important to recognize the limitations of Cronbach's Alpha. Specifically, it assumes one-dimensionality, meaning that all items in the scale measure the same underlying construct. In cases where constructs are multifaceted, this assumption may not always hold true. Therefore, it is often advisable to complement Cronbach's Alpha with other forms of reliability and validity testing, such as factor analysis, to ensure the robustness of the instrument (Field, 2013).

Level of Reliability

Nunnally's recommendations for reliability levels offer essential guidance for evaluating research instruments. According to Nunnally (1978), a Cronbach's alpha coefficient of 0.70 or higher is generally acceptable for basic research, indicating sufficient internal consistency. For more advanced research or when high precision is necessary, a higher alpha value, such as 0.80 or above, is preferred to ensure greater reliability. Nunnally also emphasizes that while a high alpha is desirable, it should not be the sole criterion for assessing an instrument's quality.

Reliability should be considered alongside other factors, such as the scale's validity and practical utility, to ensure it effectively measures the intended construct and performs well within the specific research context. Table below is summarizing the recommended levels of reliability according to Nunnally's guidelines:

Table 1: Reliability Levels, Cronbach's Alpha Ranges, and Their Interpretations.

Reliability Level	Cronbach's Alpha Range	Interpretation
Excellent	0.90 and above	Indicates very high internal consistency.
Good	0.80 - 0.89	Reflects strong internal consistency.
Acceptable	0.70 - 0.79	Indicates acceptable internal consistency.
Questionable	0.60 - 0.69	Reflects questionable internal consistency.
Poor	Below 0.60	Indicates poor internal consistency.

This table provides a clear and concise overview of the different levels of reliability, their Cronbach's Alpha ranges, and interpretations. It serves as a valuable reference for researchers in determining the appropriateness of their measurement instruments (Nunnally, 1978). By understanding these reliability thresholds, researchers can make informed decisions about the robustness of their scales in various research contexts.

Methodology

This study employs a case study approach to evaluate the reliability of a survey measuring engineering students' perceptions of online learning in Calculus using Cronbach's Alpha. The survey instrument, developed based on existing literature on online learning and student perceptions, was designed to measure two key dimensions: course content and instructor effectiveness. The survey instrument consisted of 10 items, each designed to capture a different aspect of students' perceptions of online learning in Calculus. These items were developed to reflect the multifaceted nature of online learning experiences, ensuring that the survey could provide a comprehensive assessment of students' overall attitudes and experiences. The 10 survey items were divided into two dimensions as follows:

Table 2: Survey Items Assessing Course Content and Instructor Effectiveness.

Dimension	Item
Course Content	The online course materials (videos, notes, etc.) were clear and easy to understand.
	The course content was well-organized and logically structured.
	The examples provided in the course materials were relevant and helped me understand the concepts.
	The assignments and exercises were effective in reinforcing my understanding of Calculus concepts.
	The pace at which the course content was delivered was appropriate for my learning.
Instructor Effectiveness	The instructor's explanations during online sessions were clear and easy to follow.
	The instructor was available to answer questions and provide assistance when needed.
	The feedback provided by the instructor on assignments was timely and helpful.
	The instructor made the online lectures engaging and interactive.
	The instructor created a supportive environment that encouraged me to participate and ask questions.

The survey was administered to 25 engineering students enrolled in online Calculus courses. The students were selected to represent a diverse sample in terms of academic performance, year of study, and prior experience with online learning. The survey was conducted anonymously, and students were encouraged to provide honest responses. After data collection, responses were entered into SPSS software for analysis. Cronbach's Alpha was calculated for the entire survey to determine its overall reliability. Additionally, Cronbach's Alpha was calculated separately for each of the two dimensions (course content and instructor effectiveness) to assess the reliability of the items within each dimension.

Results and Discussion

The analysis revealed that the overall Cronbach's Alpha for the survey was 0.83, indicating good internal consistency. This suggests that the 10 items work well together to measure the construct of students' perceptions of online learning in Calculus. According to Nunnally's guidelines, this level of reliability is appropriate for applied research settings (Nunnally & Bernstein, 1994).

Table 3: Cronbach's Alpha Value for Each Dimension.

Dimension	**Cronbach's Alpha**	**Reliability**	**Description**
Course Content	0.81	Good Reliability	Items consistently measured students' perceptions of the quality and organization of the online Calculus course content.
Instructor Effectiveness	0.79	Acceptable Reliability	Items assessed students' perceptions of their interactions with and satisfaction regarding the online instructor.

Results in Table 3 indicate that the Cronbach's Alpha for the course content items was 0.81, indicating good reliability. This suggests that the items within this dimension consistently measured students' perceptions of the quality and organization of the online math course content. Similarly, the Cronbach's Alpha for the instructor effectiveness items was 0.79, indicating acceptable reliability. These items effectively captured students' perceptions of their interactions with and satisfaction regarding the online instructor.

The findings indicate that the survey used to measure engineering students' perceptions of online learning in Calculus generally exhibits good reliability, as evidenced by the overall Cronbach's Alpha. However, item-level analysis revealed that certain questions may not contribute effectively to the survey's internal consistency. Identifying problematic items has important implications for the design and refinement of the survey (DeVellis, 2016; Tavakol & Dennick, 2011). Questions that were found to have lower reliability may need to be revised or replaced to better align with the overall construct of students' perceptions. For example, these questions could be reworded to reduce ambiguity, or additional items could be added to more comprehensively capture relevant dimensions of online learning experiences (Netemeyer, Bearden, & Sharma, 2003).

In light of Nunnally’s guidelines for acceptable levels of reliability, the overall Cronbach’s Alpha of the survey meets the recommended threshold for applied settings (Nunnally & Bernstein, 1994). However, given the importance of accurately measuring students’ perceptions of online learning, further refinement of the survey items could enhance the instrument’s reliability (DeVellis, 2016; Field, 2013).

Conclusion

This study demonstrates the utility of Cronbach's Alpha as a measure of internal consistency and reliability in research instruments. The case study of a survey measuring engineering students' perceptions of online learning in Calculus underscores the importance of assessing reliability at both the overall and item levels. By adhering to Nunnally's guidelines, researchers can ensure that their instruments are sufficiently reliable for their intended purposes, whether in exploratory studies or applied research settings. The findings suggest that, while the survey used in this case study is generally reliable, certain items may require refinement to enhance the overall consistency of the instrument. These insights contribute to the ongoing development of reliable and valid research instruments, ultimately leading to more accurate and meaningful research outcomes.

Limitations and Future Research

A limitation of this study is its focus on a single subject area (Calculus) and the use of a specific faculty population (engineering), which may limit the generalizability of the findings to other subjects or student populations. Future research could expand the sample to include students from different disciplines and institutions, allowing for a more comprehensive assessment of the survey's reliability across various contexts.

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THE *e-SUKUKATA TERBUKA BAHASA MELAYU* COURSEWARE DESIGN USING ONTOLOGY-BASED TECHNIQUE FOR KINDERGARTEN

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ABSTRACT

E-learning technology has transformed education by creating engaging, dynamic learning environments that greatly enhance learning outcomes. Teachers now have the ability to facilitate self-paced learning, offer timely feedback, and customize course materials to individual needs. Central to this shift is interactive courseware, which combines structured content, multimedia elements, and assessments, significantly boosting student performance. The development of this courseware involves integrating effective learning techniques such as system thinking, knowledge management, and ontology techniques. Effective knowledge management is vital in kindergarten education, aiding in the organization and dissemination of learning materials. Incorporating system thinking into e-learning design further enhances critical thinking and problem-solving skills. The Ontology-based Technique utilizes semantic frameworks to tailor content to students' specific needs, personalizing learning and improving outcomes. When teaching Bahasa Melayu to kindergarten students, multimedia-rich e-learning courseware—featuring videos, games, and audio—provides an engaging, adaptable learning experience. This approach supports personalized learning and offers immediate feedback, which is particularly beneficial in remote or underserved areas. Consequently, this research focuses on designing interactive, multimedia-enhanced e-learning courseware for 4-year-old kindergarten students, integrating knowledge management, system thinking, and ontology to enrich their educational experience.

Keywords: Courseware, Ontology Technique, Knowledge Management, System Thinking, Kindergarten

Introduction

The advent of e-learning technology has brought about a profound transformation in education delivery, providing adaptable and immersive learning environments that greatly enhance educational outcomes. Teachers can elevate student learning by facilitating self-paced learning, offering timely feedback, and customizing education through course materials. Interactive course materials play a crucial role in fostering efficient and effective learning, delivering structured content, multimedia components, assessments, and interactive functionalities. Research conducted by Agno & Ponte (2013) corroborates the positive influence of interactive course materials on student achievements.

In the context of teaching *Bahasa Melayu* to preschoolers, e-learning multimedia course materials offer a promising avenue for enhancing learning results. By incorporating interactive elements like videos, games, and audio segments, e-learning course materials can captivate the attention of young learners and make the learning process more engaging. This multimedia approach provides a dynamic and interactive learning environment that caters to the diverse learning preferences and styles of preschoolers. Additionally, e-learning course materials allow students to learn at their own pace, facilitating personalized learning experiences tailored to individual needs and abilities. Through interactive exercises and activities, students actively participate in their learning, reinforcing language skills in an enjoyable and interactive manner. Moreover, e-learning course materials can provide instant feedback, enabling students to monitor their progress and promptly address areas needing improvement. The utilization of the Ontology-based technique represents a potent strategy for enhancing learning outcomes in e-learning multimedia course materials. By employing an ontology-based semantic framework to organize course content, students can access pertinent information and resources suited to their unique needs and learning styles. Rahayu et al. (2022) underscores the pivotal role of ontologies in adaptive learning technology, highlighting how the implementation of this technique can personalize the learning journey and optimize outcomes for students.

Consequently, the primary focus of this research revolves around designing interactive course materials tailored for preschool-aged students, particularly those in the 4-year-old age group. This endeavor integrates various techniques, including multimedia elements, knowledge management, systems thinking, and ontology, with the aim of enriching the learning experience for young learners. The overarching objective is to facilitate the enhancement of students' learning abilities by comprehensively integrating these techniques.

In pursuit of this goal, the paper suggests a design phase for interactive course materials aimed at facilitating the learning of *Bahasa Melayu* among 4-year-old students, focusing particularly on *sukukata terbuka*. The study delineates the specific objectives as follows:

i. Develop a blueprint for the eLearning courseware.
ii. Design engaging and appropriate multimedia elements.
iii. Create a user-friendly interface for easy navigation.

The subsequent section will present the design framework employed. Finally, the paper will conclude with a summary of the study.

Courseware Design.

This project will explore *sukukata terbuka*, knowledge management, and the system thinking technique as integral components of e-learning courseware designed for 4-year-old students. *Sukukata terbuka* in *Bahasa Melayu* refers to syllables ending with a vowel sound without a subsequent consonant, where the vowel sound is distinctly pronounced, enhancing the language's rhythmic flow. Ahmad and WA's (2012) study identified *sukukata terbuka* using instrumental phonetic analysis.

Within the project's scope, participants include teachers, 4-year-old students, *Bahasa Melayu,* and the concept of *sukukata terbuka*. Teachers play a crucial role in implementing effective instructional strategies, customizing content to address developmental needs and promote engagement. *Bahasa Melayu* provides a cultural and linguistic backdrop, emphasizing language acquisition, while *sukukata terbuka* serves as a focal point for linguistic exploration within this framework.

This paper centers on designing an e-content package using the widely adopted ADDIE instructional model, which first emerged in 1975 (Branson, 1975). The e-content package is intended for individual learning purposes. Transitioning to the design phase, the focus lies in crafting a blueprint for the e-learning courseware. Considering the young learners' age, the design must integrate lively colors, captivating animations, and intuitive navigation to ensure a pleasant and productive learning journey. Breaking down the content into manageable, easily digestible segments is essential, taking into account the limited attention span typical of 4-year-olds. The works on this phase are: Brainstorm and sketch the course structure and content flow, Design colourful and visually appealing animations and Create wireframes for the e-learning platform.

i. Site Map

The site map for the project will strategically outline the navigation flow, content structure, and interactive elements, providing a clear roadmap for both developers and users. Figure 1 shows the sitemap of *e-sukukata* courseware.

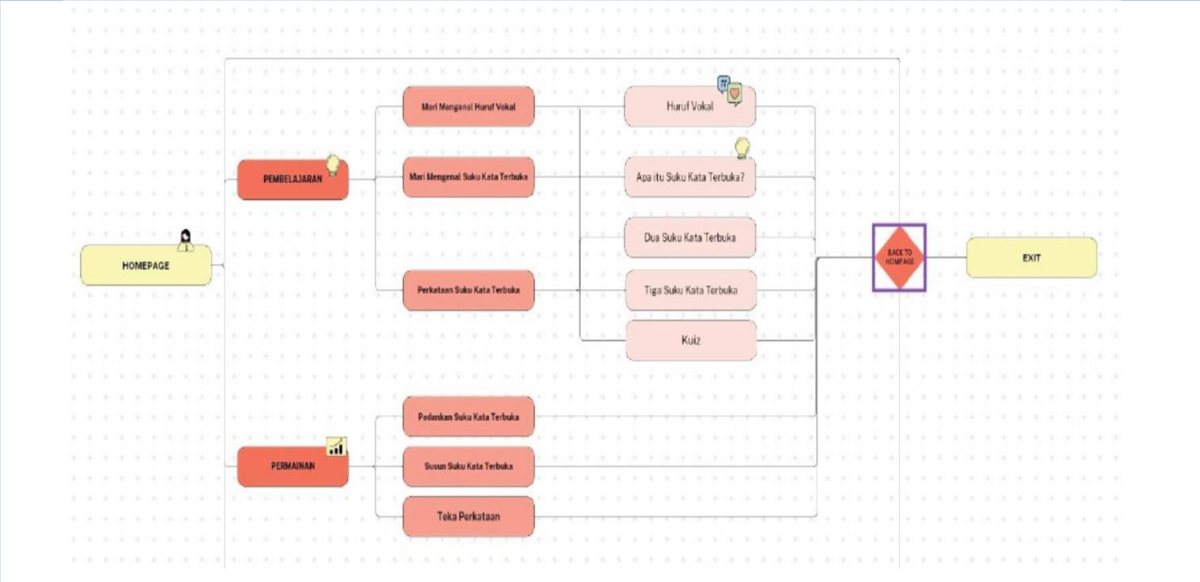

Figure 1 Sitemap of *e-Sukukata* Courseware

ii. Navigation Map

This stage involves crafting an intuitive navigation system that guides learners through the courseware effortlessly. Clear menus, icons, and interactive elements will be implemented to enhance user engagement and facilitate easy exploration of the educational content. In Table 1 shows the description of the navigation map.

Table 1 Description of the Sitemap

Screen Number	Screen Discription
1.0	Homepage
2.0	Pembelajaran
3.0	Mari Mengenal Huruf Vokal
3.1	Huruf Vokal
3.2	Kuiz
4.0	Mari Mengenal Suku Kata Terbuka
4.1	Apa Itu Suku Kata Terbuka?
5.0	Perkataan Suku Kata Terbuka
5.1	Dua Suku Kata Terbuka
5.2	Tiga Suku Kata Terbuka
5.3	Kuiz
6.0	Permainan
6.1	Padankan Suku Kata Terbuka
6.2	Susun Suku Kata Terbuka
6.3	Teka Perkataan
7.0	Back To Home
8.0	Exit

iii. Storyboard

The storyboard for this project will focus on presenting *sukukata terbuka* concepts in a captivating and age-appropriate manner, ensuring a cohesive and engaging learning journey for the young students. The details description each on storyboard is shown in Table 2 and in Figure 2 shows the storyboard of *e-sukukata.*

Table 2 Details Description on Storyboard

No. of Storyboard	Description
1	The "e-sukukata" courseware, designed for 4 years-old kindergarten students studying suku kata terbuka in bahasa melayu, features a captivating homepage adorned with vibrant colours such as blue, yellow, green, white, and red. The presence of a friendly robot and a cute kitten, along with a serene cloud, creates an inviting environment for young learners. Upon entering the homepage, users encounter two prominent buttons – "Pembelajaran" for learning materials and "Permainan" for exercises. These buttons, strategically designed to attract the attention of kindergarten students, provide a visually engaging interface.
2	Clicking on the "Pembelajaran" button leads to a set of three further options: "Mari Mengenal Huruf Vokal," "Mari Mengenal Suku Kata Terbuka," and "Perkataaan Suku Kata Terbuka". The structured progression ensures a seamless learning experience.
3	Choosing "Mari Mengenal Huruf Vokal" reveals two additional buttons: "Huruf Vokal" and "Kuiz."
4	Exploring "Huruf Vokal" allows users to view the five vocal letters - A, E, I, O, U
5	Further interaction involves tracing the selected alphabet, fostering letter recognition skills.
6	The "Kuiz" option within "Mari Mengenal Huruf Vokal" introduces an interactive quiz element, enhancing the engagement and assessment aspects of the learning process.
7	"Mari Mengenal Suku Kata Terbuka" unfolds a section dedicated to notes on Suku Kata Terbuka.
8	Followed by examples categorized based on vocal alphabets. This approach provides a structured understanding of Suku Kata Terbuka.
9	Exploring "Perkataan Suku Kata Terbuka" within "Pembelajaran" introduces subtopics like "Dua Suku Kata Terbuka," "Tiga Suku Kata Terbuka," and a "Kuiz" button
10	Each subtopic further delves into themes like "Haiwan," "Makanan," "Warna," "Aktiviti," "Benda di Rumah," and "Benda di Sekolah."
11	For the "Dua Suku Kata Terbuka" theme, users encounter categories such as "Haiwan," where examples of Dua Suku Kata Terbuka related to animals are presented, fostering thematic and linguistic connections.
12	Switching to the "Permainan" section on the homepage, users discover three interactive games – "Padankan Suku Kata Terbuka," "Susun Suku Kata Terbuka," and "Teka Perkataaan." These games inject an element of fun and reinforce the learned concepts.
13	The final page presents a simple yet crucial query – "Do you want to exit?" Users can choose between "Yes" and "No" buttons, allowing for a seamless and user-friendly exit experience from the courseware.

