The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics.

BY

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It is hereby certified that _____***Ong Shu Rou***_____ (ID No: __***22ACB00520***__) has completed this final year project entitled "The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics" under the supervision of Dr Shakiroh Binti Khamis (Supervisor) from the Department of Digital Economy Technology, Faculty of Information and Communication Technology, and Dr Noraini Binti Ibrahim (Co-Supervisor) from the Department of Digital Economy Technology, Faculty of Information and Communication Technology.

I understand that University will upload softcopy of my final year project in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

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ABSTRACT

This research investigates the profound impact of teaching strategies on students' academic performance with a particular focus on mathematics, which is a subject foundational to critical thinking and problem-solving skills. The study delves into the application of predictive analytics to evaluate and improve instructional methodologies in mathematics education, addressing the limitations of traditional teaching approaches that often fail to cater to diverse student learning styles. By critiquing the conventional "one-size-fits-all" method, the research identifies key challenges, such as the lack of personalization, inadequate responses to evolving educational needs and inefficiencies in traditional mathematics instruction. The primary objective of this study is to use predictive analytics to examine the relationship between teaching strategies and students' mathematics performance. Sub-objectives include identifying effective teaching techniques, addressing the inefficiencies of traditional methods and exploring personalized instructional solutions to accommodate diverse learning preferences. The study employs the Data Science Life Cycle (DSLC) methodology, which encompasses problem identification, data investigation, pre-processing, exploratory data analysis, data modelling and model evaluation to assess the influence of teaching strategies on academic outcomes. By focusing on undergraduate students from Universiti Tunku Abdul Rahman (UTAR) across the Business and Finance, Information and Communication Technology and Arts and Social Science faculties. The research aims to understand the diverse learning needs across these disciplines. The findings underscore the significant impact of tailored teaching strategies and enhanced through predictive analytics on students' understanding and performance in mathematics. The proposed solutions emphasize the need for flexible, inclusive and adaptive instructional methods to improve educational outcomes. This research contributes valuable insights to various stakeholders, including educators, policymakers and technology developers by offering evidence-based recommendations for integrating predictive analytics in education. Ultimately, the study aspires to enhance students' academic experiences and equipping them with the skills needed to succeed in a rapidly evolving educational landscape.

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&	and

LIST OF ABBREVIATIONS

UTAR	Universiti Tunku Abdul Rahman
DSLC	Data Science Lifecycle
FICT	Faculty Information and Communication Technology
FBF	Faculty Business and Finance
FAS	Faculty Arts and Social Science

CHAPTER 1

Introduction

The impact that teaching methods have on students' academic performance is critical in the ever-changing world of modern education, especially when it comes to complex subjects like mathematics. Predictive analytics stands out as a promising way for predicting trends and outcomes in this new era of data-driven approaches and cutting-edge technology. This study looks into the relationship between instructional strategies, mathematics proficiency and using predictive analytics to improve student learning. Therefore, enhancing teaching strategies and raising academic achievement is still a crucial goal in the constantly changing field of education. Since mathematics is essential to intellectual growth, teaching it needs to be done with a more sophisticated approach that crosses conventional boundaries. In order to evaluate predictive analytics' influence on students' academic performance in mathematics, this study aims to explore the field.

1.1 Problem Statement and Motivation

1.1.1 Problem Statement

1. Inefficiencies in Traditional Teaching Approaches for Mathematics Subjects

Teaching mathematics in the traditional sense often involves standardised techniques that might not take into consideration the various learning preferences, skills and requirements of each student. A one-size-fits-all approach may prevent some students from understanding basic ideas or from providing them with enough challenge. Students prefer different types of learning, such as kinaesthetic, auditory or visual. Traditional methods may fail to take these variations into consideration. While some students are able to pick up mathematical concepts quickly, others might need more assistance. It's possible that conventional methods don't adequately address these variations [1]. To enhance mathematics education's effectiveness, these inefficiencies must be identified and addressed. The study aims to identify alternatives that better meet the varied needs of students by identifying the weaknesses of traditional approaches.

2. Lack of Personalization in Mathematics Subjects Instruction

It is difficult to customise instruction to fulfil each student's unique needs in many traditional teaching methods. Because of this lack of personalization, students may struggle or receive insufficient challenges. If advanced mathematical students are not adequately challenged, they may lose interest. Without individualised assistance, those who struggle with particular concepts might fall behind [2]. To achieve the best learning outcomes, it becomes essential to look into ways to customise instruction. In order to foster a more diverse and productive learning environment, the study intends to investigate how customised approaches can address each student's distinct strengths and weaknesses.

3. Inadequate Adaptation to Evolving Educational Needs

Education is a field that is always changing, with new educational philosophies, teaching techniques and technologies appearing. It's possible that traditional teaching approaches won't appropriately take these modifications into account, misaligning them with the demands of modern education. The abilities and understanding needed in the quickly evolving twenty-first century landscape may not be met by traditional methods. Confusion of the situation could result in lost chances to use creative thinking to achieve better learning results [3]. In order to ensure students' success in mathematics classes and to set them up for the opportunities and challenges of the contemporary world, it is vital that teaching strategies be modified to meet the changing needs of the students.