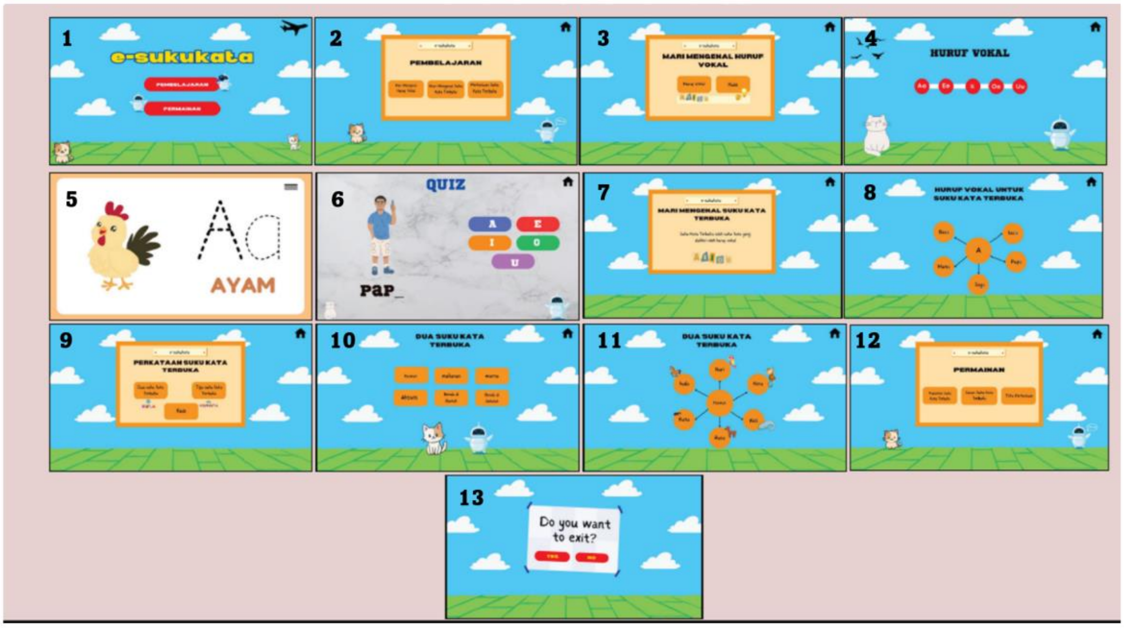

Figure 2 Storyboard of e-Sukukata Courseware

iv. Wireframe

Wireframing serves as the blueprint for the e-learning courseware's visual interface. This phase involves outlining the layout, placement of elements, and overall design aesthetics. The wireframes for this project will be meticulously crafted to strike a balance between visual appeal and educational effectiveness, providing a foundation for the subsequent development stages. Figure 3 shows the wireframe.

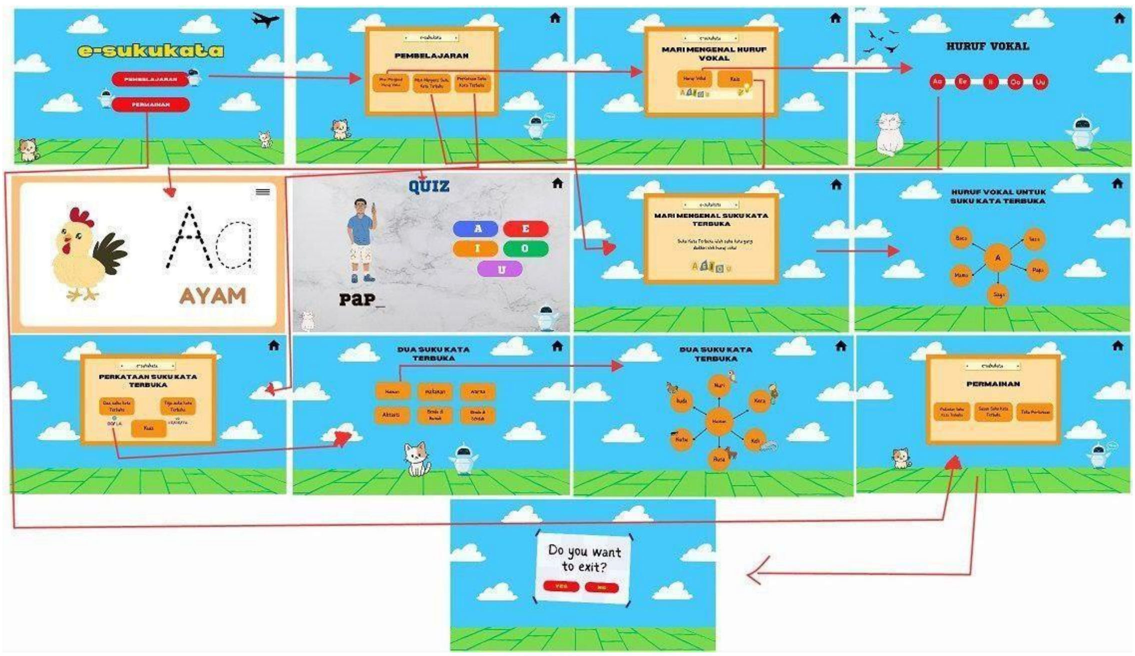

Figure 3 Wireframe of e-Sukukata Courseware

These design elements collectively contribute to the creation of an impactful and user-friendly e-learning courseware tailored for 4years-old kindergarten students learning suku kata terbuka in bahasa melayu.

Test Case

Moving to the Implementation phase, deploying the e-learning courseware involves introducing it to the kindergarten setting. Training educators on how to facilitate the use of the courseware and integrating it seamlessly into the existing curriculum is key. Continuous monitoring and feedback collection during this phase help identify any necessary adjustments. Table 3 shows the test case for the user.

Table 3 Test Case for the User

Test case	No.	Activity	Expected result
Homepage	1	Navigate to “Pembelajaran” and “Permainan” page.	Display the the “Pembelajaran” and “Permainan” button.
Pembelajaran page	1	Go to the Pembelajaran page	It will display “Mari Mengenal Huruf Vokal”, “Mari Mengenal Suku Kata Terbuka”, and “Perkataan Suku Kata Terbuka” buttons. The page also has home button.
	2.	Click on the “Mari Mengenal Huruf Vokal” button.	Navigate to the “Mari Mengenal Huruf Vokal” page.
	3.	Click on the “Mari Mengenal Suku Kata Terbuka” button.	Navigate to the “Mari Mengenal Suku Kata Terbuka” page.
	4.	Click on the “Perkataan Suku Kata Terbuka” button.	Navigate to the “Perkataan Suku Kata Terbuka” page.
	5.	Click the home button	It will display homepage.
Mari Mengenal Huruf Vokal page	1.	Go to the Mari Mengenal Huruf Vokal page	It will display “Huruf Vokal” and “Kuiz” buttons. The page also has home button.
	2.	Click on the “Huruf Vokal” button.	Navigate to the “Huruf Vokal” page.
	3.	Click on the “kuiz” button.	Navigate to the “kuiz” page.
	4.	Click the home button	It will display homepage.
Mari Mengenal Suku Kata Terbuka page	1.	Go to the Mari Mengenal Suku Kata Terbuka page.	It will display the notes and forward buttons. The page also has home button.
	2.	Click the home button.	It will display homepage.
Perkataan Suku Kata Terbuka page	1.	Go to the Perkataan Suku Kata Terbuka page.	It will display “Dua Suku Kata Terbuka”, “Tiga Suku Kata Terbuka”, and “Kuiz” buttons. The page also has home button.
	2.	Click on the “Dua Suku Kata Terbuka” button.	Navigate to the “Dua Suku Kata Terbuka” page.
		Click on the “Tiga Suku Kata Terbuka” button.	Navigate to the “Tiga Suku Kata Terbuka” page.
	3.	Click on the “kuiz” button.	Navigate to the “kuiz” page.
	4.	Click the home button	It will display homepage.
Permainan page	1.	Go to the Permainan page	It will display “Padankan Suku Kata Terbuka”, “Susun Suku Kata Terbuka”, and “Teka Perkataan” buttons. The page also has home button.
	2.	Click on the “Padankan Suku Kata Terbuka” button.	Navigate to the “Padankan Suku Kata Terbuka” page.
	3.	Click on the “Susun Suku Kata Terbuka” button.	Navigate to the “Susun Suku Kata Terbuka” page.

	4.	Click on the "Teka Perkataan" button.	Navigate to the "Teka Perkataan" page.
	5.	Click the home button.	It will display homepage.

Conclusion

In conclusion, the systematic application of the ADDIE model offers a comprehensive framework for developing e-learning courseware tailored to the specific requirements of 4-year-old kindergarten students learning sukukata terbuka in Bahasa Melayu. Commencing with the Analysis phase, a thorough understanding of learners' cognitive development, preferences, and learning environment is established. The Design phase constructs a blueprint integrating vibrant multimedia elements and a user-friendly interface, mindful of the young audience's unique traits. During Development, interactive modules and relevant content are generated, with usability testing ensuring alignment with educational objectives. Implementation involves educator training and seamless integration into the curriculum. Lastly, the Evaluation phase, segmented into areas such as User Interface, Functionality, Navigation, Activities, and Multimedia Elements, critically evaluates overall effectiveness and user satisfaction. Surveys, observations, and analytics yield valuable insights, driving iterative enhancements in interface design, functionality, navigation clarity, activity engagement, and multimedia integration. This holistic approach guarantees a refined and optimized e-learning experience, ultimately augmenting sukukata terbuka instruction effectiveness for 4-year-old Bahasa Melayu learners.

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GAMIFICATION DESIGN FOR ONLINE LEARNING OF INTRODUCTORY PROGRAMMING: A COMPARATIVE ANALYSIS

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ABSTRACT

This paper discusses the gamification design recommended for an online learning platform specifically for the introductory programming course. Initially, during literature search, more than 50 existing studies were manually selected through various literature databases. It then led to the selection of ten studies that utilised gamification design principles in online learning platforms to learn introductory programming in higher learning institutions based on the pre-determined themes during the extraction and filtration phase. A further detailed criteria of the comparative analysis during the review and analysis phase were then applied which resulted in the findings of the gamification framework, gamification principles, and gamification elements suitable for the gamified online learning environment of the introductory programming course.

Keywords: gamification, design principles, introductory programming, online learning

Introduction

In facilitating the teaching and learning of introductory programming, over these years, many studies have utilised online learning platforms. For example, a study done by Karnalim and Ayub (2017) have resulted in a development of an online learning system named PythonTutor to support the teaching and learning of an introductory programming course. The system was embedded with the visualisation technique claimed to have positive impacts towards students' understanding in programming, especially at their early stages. Moreover, Carbonaro (2018) has utilised a web-based peer code review and assessment to promote students' engagement and participation in the coding experience, while also providing feedback to their peers. The web-based programming assistance system enhances students' programming skills, engagement, and time management abilities. Through this approach, students are involved not only as learners but also as reviewers.

Additionally, gamification in online learning environments to learn introductory programming has also gained interest among researchers and academicians. For instance, a study done by Khaleel et al. (2019) has used the Mechanics-Dynamics-Aesthetics (MDA) Framework as the design guidelines in the development of the gamification-based learning website to learn Java programming. According to the study, the structure of the gamification application encompasses several key components: mechanics, which are the tools of gamification integrated with programming content to enhance student effectiveness and make the programming course more engaging; dynamics, which involve how users interact with these mechanics; and aesthetics, which pertain to the emotional responses elicited by the application's design. The use of the MDA Framework facilitated the inclusion of various gamification elements in the online learning system, including levels, a scoring system, badges, and a leaderboard, all aimed at creating a compelling user interface.

Nevertheless, designing a gamified online learning posed challenges for many instructional designers (Hunicke et al., 2004; Deterding et al., 2011). One needs to consider the game mechanics and how to dynamically instruct them to successfully deliver a gameful experience and invoking aesthetics emotions (Hunicke et al., 2004; Khaleel et al., 2019). Hence, understanding the framework, principles and elements of gamification can help to design gamified online learning that are more interactive, engaging and motivating for the introductory programming course. Therefore, this paper seeks to identify and extract the suitable gamification framework, principles and elements to be employed in a gamified online learning environment for an introductory programming course through a comparative analysis. The structure of this paper starts with the explanation of the methodology for the comparative analysis, followed by the findings and conclusions.

Methodology

This study employed the qualitative approach using the comparative analysis technique adopted from Ahmad and Abdul Mutalib (2015) which involves three main phases, i) literature search, ii) elicitation and filtration, and iii) review and analysis.

The following is the description of each of the phases involved in conducting the comparative analysis:

a) Literature search

In the first phase, an extensive literature search was conducted through various literature databases such as Scopus, Web of Science (WoS), IEEE and Google Scholar. This was to search for articles that are related to the implementation of gamification in online learning platforms, specifically in learning introductory programming. The search for the articles is being done throughout the year 2018 until 2023. Several keywords have been used, such as “introductory programming”, “online learning”, “gamification for education”, “gamification principles”, and “gamification elements”.

b) Elicitation and filtration

Through manual selection, initially, more than 50 articles were selected. To further select the most suitable articles for this study, certain themes have been pre-determined where all selected studies must i) be related to the online learning for introductory programming courses in higher learning institutions, ii) discussed the gamification framework they have referred to, iii) discussed the gamification principles that they have employed in the online learning platform, and iv) discussed the gamification elements used in the study.

Therefore, based on the pre-determined themes, only ten articles have been deemed suitable for further review and analysis. All ten selected articles have extensively discussed the implementation of gamification in online learning platforms to support the teaching and learning of introductory programming in higher learning institutions, which eventually helped to establish the direction of this study.

c) Review and analysis

All ten articles were further reviewed and analysed in terms of these criteria, i) gamification framework, ii) gamification principles, and iii) gamification elements. The following section will discuss in detail the review and analysis results.

Findings

As mentioned previously, all ten existing studies were selected based on the pre-determined themes. Table 1 shows the studies selected for the review and analysis process.

Table 1: The selected existing studies

Author	Studies
Imran (2023)	A Gamified Learning Environment Model
Nadja (2022)	A Personalized Gamification Design Model (PeGAM)
Poonsawad et al. (2022)	Problem-based Interactive Digital Story Learning Model
Alsubhi et al. (2021)	Engagement Framework for E-learning Gamification
Kamunya et al. (2020)	An Adaptive Gamification Model of E-learning
Winanti et al. (2020)	Gamification Framework for Programming Course in Higher Education
Alshammari (2019)	Gamification Design Model for E-learning
Khaleel et al. (2019)	Gamification-based Learning Framework for a Programming Course
Padirayon (2019)	Gamification Application Architecture and Elements
Piteira et al. (2018)	Conceptual Framework of Gamification on Online Courses

Through the review and analysis process, detailed criteria were extracted to determine the gamification design principles that are suitable for the online learning of introductory programming. As a result, Table 2 shows the findings of the comparative analysis conducted. As mentioned previously, the criteria extracted from the existing studies are the gamification framework, gamification principles and gamification elements.

Table 2: Comparative analysis of gamification implementation in online learning for introductory programming

Author	Gamification Framework	Gamification Principles	Gamification Elements
Imran (2023)	MDA Framework	Progression, achievement, rules and challenges, storyline/narrative	Points, badges, levels, leaderboard, progress bar
Nadja (2022)	Adaptive user centred gamification framework	Progression, rules and challenges, feedback/achievement, sensation	Badges, leaderboard, progress bar, virtual goods
Poonsawad et al. (2022)	MDA Framework	Progression, rules and challenges, feedback/achievement storyline/narrative, sensation	Points, badges, levels, leaderboard, progress bar
Alsubhi et al. (2021)	MDA Framework	Progression, achievement, rules and challenges, sensation	Points, badges, levels, leaderboard, progress bar, timer
Kamunya et al. (2020)	MDA Framework	Rules and challenges, rewards/status, achievement, competition, altruism	Badges, leaderboard, progress bar, virtual goods
Winanti et al. (2020)	Gamification framework for K-6 education	Progression, achievement, rules and challenges, sensation	Points, badges, levels, leaderboard
Alshammari (2019)	MDA Framework	Rules and challenges, rewards/status, achievement, progression	Points, badges, levels, leaderboard, timer
Khaleel et al. (2019)	MDA Framework	Progression, achievement, rules and challenges, competition, altruism, sensation	Points, badges, levels, leaderboard, progress bar
Padirayon (2019)	MDA Framework	Progression, achievement, rules and challenges, sensation	Points, badges, levels, leaderboard, progress bar
Piteira et al. (2018)	Principles of Gamified Educational Design	Progression, achievement, rules and challenges, narrative, sensation	Points, badges, levels, leaderboard, progress bar

Based on the findings depicted in Table 2, it has been found that the MDA Framework has been the most selected gamification framework among the existing studies, where seven out of ten studies have been referring to the MDA Framework. The MDA Framework, which stands for game Mechanics, Dynamics and Aesthetics was first introduced by Hunicke et al. (2004) to be used in the educational technology environment. The flexibility and adaptability of the three distinct layers of the MDA Framework have contributed to the widely applied gamification framework in the online learning environment for the introductory programming course as mentioned by Khaleel et al. (2019), Alsubhi et al. (2021) and Imran (2023). Additionally, the MDA Framework also focuses on the student's experiences and emotions which influences enjoyment, engagement and motivation (Alshammari, 2019; Poonsawad et al., 2022).

Meanwhile, Table 2 has also revealed that the most applied gamification principles for the online learning environment of learning introductory programming are achievement, rules and challenges, and progression. In most of the existing studies, the achievement principle represents the successful completion of a course, a lesson, or a challenge in a gamified online learning system (Padirayon, 2019; Alshammari, 2019; Nadja, 2022). In addition, the rules and challenges principles required a defined goal setting, telling learners what and how to achieve in a narrative or storyline. Other than that, challenges also serve as elements that instruct learners on the system's required actions, such as course obstacles that must be unlocked before progressing to the next level (Khaleel et al., 2019; Kamunya et al., 2020; Alsubhi et al., 2021; Imran, 2023). Moreover, the progression principle represented as ropes of engagement to keep users motivated and interested. Unlocking levels and interactive progress bars are typically used to represent a learner's progress (Piteira et al., 2018; Khaleel et al., 2019; Winanti et al., 2020; Poonsawad et al., 2022).

Furthermore, the gamification principles identified previously have also influenced the selection of the gamification elements among the existing studies. In most cases, as shown in Table 2, the gamification principles selected for the online learning of introductory programming often required the utilisation of gamification elements such as accumulating points, badges and acquiring ranks in the leaderboards that represent the achievement principle. Additionally, unlocking levels and progress bars also represent progression of accomplishing rules and challenges, which then led to invoking learners' sensation and motivation to stay engage with the online learning (Piteira et al., 2018; Khaleel et al., 2019; Winanti et al., 2020; Poonsawad et al., 2022. Nadja, 2022; Imran, 2023).

Therefore, based on the findings of the comparative analysis, a comprehensive gamification design can be conceptualised to provide guidance to the development of a gamified online learning system for the introductory programming. Figure 1 shows the assimilation of the extracted gamification principles and elements and how it can be integrated within the three layers of the MDA Framework.

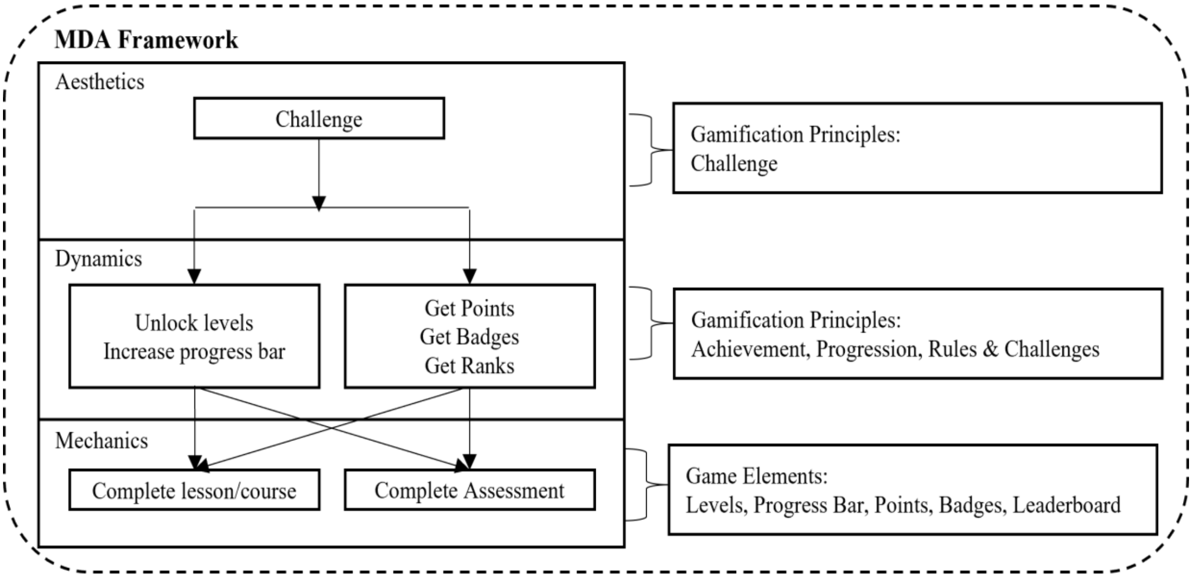

Figure 1: Integration of the recommended gamification design for a gamified online learning environment of introductory programming

Conclusion

Gamification design in online learning environments has been widely researched and implemented over the years. Nevertheless, in learning introductory programming via online platform, it is crucial to determine the suitable gamification design that would help learners to stay engaged with online learning, whilst improving their motivation. To achieve this, a comparative analysis among ten existing studies was conducted to identify and extract the suitable gamification framework, principles and elements for a gamified online learning environment of the introductory programming course. The findings have shown that the MDA Framework was most effective to be implemented in the online learning environment because of its flexibility and adaptability with its three distinct layers of gamification design; the game mechanics, dynamics and aesthetics. Meanwhile, the most suitable gamification principles identified are the achievement, rules and challenges, and progression, with gamification elements of points, badges, levels, leaderboards and progress bars. Each principle provides mechanisms to represent learners' accomplishments through narrative in challenges, and learners' progression in unlocking levels and proceeding in acquiring higher ranks. Additionally, the game elements represent the game mechanics that provide interactive elements for accumulating points and badges, virtual presentation of progress bars, unlocking levels and accomplishing ranks in the leaderboards. In conclusion, as a result of these findings, a conceptual gamification design has been developed, which in hope to lead the development of a more effective gamified online learning system for introductory programming.

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e-SUKUKATA TERBUKA BAHASA MELAYU: THE E-LEARNING COURSEWARE FOR 4-YEARS-OLD KINDERGARTEN STUDENTS

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ABSTRACT

The development of e-sukukata signify a significant advancement in early childhood education, especially for teaching "suku kata terbuka" to Bahasa Melayu-speaking children. Designed to support four-year-olds, this innovative courseware enhances language skills and enriches the learning experience through interactive multimedia and an ontology-based approach. The e-sukukata courseware was launched to tackle the challenges children face in mastering "suku kata terbuka," addressing issues like pronunciation difficulties and slow vocabulary growth. By integrating knowledge management, system thinking techniques, and ontology-based methods, the courseware provides a structured learning environment. It includes modules on vowel networking, themed word categories, and interactive quizzes. This thorough approach not only fills educational gaps but also boosts learning through engaging multimedia content, which enhances retention and understanding.

Keywords: courseware, kindergarten, multimedia, ontology, knowledge management, system thinking

Introduction

"Courseware" refers to instructional tools, software, and resources designed to help organize and present lessons and learning opportunities. It includes structured material, multimedia elements, assessments, and interactive features, making it essential for promoting effective and efficient learning. Agno and Ponte's (2013) research showed positive results with interactive courseware, allowing students to learn at their own pace, receive instant feedback, and benefit from personalized education.

E-learning has transformed education delivery, offering flexible and engaging learning environments. Multimedia e-learning courseware, particularly for teaching Malay, can significantly improve learning outcomes. This project focused on teaching "suku kata terbuka" (open syllables) to students as young as four, utilizing knowledge management and system thinking through an ontology-based approach. In Malay, "suku kata terbuka" are syllables ending in a vowel sound without a following consonant, contributing to the language's melodic flow. Ahmad and WA (2012) used instrumental phonetic analysis to identify these syllables in Bahasa Melayu.

In e-learning courseware for Bahasa Melayu, especially for learning "suku kata terbuka," effective knowledge management is crucial. By organizing, capturing, storing, and distributing relevant learning materials, teachers can provide comprehensive resources, enhancing the learning process. Petrides and Nodine (2003) emphasize that knowledge management offers a strategic framework for maximizing knowledge use and improving educational outcomes. Using an ontology-based technique, this project categorizes "suku kata terbuka" into vowels and themes, like "Dua" and "Tiga Suku Kata Terbuka," making learning interactive and allowing students to apply these concepts in everyday language. This work aims to develop e-learning courseware focused on "suku kata terbuka" in Bahasa Melayu for 4-year-old students.

In the next section, this paper explores a review of the current practices on e-learning courseware for kindergarten followed by a section containing detailed explanation on the e-Sukukata courseware. Finally, conclusions and recommendations for future research are drawn up in the final section.

Current Practices

The phonic method is the most widely used approach for teaching "suku kata terbuka" in Bahasa Melayu to 4-year-old students, as revealed through interviews with two kindergartens: Tabika Kemas Al-Ikhlas and Tabika Kemas Sri Nakhoda. These interviews uncovered consistent patterns in how teachers use phonics to help students grasp the fundamental concepts of "suku kata terbuka." The current phonic technique emphasizes the relationship between sounds and letters, enabling students to explore syllabic structures in a step-by-step manner. This method aims to enhance phonemic awareness, laying a strong foundation for language development in early childhood education.

Additionally, Tadika Naluri Kreatif Wakaf Beruas emphasizes that learning in kindergartens today is centered around practical experiences. For instance, in culinary classes, students are introduced to labeled items like "gu-la" (sugar), "ga-ram" (salt), and "te-pung" (flour). As students participate in the cooking activity, this indirect exposure aids in vocalization and repeated reading. Afterward, the instructor leads a discussion, reviewing the topic with flashcards and various exercises, such as matching.

Transitioning from the current phonics-based methods to e-learning multimedia courseware for teaching "suku kata terbuka" in Bahasa Melayu to 4-year-old students offers an innovative approach that leverages technology-enhanced education. This shift not only accommodates diverse learning preferences but also introduces a playful element, fostering a positive attitude toward language learning.

With multimedia courseware, students can learn at their own pace and receive instant feedback. This digital-age innovation will enhance the effectiveness of early childhood education by integrating technology into the classroom. Table 1 outlines the current methods used by three kindergartens to teach "suku kata terbuka" in Malay to 4-year-old students.

Table 1: Current Methods Used by Kindergartens

Kindergarten	Learning Method	Descriptions
Tabika Kemas Al-Ikhlas	Phonic Method	• Utilizes the phonics method, including resources like the "Buku Anakku," to teach kindergarten students about "suku kata terbuka." • Students practice pronouncing "suku kata terbuka" and learn to write by connecting dots to form letters using the book.
Tabika Kemas Sri Nakhida	Phonic Method	• Employs phonics-based methods, such as using books, to teach children to read and spell by linking sounds with letter combinations or individual letters.
Tabika Naluri Kreatif Wakaf Beruas	Hands-on-activities: Flashcards and paper-based activities	• Utilizes hands-on activities, such as cooking classes, where children are introduced to labeled ingredients. • Provides instruction using flashcards and a variety of exercises, including matching activities. • Incorporates paper-based exercises that involve tracing words, mimicking, matching syllables, and pasting.

The e-Sukukata Courseware

E-sukukata is a meticulously crafted tool designed to address the specific needs of four-year-old kindergarten students learning "Suku Kata Terbuka" in Bahasa Melayu. By incorporating interactive multimedia elements such as vibrant graphics, engaging games, and audio features, the courseware creates a dynamic and adaptable learning environment. Its intuitive interface encourages exploration and interaction, supporting students in mastering the basics of language and "Suku Kata Terbuka." Additionally, its flexibility allows instructors to tailor lessons to accommodate diverse learning styles while maintaining curriculum standards and educational quality.

The "e-sukukata" courseware homepage serves as the entry point for young learners, as depicted in Figure 1. Its design features a vibrant and inviting color scheme, including blue, yellow, green, white, and red, creating a welcoming environment. The page's appeal is enhanced by a delightful cat and a friendly robot set against a soothing cloud background. Prominent buttons labeled "Pembelajaran" and "Permainan" guide users to their respective areas. Clicking "Pembelajaran" directs users to three main learning modules, while the "Permainan" button leads to various educational games. The straightforward and engaging design of these buttons is intended to attract the attention of 4-year-old kindergarten students and encourage enthusiastic exploration of the courseware's content.

Figure 1: Homepage

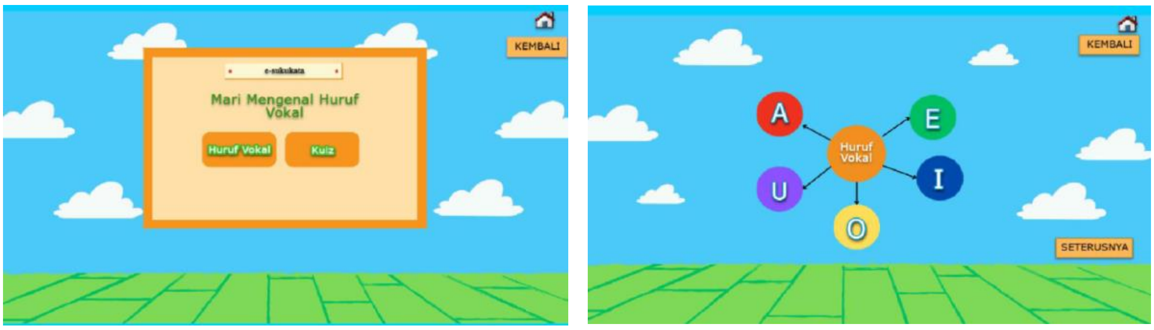
The "Pembelajaran" page, an essential part of the e-sukukata courseware, is illustrated in Figure 2. It offers a structured learning path for "Suku Kata Terbuka" in Bahasa Melayu. Upon reaching this page, users encounter three options: "Mari Mengenal Huruf Vokal," "Mari Mengenal Suku Kata Terbuka," and "Perkataan Suku Kata Terbuka," each leading to specific instructional sections.

Figure 2: Pembelajaran Page

Clicking "Mari Mengenal Huruf Vokal" allows users to explore vowel letters, while "Perkataan Suku Kata Terbuka" directs them to a section on words containing "suku kata terbuka." The "Mari Mengenal Suku Kata Terbuka" button leads to a page dedicated to understanding "suku kata terbuka."

These sections are designed to break down complex language concepts into manageable lessons, making learning more accessible. Additionally, each page features a home button for easy navigation back to the main homepage, ensuring a seamless and user-friendly experience throughout the courseware.

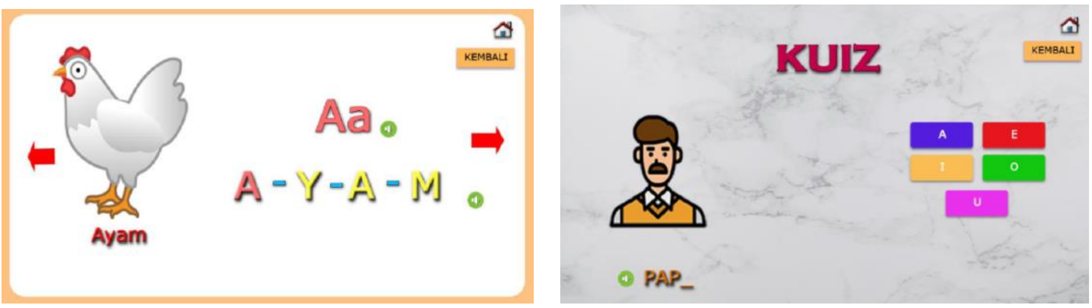
The "Mari Mengenal Huruf Vokal" page, crucial for teaching vowel letters in Bahasa Melayu, is a key component of the e-sukukata courseware, as shown in Figure 3(a). This page features two main buttons: "Huruf Vokal" and "Kuiz." Selecting the "Huruf Vokal" button takes users to a detailed page as shown in Figure 3(b) where they can explore and learn about the five vowel letters—A, E, I, O, and U. Understanding these vowel letters is essential for mastering “suku kata terbuka,” as these syllables end in vowels and are fundamental to language fluency.



(a) (b)

Figure 3: Mari Mengenal Huruf Vokal

On the vowel page, the "seterusnya" button allows users to view examples of words for each vowel, such as "A is for Ayam" as shown in Figure 4(a), which helps contextualize the vowels within meaningful sentences and enhances comprehension. The "Mari Mengenal Huruf Vokal" page focuses on the vowels A, E, I, O, and U, using examples of words that start with these vowels to teach each one. As shown in Figure 4(b), the "Kuiz" button introduces a quiz feature that lets students test their knowledge and receive immediate feedback, making learning both engaging and interactive. Additionally, a home button on the page enables users to easily return to the homepage, ensuring clear and simple navigation even for younger users.