1.1.2 Motivation

The motivation for beginning this research path comes from a deep-seated desire to improve the teaching of mathematics in the face of current challenges. Regardless of being essential the traditional teaching concepts have proven to be ineffective in achieving the wide range of academic requirements of students. It is important to reevaluate and improve the teaching methods in order to navigate an environment shaped by fast technological advancements and changing approaches to education [4].

In order to address the problems currently encountered in the education system, there is a clear need to examine the links between teaching methods, mathematical knowledge and the strategic use of predictive analytics. Advanced and adaptable

teaching strategies that transcend the limitations of traditional methods are necessary for teaching mathematics as it is critical for academic development [5]. The purpose of this study is to use predictive analytics to personalise instructional strategies based on each student's individual learning style to become an effective transformation agent [6].

The motivation for this research comes from an understanding of the limitations of traditional approaches to teaching, the lack of personalised instruction in mathematics, and the importance of evolving with developments in the educational system. The aim is to provide educators with useful information that will enable them to improve their teaching methodologies by delving into the complexity of these challenges [7].

The main motivation behind this research is a need to overcome the gap that exists between traditional teaching methods and the requirements of a changing, data-driven learning environment. It feels optimistic about the possibility of using predictive analytics to improve teaching strategies, as this could lead to improved student outcomes in mathematics as well as a more inclusive, customised and future-ready learning environment. The ultimate objective is to make a significant contribution to the larger conversation in improving quality in education in mathematics to the twenty-first century by empowering teachers and encouraging development in methodologies for teaching through this research.

1.2 Research Objectives

1.2.1 Main Objective

The main objective of this research is to utilize predictive analytics to investigate how various teaching strategies impact students' academic performance in mathematics subjects. The overall objective includes an in-depth exploration of instructional strategies and their direct effects on student outcomes. To achieve this, there are several sub-objectives have been established: -

1. **To identify impactful teaching techniques for mathematics subjects.**
2. **To develop conceptual model for mathematics subjects.**
3. **To evaluate the ITEA model by using expert review.**

1.3 Project Scope and Direction

The target audience of this research project focuses on the faculties of Information and Communication Technology (FICT), Business and Finance (FBF) and Arts and Social Science (FAS), with a specific aim of targeting undergraduate students from Universiti Tunku Abdul Rahman (UTAR). Students from different faculties will be included, which will result in a more nuanced understanding of the various learning needs within different fields of study. In order to keep the investigation of undergraduate foundational experiences limited, the research attempts not to include postgraduate students.

1.4 Contributions

The aim of this research is to provide significant benefits to different educational, technological, and policy stakeholders. The following important areas are included in the expected impact: -

1. Educators and Teaching Practitioners

The aim of the research is to give teachers a better understanding of the weaknesses of traditional methods of teaching mathematics to enhance teaching methodologies. Understanding the inefficiencies this study uncovered allows teachers to modify and improve their teaching methods, giving students more individualised and productive learning opportunities. Besides, teachers will also receive helpful advice on how to integrate predictive analytics in their teaching strategies. The investigation investigates the way predictive analytics are able to be used to adapt instruction to individual learners, taking advantage of their varying styles of learning and ultimately enhancing mathematics performance.

2. Educational Institutions

The teachers will receive helpful advice on how to integrate predictive analytics in their teaching strategies. The research project looks into the way predictive analytics are able to be used to adapt instruction to individual learners, taking advantage of their varying styles of learning and ultimately enhancing mathematics performance.

3. Policy Makers

It would be advantageous to education policymakers to have a greater understanding of the difficulties that traditional teaching methods face. This research assists in the development of accurate policies that encourage the incorporation of modern teaching approaches and ensure that educational systems continue to adapt to changing demands.

4. Technology Developers

The research project investigates the implementation for predictive analytics to the field of teaching mathematics. Applying these findings, technology developers are able to construct and enhance predictive analytics-based instructional tools, leading to the creation of creative solutions that improve the method of instruction and learning.

5. Students

The students stand to benefit the most from this research in the end. Students will receive more individualised and interesting learning experiences as a result of all the ineffectiveness within traditional teaching methods being addressed. The aim of the research is to support students' positive and meaningful educational journeys while also enhancing their academic performance in mathematics.

6. Research Community

By expanding the scope of the relationship between methods of teaching, mathematical skill, and predictive analytics, this research aims to make a valuable contribution to the wider scholarly conversation. Data-driven methodology and educational technology may see further investigation, discussion, and study as a result of the findings.

1.5 Report Organization

The report is divided into seven chapters, each serving a distinct purpose in examining the integration of teaching methodologies in mathematics education. Chapter 1 introduces the objectives of the study, setting the stage for the research and outlining the key questions to be addressed. Chapter 2 reviews the existing literature on teaching strategies in mathematics, identifying gaps and challenges in the current educational landscape. Chapter 3 explains the research methodology, detailing the approach used for data collection and analysis. Chapter 4 explains the preliminary work and Chapter

5 present the data analysis and result after getting the survey from respondents. Then, Chapter 6 to present the model development, model evaluation, result of expert review and summary for whole Chapter 6. Lastly, Chapter 7 will be discussion and conclusion on achievement of research objectives, challenges and limitations, future work and make a conclusion for whole research project.