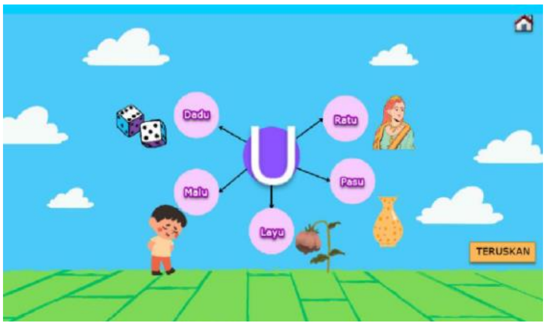


(a) (b)

Figure 4: Example for Vowel and Quiz Pages

The "Mari Mengenal Suku Kata Terbuka" page, designed to teach students about "suku kata terbuka" in Bahasa Melayu, is illustrated in Figure 5(a). Clicking the "mainkan" button plays a tutorial video on "dua suku kata terbuka," as shown in Figure Figure 5(b). After watching this video, selecting "seterusnya" will lead users to a tutorial on "dua suku kata terbuka." Following this, users can view vowel-specific examples by clicking "seterusnya" again. This action displays words containing "suku kata terbuka" for each vowel, as depicted in Figure 5(c). This structured approach enhances students' understanding of open syllables by providing clear and logical explanations, deepening their comprehension and reinforcing their knowledge with practical examples.

(a) (b)

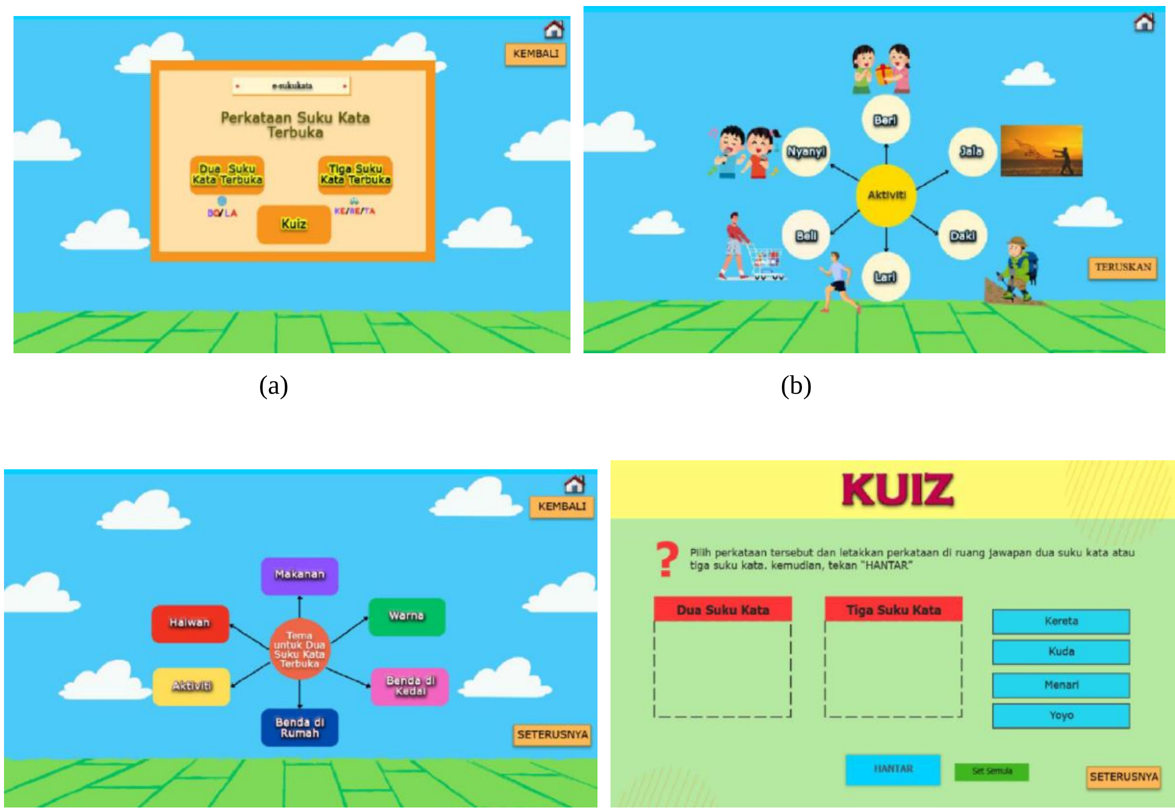


(c)

Figure 5: “Mengenali Dua Sukukata Terbuka” Page

The "Perkataan Suku Kata Terbuka" page, as shown in Figure 6(a), provides an in-depth exploration of words composed of "suku kata terbuka." This page features buttons for "Dua Suku Kata Terbuka," "Tiga Suku Kata Terbuka," and "Kuiz," each leading to more specific content. Clicking the "Dua Suku Kata Terbuka" button takes users to a page focused on two-syllable words, offering a range of themes with examples of two-syllable open syllables, as illustrated in Figure 6(b). Similarly, the "Tiga Suku Kata Terbuka" button directs users to a section on three-syllable words, organized by themes and featuring examples of three-syllable open syllables, as shown in Figure 6(c).

The "Kuiz" button provides a quiz that allows users to apply and reinforce their understanding of both two-syllable and three-syllable open syllables, as depicted in Figure 6(d). To ensure easy navigation, the page includes a home button for returning to the main page. This structured approach, featuring interactive assessments and progressive content, supports a comprehensive understanding of "suku kata terbuka" for students.



(a) (b)

(c) (d)

Figure 6: Pages provide an in-depth exploration of words and quizzes

The "Permainan" page, illustrated in Figure 7, offers an interactive and enjoyable way for students to reinforce their learning. This page features three instructional games: "Teka Perkataan," "Susun Suku Kata Terbuka," and "Padankan Suku Kata Terbuka."

Figure 7: The “Permainan” page

The "Padankan Suku Kata Terbuka" game enables students to match syllables and form words, which aids in practicing and reinforcing their grasp of syllable combinations. Similarly, the "Susun Suku Kata Terbuka" game focuses on helping students understand word structure by requiring them to arrange syllables in the correct order. Lastly, the "Teka Perkataan" game boosts vocabulary and comprehension by presenting students with clues that they must use to guess the correct words. Each game offers a unique approach to enhancing students' understanding of language. Each game is designed to reinforce key language skills while providing a fun and engaging experience.

Conclusion

In conclusion, the development and evaluation of e-sukukata represent a significant advancement in early childhood education, particularly for teaching "suku kata terbuka" to Bahasa Melayu-speaking children. This courseware supports four-year-olds in developing their language skills and enhances the learning experience through interactive multimedia and an ontology-based approach. Expert assessments and user feedback confirm its high usability, engagement, and educational impact, validating its effectiveness in achieving educational goals. Future iterations of e-sukukata will focus on continuous improvement based on evaluation insights, further optimizing its role as a valuable tool for early childhood language education and fostering a lifelong love of learning.

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BRIDGING THE GAP: ADDRESSING FOUNDATIONAL MISTAKES IN ENGINEERING CALCULUS EDUCATION

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ABSTRACT

This observational study investigates common errors made by engineering students in a calculus course at Universiti Teknologi MARA, focusing on their performance during a test covering various calculus topics, including L'Hôpital's Rule, improper integrals, total differentials, and first-order differential equations. The analysis reveals that the most frequent errors are related to basic mathematical concepts and careless mistakes, particularly in solving simultaneous equations and rewriting differential equations. The findings suggest that students' difficulties stem from inadequate foundational knowledge and insufficient practice, emphasizing the need for targeted instructional interventions to improve their understanding and application of calculus. This study provides insights that can guide educators in developing more effective teaching strategies to enhance student success in calculus.

Keywords: Calculus, engineering education, student errors, mathematical concepts, instructional strategies

Introduction

Calculus is essential in engineering as it provides the mathematical framework for analyzing and solving complex problems. It allows engineers to model and predict system behaviors, optimize processes, and understand changes in physical quantities. Differential calculus helps in determining rates of change, crucial for motion and force analysis, while integral calculus is used for computing areas, volumes, and total quantities. Mastery of calculus enables engineers to design and analyze structures, circuits, and systems with precision, ensuring functionality and safety. Overall, calculus is foundational in advancing technological innovations and practical applications in various engineering disciplines.

In the field of higher education, the accurate assessment of students' understanding, and application of mathematical principles is crucial for shaping effective teaching strategies and improving learning outcomes. Given the high failure rates in mathematics, it is important to address the errors and misconceptions students make (Voon et al., 2017). These errors can stem from misunderstanding of concepts, theorems or formulas, mistakes in applying basic techniques, incorrect presentation of solutions, or a lack of understanding of a problem’s assumption (Othman et al., 2018). This observational study examines the types of mistakes made by students in Calculus for Engineers course, MAT435. The test, conducted on June 14, 2024, encompassed a range of topics including L'Hôpital's Rule, improper integrals, total differentials, chain rule, implicit differentiation, extremum points, and first-order differential equations. By analyzing the errors committed by students, this study aims to identify common pitfalls and areas that require targeted instructional interventions, thereby contributing to the enhancement of calculus education.

Literature Review

Mathematics, particularly calculus, which was once exclusively taught at the university level, has increasingly become part of the secondary school curriculum. In secondary school, many students study mathematics with the aim of applying it in fields such as science, engineering, and commerce. However, with the rapid development of new technologies and their diverse applications, there has been growing pressure to modify the mathematics curriculum (Tall, 1978). Another concern among secondary teachers is the limited time available to meet syllabus requirements (Simmonds, 1989). When students enroll in university, courses related to calculus expect them to have a solid understanding of basic mathematical concepts. Without strong foundational knowledge from school, it is challenging for students to succeed in engineering courses.

A study of 30 engineering undergraduates found that errors related to basic calculus concepts were prevalent, indicating a moderate level of achievement that needs improvement (Alias et al., 2023). Supporting this, Torbett and Cordella (2017) note that engineering curricula are typically structured around a core mathematics curriculum, from Calculus to Differential Equations. Therefore, it is crucial to understand how engineers apply analytical thinking and mathematical practices in their tasks. Furthermore, a study at the Coimbra Institute of Engineering found a moderate correlation between performance in Introductory Programming and Differential and Integral Calculus among first-semester engineering students (Bigotte et al., 2021). Success in programming is often mirrored by success in mathematics. Additionally, research at Universitas Banten Jaya identified that careless calculations and insufficient practice were major issues among undergraduate students (Sari, 2023). By identifying the types of mistakes students make, preventive actions can be taken to help them pass their examinations (Moradi et al., 2023).

Methods

The sample test was taken from MAT435 class of semester March 2024 – July 2024. A total of 9 answer papers were included in this observational study. This test was taken on 14th June 2024. Students were given 90 minutes to answer the test. In this test, there are 7 questions. Table 1 summarizes the types of questions asked during the test.

Upon reviewing the completed test papers, five common types of mistakes were identified. The first type of mistake involved incorrect concepts or formulas, such as using the wrong formula for solving L'Hôpital's rule or applying the formula for total differentials when solving implicit problems. The second type of mistake was classified as careless errors. These included instances where a student's solution unexpectedly changed from negative to positive. Errors in solving simultaneous equations or rewriting equations into the standard form of a differential equation were categorized as basic mathematics mistakes. The fourth group of mistakes involved incorrect techniques for either differentiation or integration, despite the provision of relevant formulas during the test. For the analysis, only the first mistake made by students in each question was recorded. The results indicated that most students' errors were conceptual and computational. These mistakes stemmed from an inadequate understanding of fundamental mathematical concepts and insufficient quality of education in secondary school.

Table 1: Types of Questions Asked in the Test

Number	**Question**
Question 1(a)	**L'Hôpital's Rule**
	Use L'Hopital's Rule to evaluate $\lim_{x \to 0} \frac{\ln\left|\cos(2x)\right|}{x}$
Question 1(b)	**Improper Integer**
	Evaluate the improper integral $\int_e^{\infty} \frac{1}{x(\ln x)^3} dx$.
Question 2	**Total Differential**
	Use differential to estimate the change in $f(x,y) = \sqrt{x}\sin(3y)$ from (4,1) to (3.9,1.2). Give your answer in 4 decimal places.
Question 3	**Chain Rule**
	Given $z = 3x^2 e^{-2y}$, $x = t+1$, $y = \ln t$, find $\frac{dz}{dt}$ by using Chain Rule
Question 4	**Implicits Differentiation**
	Find the equation of the tangent line to the curve $ye^{x^2} + y^2 - 5x - 2 = 0$ at the point (0, 2) using partial differentiation
Question 5	**Extremum points**
	Locate all relative extrema and saddle point(s) of $f(x,y) = x^2 y - x^2 - 2y^2$
Question 6	**1st Order Differential Equation (1st ODE)**
	Solve the initial value problem for this separable differential equation $\frac{\cos y}{x+1}\frac{dy}{dx} = x$ at point $\left(2, \frac{\pi}{2}\right)$.

Results and discussion

The data were collected from nine undergraduate students enrolled in the MAT435 course, focusing on the types of mistakes they made during the MAT435 test. Out of nine, seven students are males, and the rest are female. Six of them are from the School of Electrical Engineering and the other three are from the School of Mechanical Engineering. The majority of them are taking MAT435 for the second time (Figure 1).

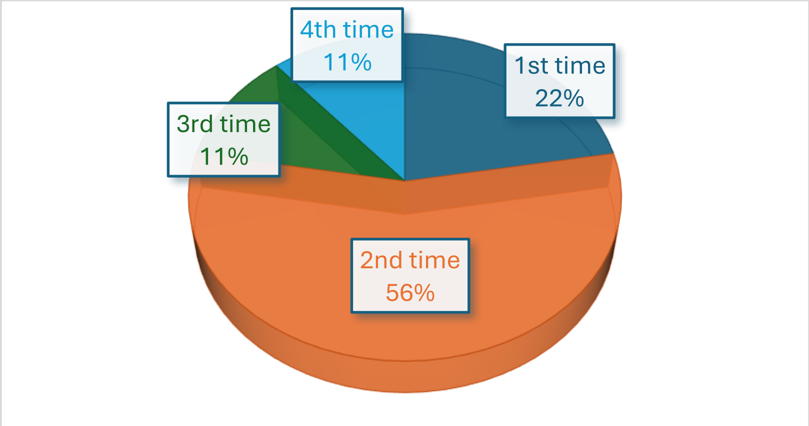

Figure 1: Number of Times Student Taking MAT435

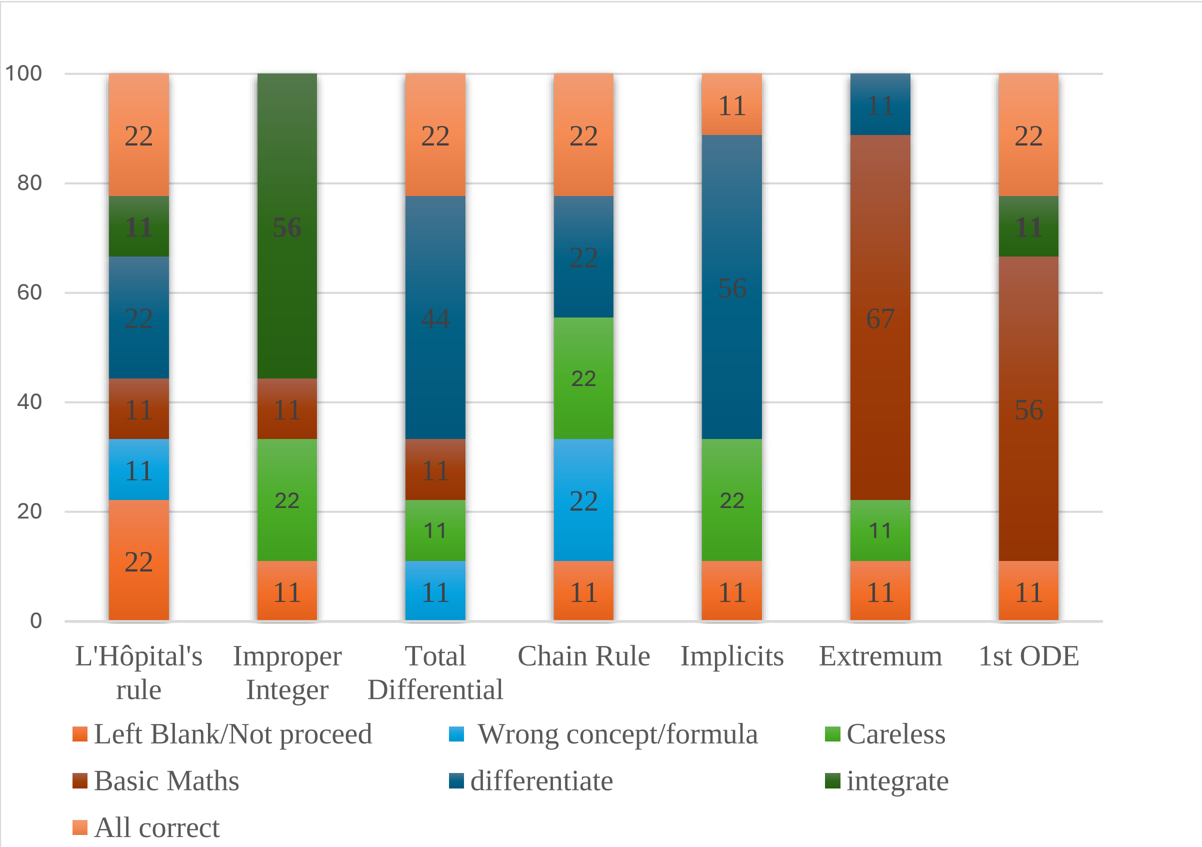

Figure 2: Type of Mistakes Made by Students (%)

The analysis revealed that the highest mistake made by students is basic mathematics. 67% of students have problem solving simultaneous equations in extremum point question while 56% students have problem rewriting the first order differential equation into the standard form of separable differential equation (Figure 2). 55.55% of the students struggled with improper integral problems. In addition, 55.55% of them have problems with differentiation in first-order differential equations, and 44.44% in extremum problems. The results of this study provide valuable insights into the common mistakes made by students during calculus tests and highlight the important basic knowledge that educational should focus on.

Careless and basic mathematics errors were prevalent among students, indicating a need for better foundational understanding and careful attention during tests. This might suggest that students are either rushing through problems or not fully understanding the basic mathematical principles required for solving calculus problems. Such errors could stem from inadequate foundational learning during secondary school years, where impractical teaching methods may have hindered students' understanding of basic mathematics. Previous studies have identified that the exam-oriented approach used by teachers in secondary schools has resulted in a focus on learning concepts, rules, or formulas solely to pass exams (Köğce, 2022; Lasheras et al., 2019).

Differentiation and integration mistakes highlight the areas where students struggle the most. A poor grasp of basic mathematics might contribute to the challenges they face in learning and understanding these two main branches of calculus. Enhanced instructional focus on these topics could help in reducing such errors. On the other hand, conceptual and formula errors indicate gaps in understanding specific calculus concepts and the application of formulas. Targeted tutoring and practice sessions could mitigate these mistakes. Furthermore, Peer Assisted Learning Strategies (PALS) could be implemented to help less skillful students reduce their errors by learning from more competent peers. This approach is one of several strategies summarized in the study by Othman et al. (2018).

Conclusion

The findings of this study reveal that basic mathematical errors and careless mistakes are predominant among students in the MAT435 calculus course. These errors suggest a need for reinforced foundational knowledge and greater attention to detail during problem-solving. Additionally, difficulties with differentiation and integration indicate specific areas where students struggle, highlighting the necessity for improved instructional focus on these topics. Conceptual and formula errors further underscore gaps in understanding that could be addressed through targeted tutoring and practice sessions. Overall, this study provides valuable insights into the common mistakes made during calculus tests, offering guidance for educators to develop more effective teaching strategies aimed at reducing these errors and enhancing student comprehension in mathematics.

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THE EVALUATION OF *e-SUKUKATA* BAHASA MELAYU COURSEWARE FOR KINDERGARTEN

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ABSTRACT

The "e-sukukata" e-learning courseware, created for 4-year-old kindergarten students to learn "suku kata terbuka" in Bahasa Melayu, addresses key challenges in early childhood education. These challenges include difficulties in recognizing open syllables, limited vocabulary, and the lack of modern methods for vocabulary acquisition. The project employed the ADDIE model—Analysis, Design, Development, Implementation, and Evaluation—to identify effective teaching and learning requirements. It used an ontology-based technique to design and develop the courseware and conducted thorough evaluations of its functionality and usability. This paper explores the finding on the effectiveness of the courseware. The study involved expert assessments by IT lecturers, as well as formal evaluations by teachers and parents, demonstrating the courseware's effectiveness in enhancing the learning experience. The results showed high levels of user satisfaction, ease of use, and educational impact, indicating that "e-sukukata" courseware is a valuable tool for early language development. This research underscores the importance of incorporating interactive multimedia and modern educational methods to support linguistic development in young students, making a significant contribution to early childhood education.

Keywords: courseware, kindergarten, usefulness, ease of use, ease of learning, satisfaction.

Introduction

The *e-Sukukata* courseware work was initiated to address the challenges students face in understanding *sukukata terbuka* in Bahasa Melayu. The curriculum is designed to tackle developmental issues such as difficulties with pronunciation and slow vocabulary acquisition. By consulting with educators from Tabika Kemas Al-Ikhlas, Tabika Kemas Sri Nakhoda, and Tadika Naluri Kreatif Wakaf Beruas, the work identified specific needs and developed tailored solutions. The courseware integrates knowledge management principles, systems thinking, and ontology-based techniques. To engage students effectively, the courseware features modules on vowel networking, thematic word categories, and interactive quizzes. This comprehensive approach not only addresses educational gaps but also enhances learning through engaging multimedia content, which aids in retention and comprehension.

The work focusses on enhancing language skills and cultural relevance by deeply embedding concepts of Bahasa Melayu and *suku kata terbuka*. The e-Sukukata courseware aims to transform traditional teaching methods into dynamic, interactive learning experiences tailored to the needs of four-year-old students. During its research and implementation phases, this work encountered various challenges despite its innovative design and positive outcomes. The initial complexity of the design required iterative adjustments to enhance multimedia integration and pedagogical effectiveness (Khedif, Engkamat, & Jack, 2014; Durdu, Yalabik, & Cagiltay, 2009). Technical constraints, such as issues with internet accessibility and device compatibility, complicated efforts to ensure a smooth user experience across different learning environments (Vladoiu, 2011). Additionally, ongoing improvements based on user feedback and evolving instructional strategies were necessary to maintain engagement and educational effectiveness (Su et al., 2024; William, Graves, & Bernas, 2001).

These challenges underscore the iterative nature of developing instructional technology and highlight areas for future improvement. To effectively integrate adaptive learning technologies, expand content modules, and enhance user interface design, further research and development are required. By addressing these issues, e-sukukata aims to sustain its impact and relevance in early childhood language education, supporting lifelong learning and educational growth.

The e-Sukukata Courseware

This section discusses the capability of the courseware in providing features that can help students in learning open syllables. The e-Sukukata courseware incorporates interactive multimedia elements—such as vibrant graphics, engaging games, and audio features—to create an adaptable and dynamic learning environment. This courseware is designed with an intuitive interface to encourage exploration and interaction, catering to various learning styles while meeting curriculum standards.

In fostering interest among kindergarten children, the courseware's homepage is visually appealing, featuring a colorful design with a friendly cat and robot, which guides students to either learning modules or educational games. The modul divided into two which are: The *Pembelajaran* and *Permainan*. The *Pembelajaran* section offers structured lessons on vowels, *suku kata terbuka*, and relevant vocabulary, breaking down complex language concepts into accessible segments. Each section includes clear navigation buttons to ensure a user-friendly experience. The subsection of *Pembelajaran* is the *Mari Mengenal Huruf Vokal* page, focuses on teaching vowel letters (A, E, I, O, U) through interactive content and quizzes. This page helps students understand how vowels are integral to mastering *suku kata terbuka*. Also, the subsection the *Mari Mengenal Suku Kata Terbuka* page provides a tutorial on open syllables, using videos and examples to explain syllable structures.

The *Perkataan Suku Kata Terbuka* page explores words made up of *suku kata terbuka*, offering sections on two-syllable and three-syllable words, accompanied by quizzes to reinforce learning. Additionally, the *Permainan* page features three instructional games— *Teka Perkataan*, *Susun Suku Kata Terbuka*, and *Padankan Suku Kata Terbuka*—which make learning engaging by allowing students to practice and reinforce their language skills in a fun, interactive manner. These games support vocabulary building, word structure understanding, and syllable matching, enhancing the overall educational experience.

For that, e-Sukukata courseware aims to provide a comprehensive, engaging learning tool for young students, promoting effective language acquisition through interactive and adaptive methods. In Figure 1 depicted the e-Sukukata courseware pages.

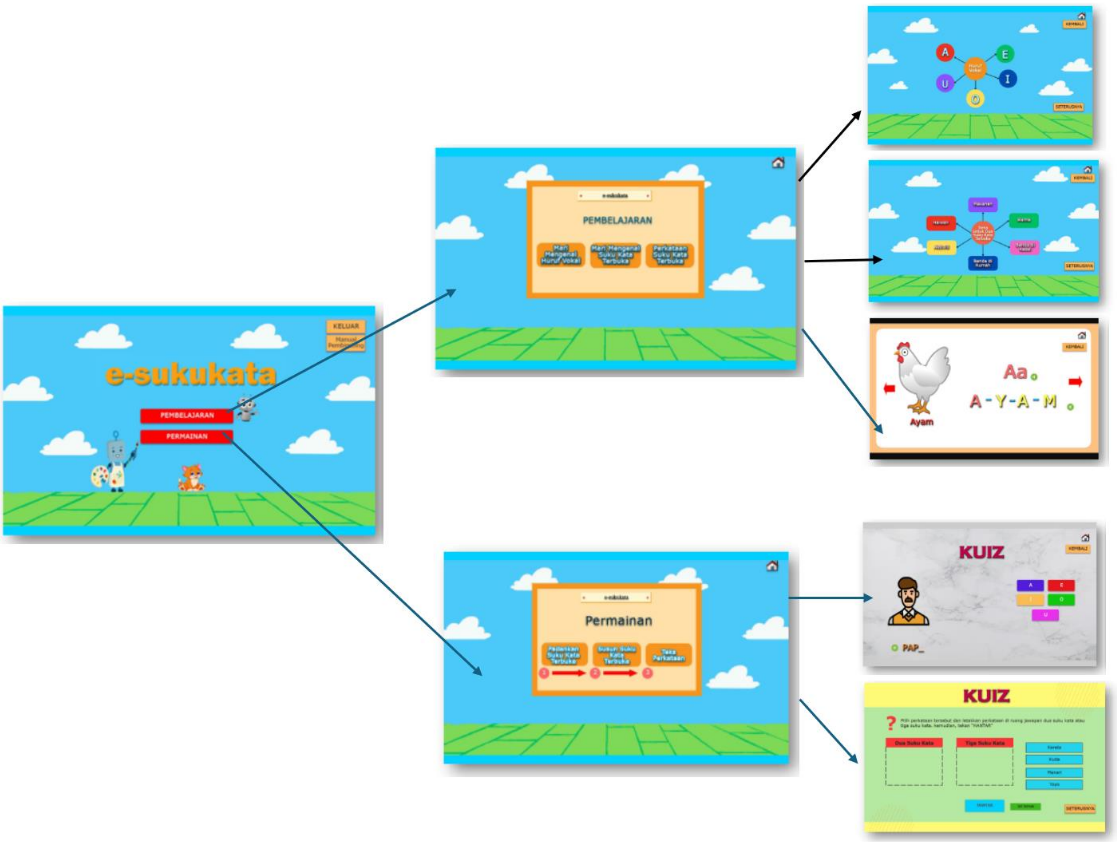

Figure 1 The e-Sukukata Pages

Result and Discussion

i) Evaluation on Theories Applied

Developed as an interactive e-learning tool, e-Sukukata courseware features vibrant graphics, engaging games, and audio elements to create an immersive learning environment. This courseware focuses on making language learning both effective and enjoyable by incorporating age-appropriate content and visually appealing designs. This section reviews the outcomes and insights gained from the development and implementation phases, highlighting their importance for early childhood education.

During the courseware development process, several enhancements were identified to optimize user engagement and educational outcomes. To create an immersive learning experience that captivates students, it is essential to integrate interactive games and vibrant visuals (Zellner, 2011). A well-designed feedback mechanism was implemented to gather data and adjust content based on user interactions, ensuring continuous improvement and alignment with learning objectives. Additionally, a thorough assessment strategy was utilized to evaluate the effectiveness of the curriculum in fostering language proficiency and literacy development among kindergarten students. The implementation of e-Sukukata courseware significantly transformed the way four-year-old kindergarten students learned *suku kata terbuka* in Bahasa Melayu. In Table 1 below highlights the differences in the learning process before and after the introduction of e-Sukukata courseware.

Table 1 The differences in the learning process after the introduction of e-sukukata courseware

Process Stage	Before e-sukukata (Current Practice)	After e-sukukata
Content Delivery	dependence on conventional phonics-based instruction.	Combining interactive multimedia components (games, audio, and images)
Engagement	minimal interaction with static course materials.	Increased interaction with lively graphics and interactive games.
Feedback Mechanisms	informal, mostly verbal feedback collection.	Courseware with structured feedback loops integrated for ongoing development.
Customization	uniform instruction with little room for modification.	customized educational opportunities based on each student's development
Evaluation	regular evaluations with little in the way of immediate feedback.	ongoing assessment coupled with quick response systems.

This section will present findings from the evaluation conducted, focusing on the theories applied within this courseware, namely: ontology-based techniques, knowledge management, and systems thinking. Below are the findings from the evaluation that has been carried out.

a) *Ontology-based Technique*

The vowel networking system exemplifies the ontology-based technique utilized in the e-sukukata courseware. When a user clicks on a vowel, examples of words featuring *suku kata terbuka* with that vowel are displayed. This system also organizes *suku kata terbuka* into themes, such as activity themes. Clicking on an activity theme reveals related activities to *suku kata terbuka*. This structured approach helps children make connections between different linguistic elements. In the following figure (as in Figure 2) shows the ontology-based technique that applied in the courseware.

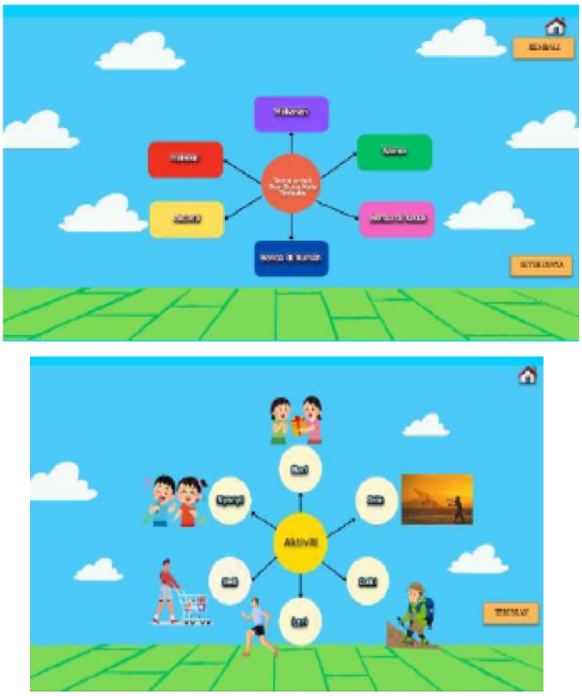

Figure 2 The application of Ontology-based Technique in the courseware

It is found that, the e-Sukukata courseware employs an ontology-based technique through its vowel networking system, enabling students to click on a vowel and view examples of words that include that vowel. This technique helps children understand how words are interconnected by shared vowel sounds and organizes these connections into themes. By visually linking vowels to related words and examples, children gain a clearer understanding of and better retention of the relationships between these linguistic components.

b) *Knowledge Management*

The training materials feature numerous examples of *suku kata terbuka* and include video lectures on *Mari Mengenal Suku Kata Terbuka*. This extensive array of resources systematically enhances students' understanding of *suku kata terbuka* and improves their knowledge management. The information is organized in a structured way to ensure that students can easily access and retain it, thereby enhancing both comprehension and memory. In Figure 3 shows the knowledge management technique that applied in the courseware.

Figure 3 The application of Knowledge Management Technique in the courseware

The courseware employs a range of examples and video lectures to systematically teach *suku kata terbuka*. By organizing the information effectively, it is found that it allows students to access and retain knowledge more efficiently. This structured method enhances their understanding and memory of *suku kata terbuka*, enabling them to build on their learning progressively.

c) System Thinking Technique

The tasks and quizzes in the courseware effectively illustrate the system thinking technique. These activities encourage children to engage in critical thinking and problem-solving. By participating in these interactive projects, students enhance their cognitive skills and apply their learning to real-world scenarios, thereby reinforcing their understanding of *suku kata terbuka* in an enjoyable manner. In the following figure (Figure 4) shows the system thinking technique that applied in the courseware.

Figure 4 The application of System Thinking Technique in the courseware

The courseware features quizzes and games designed to foster system thinking. It is found that, these activities encourage children to think critically, solve problems, and apply their knowledge of *suku kata terbuka* in practical contexts. Through these interactive exercises, children not only enhance their cognitive skills but also reinforce their learning in an engaging and meaningful way.

ii) User Evaluation

Next, this section will discuss the findings from the evaluation conducted on the users. A diverse group of thirty individuals, including parents, teachers, and students, participated in the user evaluation of the e-Sukukata courseware. This mixed group was selected to offer a broad range of feedback on the courseware's effectiveness and usability. The participants varied widely in age: 10% were aged 18–20 years, 36.7% were 21–24 years, and 53.3% were 25 years and older. The group included 40% males and 60% females. Educational backgrounds varied, with 10% holding a diploma, 30% a degree, and 40% being parents, while 10% were instructors. Additionally, 60% of the participants had previous experience with online interactive learning systems, whereas 40% did not. This diverse demographic provided a comprehensive and representative evaluation of the courseware from different user perspectives. The demographic information of the respondents is summarized in table (Table 2) below.

Table 2 Respondents' Demographic

Respondent Demography		Total Participant	Percentage (%)
Gender	Male	12	40
	Female	18	60
Age	18 – 20	3	10
	21 - 24	11	36.7
	25 and above	16	53.3
Participant Classification	Diploma	3	10
	Degree	9	30
	Postgraduate	3	10
	Parents	12	40
	Teacher	3	10
Use on online interactive learning platforms	Yes	18	60
	No	12	40

In analyzing the user assessment, statistical metrics such as mean, mode, and standard deviation were employed. The mean, or average score, indicates the overall trend for each question, providing a general sense of user feedback. The mode represents the most frequently occurring score, highlighting common responses among participants. Standard deviation measures the variability or dispersion of the scores, illustrating how much the responses deviate from the mean. Together, these metrics offer a comprehensive understanding of user satisfaction and identify areas where the courseware may need improvement. Four key features were assessed for users: usefulness, ease of use, ease of learning, and user satisfaction. Below are the results from the evaluation.

a) Result of Usefulness

In Table 3 shows the result of usefulness. Respondents evaluating the effectiveness of the e-Sukukata courseware provided valuable feedback on its support for 4-year-old students learning *sukukata terbuka*. The courseware received a high mean score of 4.2, indicating that users generally found it effective. The mode of 4 reflects that most participants rated the courseware's usefulness positively. The standard deviation of 0.571 shows low variability in responses, suggesting that user experiences were largely consistent. Feedback highlighted that the courseware effectively supported specific learning objectives and was well-suited for young students. The variety of activities was noted as a crucial factor in sustaining student engagement, significantly enhancing the educational impact of the courseware.

Table 3 Result of Usefulness

No.	Descriptions	Mean	Mod	Standard Deviation
1	The activities in the e-sukukata courseware help 4- years-old kindergarten students learn *suku kata terbuka* effectively.	4.00	5	0.52
2	The feedback provided by the courseware helps improve student's understanding of *suku kata terbuka.*	4.20	4	0.63
3	The courseware supports the specific learning objectives for teaching *suku kata terbuka* in *Bahasa Melayu.*	4.13	4	0.66
4	The content of the e-sukukata courseware is suitable for teaching *suku kata terbuka* to 4-years-old kindergarten students.	4.33	5	0.71
5	The courseware provides a variety of activities that keep students engaged in learning *suku kata terbuka.*	4.27	5	0.75

b) Result of Ease of Use

The ease-of-use criterion received a mean score of 4.23, reflecting very positive feedback on its navigational elements and user interface. The mode of 4 confirms that the most common reaction was favorable, aligning with the overall mean score. Despite some variability, indicated by a standard deviation of 0.588, users generally found the courseware to be user-friendly and intuitive. Key praises included the accessibility of the main menu, the readability and clarity of text and labels, and the absence of technical issues. The courseware’s responsiveness to user input was also highlighted, contributing to a smooth and efficient user experience. These findings suggest that the courseware effectively meets usability standards, making it a reliable tool for teaching both educators and young learners. The result is shown in Table 4.

Table 4 Result of Ease of Use

No.	Descriptions	Mean	Mod	Standard Deviation
1	The user interface of the e-sukukata courseware is easy for students to navigate.	4.33	5	0.33
2	It is easy to access the main menu or home page from any part of the courseware.	4.33	5	0.33
3	The text and labels on the user interface are clear and understandable for students.	4.33	4	0.32
4	The courseware is free from technical issues and bugs.	4.33	4	0.46
5	The courseware responds quickly tointeractions from students.	4.33	4	0.44

c) Result of Ease of Learning

As shown in Table 5, the ease of learning criterion achieved a mean score of 4.2, indicating that the materials are well-suited for quick and self-directed learning by students. The most frequent score was 4, suggesting consistently positive feedback. The standard deviation of 0.588 shows minimal variation in user experience, reinforcing the overall consistency of responses. Users appreciated the straightforward and easy-to-follow activity instructions, which are particularly beneficial for the target age group. The courseware's user-friendly layout supports self-paced learning, allowing students to explore and engage with the content independently. The exercises were noted for being both entertaining and educational, facilitating effective and enjoyable learning of *sukukata terbuka*. Overall, the courseware's design promotes individual learning, making it a valuable resource for early childhood education.

Table 5 The Result of Ease of Learning

No.	Descriptions	Mean	Mod	Standard Deviation
1	The instructions for the activities are simple and easy for students to follow.	4.20	45	0.36
2	Students can quickly learn how to use the e-sukukata courseware to study *suku kata terbuka.*	4.27	4	0.48
3	The courseware is intuitive and does not require much adult guidance for students to use.	4.07	4	0.53
4	The activities are designed in a way that students find engaging and educational for *suku kata terbuka.*	4.20	4	0.28
5	The courseware supports self-paced learning for students studying *suku kata terbuka.*	4.27	4	0.50

d) Result of User Satisfaction

For user satisfaction, the courseware received a mean satisfaction score of 4.1, reflecting a high level of overall user contentment. Refer to Table 6, the mode of 4 further emphasizes the generally positive feedback. Although the standard deviation of 0.607 is slightly higher than in other areas, it still indicates a fairly consistent user experience. Users appreciated the courseware's ability to keep students engaged with learning *sukukata terbuka*, with particular praise for the audio, video, and animation elements that enhanced the learning experience. The courseware effectively met user expectations, and many respondents indicated they would recommend it to other parents, educators, and teachers. This positive feedback underscores the courseware's potential for wider use in early childhood education, affirming its effectiveness and value as a teaching resource.

Table 6 The Result of User Satisfaction

No.	Descriptions	Mean	Mod	Standard Deviation
1	I am satisfied with the overall experience of the e-sukukata courseware.	4.03	4	0.40
2	The e-sukukata courseware keeps students engaged and interested in learning *suku kata terbuka*.	4.13	4	0.55
3	The multimedia elements (audio, video, animation) in the courseware enhance student's learning of *suku kata terbuka*.	4.17	4	0.54
4	The courseware meets my expectations as an educational tool for teaching *suku kata terbuka*.	4.03	4	0.40
5	I would recommend the e-sukukata courseware to other parents, teachers, or educators.	4.07	4	0.37

iii) Discussion

In Table 7 is the summarization of the elements that are evaluated, The user evaluation of the e-Sukukata courseware reveals overall positive feedback across several key areas. The Usefulness received a mean score of 4.2 and a mode of 4, indicating that respondents felt the activities effectively supported learning *sukukata terbuka*. This confirms the courseware's educational value and its alignment with teaching objectives. Ease of Use scored a mean of 4.23, suggesting that the user interface and navigation are generally intuitive and accessible. For Ease of Learning, the mean score of 4.2 reflects users' appreciation for the clear design and minimal need for adult assistance. The User Satisfaction had a mean score of 4.1, highlighting overall positive opinions about the courseware's effectiveness and user experience. These results underscore how e-Sukukata effectively engages four-year-olds, enhances their understanding of *sukukata terbuka* in Bahasa Melayu, and supports their educational journey in a user-friendly manner.

Table 7 Summary of the results

Criterion	Mean	Mod	Standard Deviation
Usefulness	4.03	4	0.40
Ease of Use	4.13	4	0.55
Ease of Learning	4.17	4	0.54
User Satisfaction	4.03	4	0.40

Therefore, it can conclude that, to revolutionize early childhood education, this courseware has created interactive online course materials tailored for four-year-old kindergarten students learning *sukukata terbuka* in Bahasa Melayu. Recognizing the importance of building linguistic foundations at this developmental stage, the courseware employs ontology-based strategies to organize content and enhance learning outcomes. The e-Sukukata courseware provides an engaging platform with vibrant visuals, interactive exercises, and intuitive navigation, allowing students to explore the intricacies of *sukukata terbuka*.

Conclusion

In conclusion, the development and evaluation of e-Sukukata courseware represents a significant advancement in early childhood education, particularly for Bahasa Melayu-speaking children. The courseware's integration of interactive multimedia and ontology-based methodologies has notably enhanced the learning outcomes for four-year-olds studying *sukukata terbuka*. Users feedback have highlighted its high usability, engaging features, and positive educational impact, confirming its effectiveness in meeting educational objectives. Collaboration among teachers, parents, and other stakeholders has been instrumental in refining this courseware to align with educational standards and pedagogical practices. Moving forward, e-Sukukata courseware will be continuously improved based on evaluation insights, further solidifying its role as a vital tool for early childhood language development and education.

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PERBANDINGAN PENCAPAIAN KALKULUS I DAN KALKULUS II BAGI PELAJAR DIPLOMA KEJURUTERAAN

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ABSTRACT

Matematik, khususnya kalkulus, adalah asas penting bagi pelajar diploma kejuruteraan kerana ia membentuk kemahiran analitikal dan penyelesaian masalah yang kritikal dalam bidang tersebut. Kajian ini bertujuan untuk mengkaji dan membandingkan pencapaian pelajar dalam subjek Kalkulus I dan Kalkulus II di kalangan pelajar diploma kejuruteraan. Seramai 67 orang pelajar dari program diploma kejuruteraan telah dipilih sebagai sampel kajian. Analisis deskriptif digunakan untuk menilai prestasi pelajar dalam kedua-dua subjek kalkulus ini, termasuk penilaian melalui jadual dan graf. Hasil kajian menunjukkan terdapat perbezaan dalam pencapaian pelajar antara Kalkulus I dan Kalkulus II. Pelajar yang memperoleh gred tinggi dalam Kalkulus I umumnya mengekalkan prestasi cemerlang dalam Kalkulus II, manakala pelajar dengan gred sederhana atau rendah dalam Kalkulus I menunjukkan variasi prestasi dalam Kalkulus II. Faktor seperti pemahaman konsep asas, keupayaan menyelesaikan masalah, dan tahap keyakinan diri terus memainkan peranan penting dalam mempengaruhi pencapaian mereka. Penemuan ini menekankan keperluan untuk menilai semula dan memperbaiki strategi pengajaran dan pembelajaran yang digunakan dalam kursus kalkulus bagi meningkatkan prestasi akademik pelajar. Kajian ini diharapkan dapat memberi sumbangan dalam mempertingkatkan pendekatan pendidikan matematik di peringkat diploma kejuruteraan.

Katakunci: Kalkulus I, Kalkulus II, deskriptif, gred, kejuruteraan

Pengenalan

Pada dasarnya, kalkulus dianggap sebagai subjek yang mencabar kerana melibatkan konsep-konsep abstrak, analisis matematik yang kompleks, dan kemahiran penyelesaian masalah yang tinggi. Bagi sesetengah pelajar, kalkulus dilihat sebagai asas yang penting untuk memahami konsep-konsep lanjutan dalam bidang sains, teknologi, kejuruteraan, dan matematik (STEM). Mereka mungkin melihatnya sebagai satu cabaran yang menarik, terutamanya jika mereka berminat dalam bidang-bidang yang memerlukan pemahaman matematik yang mendalam. Namun begitu, terdapat juga pelajar yang menganggap kalkulus sebagai subjek yang menakutkan dan sukar untuk dikuasai.

Bagi pelajar yang mengikuti program Diploma Kejuruteraan, kalkulus memainkan peranan yang sangat penting kerana ia merupakan asas matematik yang diperlukan untuk memahami konsep-konsep lanjutan yang digunakan dalam pelbagai bidang kejuruteraan. Bidang kejuruteraan seperti mekanikal, awam, elektrik, dan kimia memerlukan pemahaman yang mendalam tentang perubahan dan kadar perubahan, yang hanya boleh dianalisis dengan menggunakan kalkulus. Dalam era teknologi moden, kalkulus juga digunakan dalam pelbagai aplikasi inovatif seperti kecerdasan buatan (AI), pembelajaran mesin (machine learning), analisis data, dan simulasi komputer. Pelajar kejuruteraan yang memahami kalkulus dengan baik akan mempunyai kelebihan dalam mengaplikasikan teknologi ini dalam penyelesaian masalah kejuruteraan. Secara umumnya kalkulus membantu pelajar mengembangkan kemahiran penyelesaian masalah yang kritikal untuk kerjaya dalam kejuruteraan yang bukan sahaja penting untuk kejuruteraan, tetapi juga untuk membina asas yang kukuh dalam pemikiran analitikal yang dapat digunakan dalam pelbagai situasi profesional.

Kalkulus I dan kalkulus II merupakan dua kursus asas dalam matematik yang penting untuk pelajar jurusan sains dan kejuruteraan. Kalkulus I biasanya menumpukan pada konsep asas seperti had, pembezaan , pengamiran dan aplikasi mereka, manakala Kalkulus II memperkenalkan konsep yang lebih kompleks seperti kamiran lanjutan, siri tak terhingga, dan fungsi parameter. Kurikulum yang diatur secara berperingkat, iaitu dengan mengajar Kalkulus I sebelum Kalkulus II, memudahkan pelajar membina pengetahuan mereka secara berperingkat, dengan setiap tahap pembelajaran memperkukuh tahap yang sebelumnya. Struktur ini memastikan pembelajaran yang lebih berkesan dan pemahaman yang lebih mendalam.

Walaupun menyedari tentang kepentingan kalkulus dalam kejuruteraan, ramai yang masih mempunyai persepsi negatif tentang kursus ini.Pencapaian pelajar dalam subjek kalkulus, terutamanya di peringkat diploma kejuruteraan, sering kali berbeza-beza dan dipengaruhi oleh pelbagai faktor seperti asas matematik yang lemah. Pelajar yang asas matematiknya tidak kukuh mungkin menghadapi kesukaran untuk memahami konsep-konsep dalam Kalkulus I dan lebih-lebih lagi dalam Kalkulus II, yang memerlukan pemahaman yang lebih mendalam. Kelemahan dalam konsep-konsep asas seperti algebra, fungsi, dan trigonometri boleh menjejaskan kemampuan mereka untuk berjaya dalam kursus kalkulus. Dapatan kajian oleh Mohamed et al. (2024) mendapati asas matematik di peringkat sekolah menengah yang tidak kukuh akan mempengaruhi pencapaian pelajar dalam subjek kalkukus di peringkat ijazah. Selain itu, peralihan dari konsep asas ke konsep lanjutan juga boleh mempengaruhi pencapaian pelajar. Kalkulus I memperkenalkan konsep asas manakala Kalkulus II memperkenalkan konsep yang lebih kompleks. Peralihan ini memerlukan tahap pemahaman yang lebih tinggi, yang boleh menjadi cabaran bagi sesetengah pelajar.

Dapatan kajian oleh Mahat et al. (2020) menunjukkan bahawa pelajar agak sukar dengan topik seperti pembezaan dan pengamiran dalam kalkulus yang mana ianya boleh memberi kesan negatif terhadap prestasi peperiksaan mereka. Untuk menangani kesukaran ini, alat bantu mengajar yang inovatif seperti "Calculo on Desk" telah dibangunkan untuk meningkatkan kemahiran menyelesaikan masalah dan seterusnya dapat menaikkan prestasi peperiksaan pelajar (Mahat et al., 2020). Kajian terdahulu yang menggunakan perisian seperti MAPLE untuk kaedah berangka (Teh & Rahim, 2005) dan SketchUp untuk visualisasi geometri (Mahmood, 2016) didapati dapat meningkatkan pemahaman dan prestasi pelajar dalam matematik kejuruteraan. Walau bagaimanapun, cabaran masih wujud terutamanya dalam keupayaan pelajar menyelesaikan masalah kalkulus disebabkan kelemahan dalam pengetahuan asas matematik (Tampubolon & Sianturi, 2020). Kajian-kajian ini menekankan kepentingan menangani kesukaran matematik pelajar untuk mempertingkatkan prestasi keseluruhan mereka dalam kursus kejuruteraan.

Kajian terdahulu menunjukkan bahawa faktor psikologi seperti sikap dan motivasi pelajar juga sangat mempengaruhi pencapaian mereka di mana pelajar yang menganggap kalkulus sebagai subjek yang sukar atau tidak relevan mungkin kurang bermotivasi untuk belajar dan memahami konsep-konsep yang diajarkan. Pelajar yang melihat kalkulus sebagai sesuatu yang relevan dengan masa depan mereka dalam bidang kejuruteraan, didapati bermotivasi untuk mempelajari kalkulus (Kenyon, 2023). Di samping itu, kebimbangan terhadap matematik juga merupakan faktor yang tidak boleh diabaikan. Sesetengah pelajar mengalami perasaan cemas atau takut apabila berhadapan dengan subjek matematik. Kebimbangan ini boleh mengurangkan keyakinan diri mereka dan menghalang kemampuan untuk memahami konsep-konsep kalkulus dengan baik. Menurut Tang (2021), ketekunan pelajar dalam mempelajari kalkulus dipengaruhi oleh keadaan emosi mereka, termasuk kegembiraan dan kebimbangan. Kadangkala beban kerja akademik yang terlalu berat atau terlalu banyak kursus yang diambil serentak juga boleh mengganggu fokus pelajar dan mempengaruhi pencapaian mereka dalam kalkulus. Pelajar yang mengalami tekanan akibat beban kerja yang tinggi mungkin tidak mempunyai masa yang mencukupi untuk menumpukan perhatian kepada pembelajaran kalkulus, terutamanya Kalkulus II yang memerlukan pemahaman yang lebih mendalam.

Persekitaran yang baik seperti sokongan akademik dan sosial juga mempengaruhi pencapaian pelajar dalam Kalkulus. Sokongan daripada pensyarah, rakan sebaya, dan keluarga adalah penting untuk kejayaan akademik pelajar. Pelajar yang menerima sokongan akademik yang mencukupi, seperti bimbingan tambahan, kelas tutorial, atau kumpulan belajar, lebih cenderung untuk memahami konsep-konsep kalkulus dengan lebih baik dan mencapai pencapaian yang lebih tinggi. Sokongan sosial juga boleh meningkatkan motivasi pelajar untuk belajar dan berjaya. Dapatan kajian oleh Fernandez et al. (2020) menunjukkan sokongan sosial yang diterima daripada keluarga, rakan dan guru dapat meningkatkan keyakinan mereka terhadap kebolehan akademik mereka.

Usaha kendiri juga dikenal pasti sebagai faktor utama yang berkait rapat dengan prestasi pelajar dalam kalkulus (Ahmad et al., 2017). Gaya pembelajaran yang tidak sistematik dan kecenderungan untuk belajar secara bersendirian berbanding dalam kumpulan juga didapati menyumbang kepada kadar kegagalan yang tinggi (Alwadood et al., 2018). Keupayaan awal, konsep kendiri, sikap terhadap matematik, dan motivasi pencapaian secara kolektif mempengaruhi pencapaian dalam kalkulus, dengan keupayaan awal menunjukkan kesan individu yang paling ketara (Nurhidayah, 2020). Di samping itu, sikap pelajar terhadap kalkulus yang diukur merentasi domain kognitif, efektif, dan tingkah laku, berbeza dengan ketara di mana ramai pelajar menunjukkan sikap yang kurang positif. Penemuan ini menyerlahkan interaksi kompleks faktor-faktor yang mempengaruhi prestasi kalkulus dan mencadangkan beberapa bidang untuk intervensi yang berpotensi bagi meningkatkan pencapaian pelajar.

Kajian oleh Hussin et al. (2018) dan Morán-Soto et al. (2023) menunjukkan bahawa terdapat hubungan yang signifikan di antara pencapaian matematik di sekolah menengah dan prestasi dalam kursus matematik kejuruteraan di peringkat politeknik atau universiti. Kalkulus pembezaan, khususnya, memainkan peranan penting dalam prestasi akademik keseluruhan pelajar kejuruteraan semasa semester pertama mereka (Morán-Soto et al., 2023). Walaupun beberapa kajian mendapati tiada hubungan yang signifikan antara kalkulus dan markah dalam persamaan pembezaan bagi disiplin kejuruteraan tertentu (Memon et al., 2021), namun kajian lain menekankan kepentingan kebolehan matematik untuk kejayaan pelajar kejuruteraan (Morán-Soto et al., 2023). Penemuan ini menyerlahkan keperluan untuk menambah baik strategi pengajaran bagi meningkatkan kemahiran matematik pelajar kejuruteraan serta pemahaman mereka tentang aplikasi dalam bidang kejuruteraan (Morán-Soto et al., 2023).

Beberapa kajian terdahulu dan terkini telah meneroka pendekatan inovatif dalam pengajaran kalkulus kepada pelajar kejuruteraan, terutamanya sebagai maklumbalas kepada cabaran pembelajaran jarak jauh. Penggunaan teknologi seperti perisian kursus multimedia interaktif terbukti dapat meningkatkan pencapaian pelajar dalam kalkulus berbanding kaedah tradisional (Ayub et al., 2008). Pendekatan yang menggabungkan pengajaran melalui video dan pembelajaran kolaboratif, juga menunjukkan keberkesanan dalam meningkatkan kemahiran menyelesaikan masalah dan penguasaan kalkulus (Cablas, 2023). Strategi pengajaran jarak jauh yang menggabungkan teori pembelajaran transformatif dan prinsip pembelajaran aktif berjaya meningkatkan motivasi dan penglibatan pelajar (Ng et al., 2020). Namun begitu, kesukaran dalam kursus kalkulus terutamanya bagi topik pembezaan dan kamiran mengakibatkan kadar kegagalan yang tinggi dalam kalangan pelajar kejuruteraan tahun pertama seterusnya mungkin akan mempengaruhi prestasi kalkulus bagi tahun yang seterusnya. Untuk menangani isu ini, penyelidik mencadangkan pembangunan persekitaran pembelajaran yang menggalakkan penglibatan dan penyertaan aktif pelajar dalam proses pembelajaran mereka sendiri (Bigotte de Almeida et al., 2020). Penemuan ini menekankan kepentingan penyesuaian kaedah pengajaran untuk memenuhi keperluan pelajar kejuruteraan yang berkembang dalam pendidikan kalkulus.

Metodologi

Kajian ini dijalankan terhadap pelajar diploma kejuruteraan yang mengambil subjek Kalkulus I pada semester March–August 2023 dan Kalkulus II pada semester October 2023–February 2024. Seramai 67 orang pelajar terlibat dalam kajian ini dan lulus kedua-dua subjek kalkulus. Data prestasi pelajar dikumpulkan melalui rekod peperiksaan akhir bagi subjek Kalkulus I dan Kalkulus II, yang merupakan penunjuk utama bagi pencapaian akademik pelajar dalam kedua-dua kursus ini. Kalkulus II merupakan subjek yang diambil oleh pelajar kejuruteraan ketika di semster 2 dan prasyarat untuk mengambilnya adalah perlu lulus Kalkulus I pada semester 1. Kedua-dua subjek ini adalah merangkumi tajuk pembezaan dan pengkamiran serta aplikasinya.

Data daripada markah akhir penilaian pelajar untuk kedua-dua subjek telah diambil dan dianalisa secara deskriptif menggunakan perisisan statistik, SPSS version 20.0. Gred markah pelajar pula telah diklasifikasikan sebelum analisa dijalankan dan ditunjukkan seperti dalam Jadual 1 berikut:

Jadual 1: Klasifikasi Gred Markah Kalkulus

Klasifikasi	Gred Markah Subjek Kalkulus
1	A, A-
2	B, B-, B+
3	C, C+

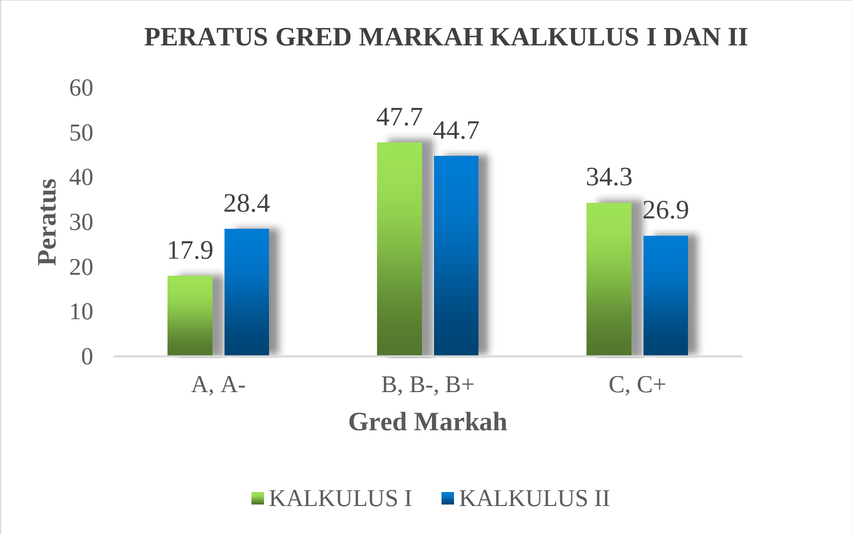
Analisa deskriptif yang dijalankan adalah untuk menilai dan membandingkan pencapaian pelajar dalam Kalkulus I dan Kalkulus II. Analisis deskriptif yang digunakan melibatkan pengiraan statistik seperti min, peratusan, dan taburan kekerapan. Di samping itu, graf dan carta bar yang digunakan adalah untuk menggambarkan data secara visual, membolehkan perbandingan yang lebih mudah antara pencapaian dalam Kalkulus I dan Kalkulus II. Graf ini membantu mengenal pasti pola pencapaian pelajar, variasi antara kedua-dua kursus, serta trend umum dalam prestasi akademik.

Analisa dan Perbincangan

Jadual 2 dan Rajah 1 menunjukkan perbandingan keputusan markah pelajar dalam subjek Kalkulus I dan Kalkulus II berdasarkan gred yang diperoleh. Didapati bahawa seramai 12 pelajar (17.9%) memperoleh gred A atau A- dalam Kalkulus I, manakala jumlah ini meningkat kepada 19 pelajar (28.4%) dalam Kalkulus II. Ini menunjukkan bahawa terdapat peningkatan peratusan pelajar yang mencapai gred tertinggi dalam Kalkulus II berbanding Kalkulus I.

Jadual 2: Keputusan Markah Subjek Kalkulus I dan Kalkulus II

		Kalkulus I		**Kalkulus II**	
		Jumlah Pelajar	**Peratus(%)**	**Jumlah Pelajar**	**Peratus(%)**
	A, A-	12	17.9	19	28.4
Gred	**B, B-, B+**	32	47.7	30	44.7
	C, C+	23	34.3	18	26.9



Rajah 1: Peratus Gred Markah Kalkulus I dan Kalkulus II

Bagi gred B, B-, dan B+, seramai 32 pelajar (47.7%) mencapai gred ini dalam Kalkulus I, sementara dalam Kalkulus II, bilangan ini sedikit berkurang kepada 30 pelajar (44.7%). Walaupun terdapat sedikit penurunan dalam peratusan pelajar yang memperoleh gred B dan ke atas dalam Kalkulus II, kumpulan pelajar ini masih membentuk peratusan terbesar dalam kedua-dua subjek, menunjukkan penguasaan yang agak konsisten di kalangan majoriti pelajar.

Sebaliknya, bagi gred C dan C+, seramai 23 pelajar (34.3%) mendapat gred ini dalam Kalkulus I, namun jumlah ini berkurang kepada 18 pelajar (26.9%) dalam Kalkulus II. Penurunan ini menunjukkan bahawa beberapa pelajar mungkin berjaya memperbaiki prestasi mereka apabila beralih dari Kalkulus I ke Kalkulus II, dengan sebahagian daripada mereka meningkatkan gred ke tahap yang lebih tinggi.

Secara keseluruhannya, analisis ini menunjukkan bahawa prestasi pelajar dalam Kalkulus II sedikit lebih baik berbanding Kalkulus I, dengan peningkatan dalam peratusan pelajar yang mencapai gred A atau A-. Walau bagaimanapun, terdapat juga penurunan kecil dalam bilangan pelajar yang memperoleh gred B dan ke atas, yang mencadangkan variasi dalam penguasaan konsep kalkulus di kalangan pelajar. Penemuan ini mencadangkan bahawa beberapa pelajar berjaya menyesuaikan diri dengan cabaran yang diberikan dalam Kalkulus II, manakala yang lain mungkin memerlukan pendekatan pengajaran yang lebih sesuai untuk meningkatkan pemahaman dan prestasi mereka dalam kedua-dua kursus.

Jadual 3 : Keputusan Gred Kalkulus II mengikut Gred Kalkulus I

		Kalkulus I					
		A, A-	**Peratus(%)**	**B, B-, B+**	**Peratus(%)**	**C, C+**	**Peratus(%)**
Kalkulus II	**A, A-**	8	12%	10	15%	1	1%
	B, B-, B+	4	6%	14	21%	12	18%
	C, C+	0	0%	8	12%	10	15%

Jadual 3 menunjukkan keputusan gred dalam Kalkulus II berdasarkan gred yang diperoleh pelajar dalam Kalkulus I. Analisis data ini memberi gambaran mengenai hubungan antara pencapaian dalam Kalkulus I dan Kalkulus II.

Bagi pelajar yang memperoleh gred A atau A- dalam Kalkulus I, sebahagian besar daripada mereka juga mencapai gred yang baik dalam Kalkulus II. Secara khusus, 8 pelajar (12%) daripada kumpulan ini memperoleh gred A atau A- dalam Kalkulus II, manakala 10 pelajar (15%) memperoleh gred B, B-, atau B+, dan hanya 1 pelajar (1%) mendapat gred C atau C+ dalam Kalkulus II. Ini menunjukkan bahawa pelajar yang berjaya dalam Kalkulus I cenderung untuk meneruskan prestasi yang baik dalam Kalkulus II.

Sebaliknya, bagi pelajar yang mendapat gred B, B-, atau B+ dalam Kalkulus I, 4 pelajar (6%) memperoleh gred A atau A- dalam Kalkulus II, 14 pelajar (21%) mencatatkan gred B, B-, atau B+, dan 12 pelajar (18%) mendapat gred C atau C+. Data ini menunjukkan variasi yang lebih besar dalam prestasi pelajar yang mempunyai gred sederhana dalam Kalkulus I, dengan sebahagian besar daripada mereka menunjukkan pencapaian yang agak baik dalam Kalkulus II tetapi juga terdapat bilangan pelajar yang memperoleh gred kurang memuaskan.

Bagi pelajar yang memperoleh gred C atau C+ dalam Kalkulus I, tiada pelajar yang mencapai gred A atau A- dalam Kalkulus II. Sebanyak 8 pelajar (12%) daripada mereka memperoleh gred B, B-, atau B+, manakala 10 pelajar (15%) mendapat gred C atau C+ dalam Kalkulus II. Ini mencadangkan bahawa pelajar dengan prestasi rendah dalam Kalkulus I mungkin menghadapi cabaran yang lebih besar untuk meningkatkan pencapaian mereka dalam Kalkulus II.

Secara keseluruhan, analisis ini menunjukkan bahawa terdapat hubungan antara pencapaian dalam Kalkulus I dan Kalkulus II, di mana pelajar yang mempunyai gred yang lebih baik dalam Kalkulus I lebih cenderung untuk memperoleh gred yang baik dalam Kalkulus II. Walau bagaimanapun, terdapat variasi dalam pencapaian pelajar yang memperoleh gred sederhana dan rendah dalam Kalkulus I, menunjukkan bahawa faktor-faktor lain mungkin mempengaruhi prestasi mereka dalam Kalkulus II. Penemuan ini menekankan pentingnya pengukuhan konsep asas dalam Kalkulus I untuk memudahkan kejayaan dalam Kalkulus II.

Jadual 4: Min Markah Kalkulus I mengikut gred Kalkulus II

Gred Kalkulus II	Min Markah Kalkulus I	Jumlah Pelajar
A, A-	72.1	12
B, B-, B+	63.2	32
C, C+	56.6	23

Jadual 4 menunjukkan min markah bagi subjek Kalkulus I mengikut gred yang diperoleh pelajar dalam Kalkulus II. Bagi pelajar yang memperoleh gred A atau A- dalam Kalkulus II, min markah mereka dalam Kalkulus I adalah 72.1, dengan jumlah seramai 12 orang pelajar. Pelajar yang memperoleh gred B, B-, atau B+ dalam Kalkulus II mencatatkan min markah 63.2 dalam Kalkulus I, dengan jumlah seramai 32 orang pelajar. Sementara itu, pelajar yang mendapat gred C atau C+ dalam Kalkulus II menunjukkan min markah yang lebih rendah dalam Kalkulus I, iaitu 56.6, dengan jumlah 23 orang pelajar. Data ini menunjukkan terdapat hubungan positif antara gred yang diperoleh dalam Kalkulus II dan pencapaian dalam Kalkulus I, di mana pelajar dengan gred yang lebih tinggi dalam Kalkulus II cenderung mempunyai markah yang lebih tinggi dalam Kalkulus I.

Kesimpulan

Secara keseluruhannya, pencapaian pelajar dalam Kalkulus I dan II bagi pelajar diploma kejuruteraan menunjukkan terdapat perbezaan ketara, di mana pelajar yang mencapai gred lebih tinggi dalam

Kalkulus I cenderung mengekalkan prestasi yang baik dalam Kalkulus II. Walau bagaimanapun, variasi dalam pencapaian pelajar dengan gred sederhana dan rendah menunjukkan bahawa penguasaan awal dalam Kalkulus I memainkan peranan penting dalam pencapaian mereka di Kalkulus II. Dapatan ini mungkin dipengaruhi oleh pelbagai faktor yang saling berkait rapat, termasuk tahap pemahaman asas, motivasi, dan gaya pembelajaran pelajar. Kajian lanjut boleh dilakukan bagi memahami faktor-faktor yang berkaitan kerana ianya dapat membantu pensyarah dan pengajar merancang strategi pengajaran yang lebih berkesan dan menyediakan sokongan yang lebih baik kepada pelajar. Dengan mengatasi cabaran-cabaran ini, pencapaian pelajar dalam kalkulus dapat ditingkatkan, seterusnya memastikan kejayaan mereka dalam pembangunan kerjaya profesional dalam bidang kejuruteraan. Penemuan ini menyerlahkan kepentingan pengukuhan konsep asas kalkulus serta penggunaan alat bantu mengajar yang sesuai untuk membantu pelajar menghadapi cabaran dalam topik yang lebih kompleks.

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PENGARUH GAYA PEMBELAJARAN PELAJAR DALAM SUBJEK KALKULUS: KAJIAN DI KALANGAN PELAJAR KEJURUTERAAN

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ABSTRACT

Kajian ini bertujuan untuk meneliti pengaruh gaya pembelajaran terhadap pencapaian pelajar dalam subjek kalkulus di kalangan pelajar kejuruteraan di peringkat pengajian tinggi. Kalkulus merupakan subjek asas yang penting dalam program kejuruteraan, namun ia sering kali menjadi cabaran kepada pelajar disebabkan oleh sifatnya yang abstrak dan kompleks. Melalui pendekatan kuantitatif, seramai 50 pelajar kejuruteraan telah dikaji menggunakan soal selidik berdasarkan model VARK (Visual, Auditory, Reading/Writing, Kinesthetic) untuk mengenal pasti gaya pembelajaran dominan mereka. Dapatan kajian menunjukkan bahawa gaya pembelajaran visual dan kinestetik adalah yang paling dominan di kalangan pelajar kejuruteraan. Selain itu, terdapat korelasi positif antara penggunaan gaya pembelajaran visual dan kinestetik dengan pencapaian akademik dalam subjek kalkulus, di mana pelajar yang menggunakan kedua-dua gaya ini mencatatkan pencapaian yang lebih tinggi berbanding pelajar yang menggunakan gaya pembelajaran auditori dan bacaan/penulisan. Kajian ini menekankan kepentingan pensyarah untuk menyesuaikan kaedah pengajaran mereka dengan gaya pembelajaran pelajar untuk meningkatkan pemahaman dan pencapaian akademik dalam subjek kalkulus.

Keywords: gaya pembelajaran, kalkulus, kejuruteraan, pencapaian akademik

Pendahuluan

Kalkulus merupakan komponen kritikal dalam program kejuruteraan di peringkat pengajian tinggi. Penguasaan terhadap kalkulus sangat penting kerana ia menyediakan asas bagi kebanyakan subjek kejuruteraan lain, termasuk mekanik, termodinamik, dan kejuruteraan elektrik. Walau bagaimanapun, pengajaran dan pembelajaran kalkulus sering kali menjadi cabaran besar, bukan sahaja kepada pelajar, tetapi juga kepada pensyarah yang bertanggungjawab menyampaikan subjek ini. Gaya pembelajaran yang berbeza di kalangan pelajar memainkan peranan penting dalam menentukan sejauh mana mereka dapat memahami dan menguasai konsep-konsep kalkulus. Gaya pembelajaran merujuk kepada kaedah yang digunakan oleh pelajar untuk mengasimilasi, memproses, dan mengingati maklumat yang dipelajari (Fleming dan Mills 1992).

Kajian ini bertujuan untuk meneliti pengaruh gaya pembelajaran terhadap pencapaian pelajar kejuruteraan dalam subjek kalkulus. Dengan memahami bagaimana pelajar belajar dengan berkesan, pensyarah boleh menyesuaikan kaedah pengajaran mereka untuk memenuhi keperluan pelajar dan seterusnya meningkatkan pencapaian akademik dalam subjek ini. Kalkulus adalah asas kepada kebanyakan disiplin dalam kejuruteraan dan memainkan peranan penting dalam memahami konsep-konsep teknikal yang lebih kompleks. Namun begitu, ramai pelajar kejuruteraan sering kali menghadapi kesukaran dalam menguasai kalkulus, yang boleh memberi impak negatif terhadap pencapaian akademik dan motivasi mereka. Kajian terdahulu menunjukkan bahawa gaya pembelajaran memainkan peranan penting dalam bagaimana pelajar memproses dan memahami maklumat. Walau bagaimanapun, masih terdapat jurang dalam penyelidikan mengenai pengaruh gaya pembelajaran khusus terhadap pencapaian dalam subjek kalkulus, terutama di kalangan pelajar kejuruteraan. Tambahan pula, dengan perkembangan pesat teknologi pendidikan, terdapat potensi yang besar untuk mengintegrasikan teknologi dalam pengajaran dan pembelajaran kalkulus. Oleh itu, kajian ini bertujuan untuk mengisi jurang ini dengan menyiasat bagaimana gaya pembelajaran dan penggunaan teknologi mempengaruhi pencapaian pelajar kejuruteraan dalam subjek kalkulus.

Objektif kajian ini adalah untuk menyelidik beberapa aspek berkaitan gaya pembelajaran pelajar kejuruteraan dalam subjek kalkulus melalui pendekatan kuantitatif. Pertama, kajian ini bertujuan untuk menentukan gaya pembelajaran yang paling dominan di kalangan pelajar kejuruteraan ketika mempelajari kalkulus. Kedua, kajian ini akan menganalisis hubungan antara gaya pembelajaran yang digunakan oleh pelajar kejuruteraan dan pencapaian akademik mereka dalam subjek ini untuk memahami sejauh mana gaya pembelajaran tersebut mempengaruhi kejayaan akademik mereka. Selain itu, kajian ini juga bertujuan untuk mengenal pasti kesan penggunaan teknologi pembelajaran terhadap gaya pembelajaran dan pencapaian dalam subjek kalkulus bagi menilai keberkesanan teknologi sebagai alat sokongan dalam proses pembelajaran. Akhirnya, kajian ini akan mengkaji perbezaan dalam gaya pembelajaran dan pencapaian akademik berdasarkan faktor demografi seperti jantina, tahun pengajian, dan latar belakang pendidikan, untuk mengenal pasti faktor-faktor yang mungkin mempengaruhi cara pelajar belajar dan pencapaian mereka dalam kalkulus. Dengan memahami aspek-aspek ini, kajian ini diharapkan dapat menyumbang kepada pembangunan strategi pengajaran yang lebih berkesan dan disesuaikan, seterusnya meningkatkan kualiti pembelajaran dan pencapaian pelajar dalam subjek kalkulus

Kajian Literatur

Kajian terkini tentang gaya pembelajaran dan pencapaian pelajar dalam subjek kalkulus di kalangan pelajar kejuruteraan menunjukkan beberapa persamaan penting. Sebilangan besar penyelidikan, seperti yang dilakukan oleh (Kumar et al. 2019) dan (Singh et al. 2021), mendapati bahawa gaya pembelajaran visual dan kinestetik adalah yang paling dominan dan berkesan di kalangan pelajar kejuruteraan. Kajian-kajian ini menunjukkan bahawa pelajar yang menggunakan bahan pengajaran yang melibatkan elemen visual seperti grafik, animasi, dan simulasi, serta pendekatan hands-on melalui eksperimen praktikal, cenderung memahami konsep kalkulus yang kompleks dengan lebih baik. Selain itu, kajian oleh (Zhang et al. 2020) dan (Kim & Kim 2022) menyokong idea bahawa teknologi pembelajaran memainkan peranan penting dalam menyokong gaya pembelajaran ini, dengan penekanan pada bagaimana perisian matematik dan platform pembelajaran dalam talian dapat memperkayakan pengalaman pembelajaran dan meningkatkan pencapaian pelajar.

Walau bagaimanapun, terdapat beberapa perbezaan dalam fokus dan pendekatan kajian-kajian ini. Misalnya, (Kumar et al. 2019) menggunakan pendekatan kuantitatif untuk mengukur hubungan antara gaya pembelajaran dan pencapaian akademik pelajar dalam kalkulus, (Kim & Kim 2022) menggunakan pendekatan campuran yang menggabungkan data kuantitatif dan kualitatif untuk mendapatkan gambaran yang lebih mendalam tentang persepsi pelajar terhadap penggunaan teknologi dalam pembelajaran kalkulus. Selain itu, kajian oleh (Abdullah et al. 2023) menekankan pengaruh faktor demografi seperti jantina dan latar belakang akademik terhadap gaya pembelajaran, yang kurang dititikberatkan dalam kajian-kajian lain. Perbezaan ini menunjukkan bahawa walaupun terdapat konsensus mengenai kepentingan gaya pembelajaran visual dan kinestetik serta teknologi dalam meningkatkan pencapaian, pendekatan dan konteks penyelidikan yang berbeza boleh menghasilkan hasil yang berbeza.

Namun demikian, terdapat beberapa kekurangan dalam literatur yang ada. Sebagai contoh, kebanyakan kajian menggunakan data keratan rentas yang tidak menyediakan maklumat tentang bagaimana gaya pembelajaran dan pencapaian akademik pelajar berubah dari masa ke masa. Tambahan pula, meskipun teknologi pembelajaran sering dibincangkan, kajian yang mengkaji secara mendalam bagaimana teknologi ini dapat dioptimumkan untuk menyokong pelbagai gaya pembelajaran masih kurang. Selain itu, beberapa kajian seperti oleh (Kumar et al. 2019) dan (Singh et al. 2021) menggunakan sampel yang terhad dari satu universiti sahaja, yang boleh menjejaskan kebolehgunaan hasil kajian ke populasi yang lebih luas. Secara keseluruhan, walaupun kajian-kajian ini memberikan wawasan berharga tentang pengaruh gaya pembelajaran terhadap pencapaian akademik dalam subjek kalkulus, terdapat keperluan untuk penyelidikan yang lebih luas dan mendalam yang mengambil kira faktor kontekstual dan temporal untuk memahami dengan lebih baik bagaimana pelajar kejuruteraan belajar dan bagaimana pencapaian mereka dalam kalkulus dapat ditingkatkan.

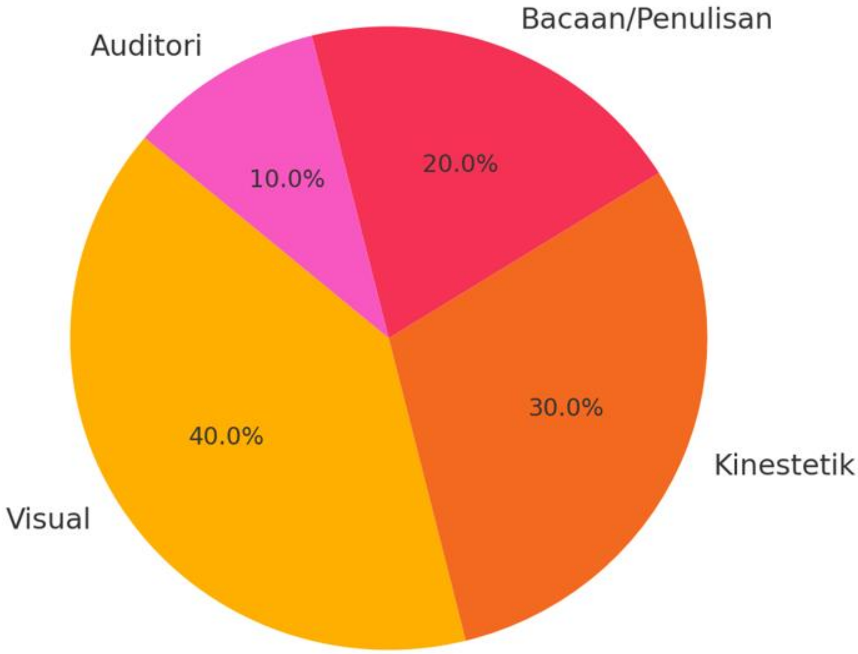
Metodologi

Untuk menilai pengaruh gaya pembelajaran terhadap pencapaian pelajar kejuruteraan dalam subjek kalkulus, kajian ini menggunakan pendekatan kuantitatif. Sebanyak 50 pelajar kejuruteraan semester satu dan dua dipilih sebagai responden kajian. Pemilihan responden ini dilakukan melalui teknik persampelan rawak untuk memastikan bahawa sampel kajian ini mewakili populasi yang lebih besar secara adil. Soal selidik yang dibangunkan berdasarkan model VARK (Visual, Auditory, Reading/Writing, Kinesthetic) digunakan untuk mengenal pasti gaya pembelajaran dominan pelajar. Soal selidik ini merangkumi pelbagai soalan untuk menilai kecenderungan pelajar terhadap setiap gaya pembelajaran yang berbeza. Selain itu, data pencapaian akademik pelajar dalam subjek kalkulus dikumpul melalui rekod markah peperiksaan akhir semester. Analisis statistik deskriptif digunakan untuk menentukan kekerapan dan peratusan gaya pembelajaran yang dominan di kalangan responden, manakala analisis inferensi digunakan untuk mengkaji hubungan antara gaya pembelajaran dan pencapaian akademik pelajar berdasarkan data markah peperiksaan mereka. Hasil daripada analisis ini membantu dalam memahami pengaruh gaya pembelajaran terhadap prestasi pelajar dalam kalkulus.

Dapatan dan Perbincangan

Kajian ini mendapati bahawa gaya pembelajaran yang paling dominan di kalangan 50 pelajar kejuruteraan dalam subjek kalkulus adalah gaya pembelajaran visual dan kinestetik. Sebanyak 40% daripada responden (20 pelajar) menunjukkan kecenderungan terhadap gaya pembelajaran visual, menjadikannya gaya pembelajaran yang paling banyak digunakan. Ini diikuti oleh gaya pembelajaran kinestetik, yang digunakan oleh 30% (15 pelajar). Gaya pembelajaran bacaan/penulisan pula digunakan oleh 20% (10 pelajar), manakala gaya pembelajaran auditori mencatatkan penggunaan paling rendah, iaitu hanya 10% (5 pelajar).

Dari segi pencapaian akademik, pelajar yang menggunakan gaya pembelajaran visual mempunyai purata markah peperiksaan tertinggi dalam subjek kalkulus, iaitu 78%. Pelajar dengan gaya pembelajaran kinestetik mencatatkan purata markah kedua tertinggi pada 75%. Sebaliknya, pelajar yang menggunakan gaya pembelajaran bacaan/penulisan mempunyai purata markah 68%, dan pelajar dengan gaya pembelajaran auditori mencatatkan purata markah terendah, iaitu 60%.



Rajah 1: Taburan Gaya Pembelajaran Pelajar

Jadual 1: Taburan Gaya Pembelajaran Terhadap Pencapaian Pelajar dalam Subjek Kalkulus

Gaya Pembelajaran	Bilangan Pelajar (n)	Peratusan Pelajar	Purata Markah Peperiksaan
Visual	20	40%	78%
Kinestetik	15	30%	75%
Bacaan/Penulisan	10	20%	68%
Auditori	5	10%	60%

Dapatan kajian ini menunjukkan bahawa gaya pembelajaran visual dan kinestetik lebih efektif dalam meningkatkan pencapaian pelajar kejuruteraan dalam subjek kalkulus, berbanding dengan gaya pembelajaran bacaan/penulisan dan auditori. Penemuan ini selaras dengan kajian oleh (Felder dan Silverman 1988), yang menyatakan bahawa pelajar dalam bidang kejuruteraan lebih cenderung untuk memahami konsep-konsep yang kompleks melalui bahan visual dan aktiviti hands-on. Ini juga diperkuatkan oleh kajian (Zhang et al. 2020), yang mendapati bahawa penggunaan alat bantu visual seperti simulasi komputer dan perisian matematik dapat memperkayakan pengalaman pembelajaran pelajar, sekaligus meningkatkan pemahaman dan prestasi akademik mereka dalam subjek teknikal seperti kalkulus.

Walau bagaimanapun, penemuan kajian ini juga menunjukkan bahawa pendekatan pembelajaran bacaan/penulisan dan auditori mungkin kurang berkesan dalam subjek kalkulus. Ini seiring dengan kajian oleh (Pashler et al. 2008), yang menyatakan bahawa gaya pembelajaran yang bergantung kepada teks atau pendengaran semata-mata tidak mencukupi untuk membantu pelajar memahami konsep-konsep yang memerlukan visualisasi dan penerapan praktikal. Walaupun gaya pembelajaran ini mempunyai peranan dalam konteks pembelajaran yang berbeza, ia mungkin memerlukan sokongan tambahan seperti bahan visual atau aktiviti praktikal untuk membantu pelajar mencapai pemahaman yang lebih mendalam dalam subjek yang kompleks seperti kalkulus.

Secara keseluruhannya, dapatan ini menggariskan kepentingan menyesuaikan kaedah pengajaran dengan gaya pembelajaran pelajar, terutama dalam subjek teknikal seperti kalkulus. Penggunaan pendekatan pengajaran yang lebih berorientasikan visual dan praktikal dapat membantu meningkatkan pencapaian akademik pelajar dengan memberi mereka peluang untuk melihat dan menerapkan konsep-konsep matematik yang abstrak dalam konteks yang lebih nyata dan interaktif.

Kesimpulan

Kajian ini menyimpulkan bahawa gaya pembelajaran visual dan kinestetik mempunyai pengaruh yang signifikan terhadap pencapaian pelajar kejuruteraan dalam subjek kalkulus. Pelajar yang menggunakan gaya pembelajaran visual dan kinestetik, serta memanfaatkan teknologi pembelajaran, cenderung mencapai pencapaian akademik yang lebih tinggi berbanding mereka yang menggunakan gaya pembelajaran auditori atau bacaan/penulisan. Oleh itu, pensyarah perlu menyesuaikan kaedah pengajaran mereka mengikut gaya pembelajaran pelajar dan mengintegrasikan teknologi dalam pengajaran kalkulus untuk meningkatkan pencapaian akademik pelajar. Kajian lanjut diperlukan untuk menilai perubahan dalam gaya pembelajaran dan pencapaian akademik pelajar dari masa ke masa serta mengkaji bagaimana integrasi teknologi dapat dioptimumkan untuk menyokong gaya pembelajaran yang berbeza.

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