The next chapter will discuss Chapter 2 which are literature reviews regarding the research.

CHAPTER 2

Literature Reviews

2.1 Literature Review

The literature review on modern educational practices, focusing on interactive and student-centred learning, technology integration, and continuous professional development. It examines the strengths and limitations of these approaches, highlighting their impact on student engagement and learning outcomes. The chapter also proposes solutions, including adaptive learning platforms and data-driven strategies, to address the challenges identified in the current educational landscape.

2.1.1 Interactive and Student-Centred Learning

Firstly, interactive and student-centred learning is the other researchers or developers done to resolve the problem. This is because the traditional teaching technique, typified by teacher centred education and low student interaction, has frequently been contrasted with contemporary teaching methodologies. This method is known as teacher-centred because the teacher is the major source of knowledge, with complete authority over the environment for learning, instructional methods, and curriculum. It usually consists of classes, memorising information, and an excessive reliance on textbooks, which limits student exploration and participatory learning. According to critics, traditional teaching methods encourage students' passivity and impede the development of abilities to learn independently. While some features of the conventional approach continue to be used in educational organisations, there is a strong acknowledgment of the need to incorporate modern elements to adapt to changing educational environments and encourage increased student participation [8].

While in a new teaching method, the concept of instruction and study is continually evolving to serve diverse learners in new and novel ways. New study and investigation findings have an influence. According to studies, when a teacher permits their students to inquire or even lay the foundation for his or her scholastic success, learning takes on new meaning more efficiently. The instructor in a student-centred classroom as opposed to being an instructor, acts as a facilitator. Developing a relationship working with learners is an important element of education and instruction

that a teacher could use to assess pupils' progress in a classroom. Interactive learning is an increased hands-on, real-world method of learning. In classrooms, information is communicated. Passive learning is based on listening to a teacher's presentation or memorising facts, figures or equations are examples of equations [9].

2.1.2 Technology Integration

Several classic teaching methodologies have come under fire for apparent flaws in ensuring successful student learning. Homework, despite being a regular practice, was discovered to provide obstacles, such as discrepancies in student utilisation of resources and time limits. Although the pause technique has demonstrated enhanced efficiency in specific cases, its applicability decreases with bigger class sizes. The comparison of PowerPoint and Blackboard, Inc. raises issues about technological dependence in educational environments, which may disadvantage some students due to the rapid pace of instruction and limited accessibility for both educators and learners. These topics highlight the shortcomings and limitations connected with traditional teaching approaches, as well as the effect on student outcomes [10].

In new teaching methods, many digital tools play an important part in improving students' learning experiences. Learning administration Systems (LMS) such as Google Classroom, Moodle, and Blackboard are commonly used solutions for effective content administration and distribution. Teachers can use interactive whiteboards, which are big touchscreen screens, to present and interact with online materials such as films and photographs. On mobile devices, educational apps such as Kahoot!, Duolingo, and Khan Academy provide interactive learning experiences. Remote connections are made possible by video conferencing applications such as Zoom and Google Meet, which create virtual learning settings. Google Expeditions and Nearpod VR, for example, use augmented reality (AR) and virtual reality (VR) tools to fully engage students in interactive learning experiences. Content management, communication, evaluation, personalization, and tracking are all characteristics of Learning Management Systems, which are crucial for providing material and assessment. Touch-based interaction, collaborative instruction, and multimedia integration are all features of interactive whiteboards. Interactive material and personalization are provided by educational apps, which are available on tablets and smartphones. Online learning and collaboration are

made easier using video conferencing tools. AR and VR technologies provide realistic simulations and visualisations to students, encouraging engagement, customization, and accessibility. These digital resources, when used together, offer a complete and dynamic education landscape that fosters interactive, engaging, and individualised educational opportunities for students [11].

2.1.3 Professional Development and Continuous Learning

Classical methods of teaching educators confront problems that are consistent with known infrastructural and cultural issues identified in previous studies. These obstacles include tough educational conditions such as financial limits, insufficient teaching tools, intermittent electrical supply, a lack of drinking water, and safety concerns. Teachers, particularly in rural locations, face tough working conditions, such as a lack of acceptable housing nearest educational institutions and meagre and frequently delayed remuneration. These limits lead to a powerless and demotivated teaching power, which is exacerbated by high turnover of staff, absence between educators and pupils, and low morale [12].

In new teaching methods, continuing learning and professional growth are essential for educators, particularly when it comes to adjusting to new teaching approaches. Professional development entails continuous learning and professional training, with options including teaching classes, independent study classes, workshops, seminars, systems, meetings, guidance, and job rotation. Educators face the issue of moving to a technology-mediated world in terms of teaching and research, which necessitates a reconsideration of assumptions and instructional approaches. Despite their subject matter expertise, educators must ongoing training to stay current, increase their knowledge, and effectively integrate technology. Web-based technology, notably Learning Management Systems (LMS), perform a critical role in assisting lecturers by forcing them to learn abilities for efficient communication, humanising experiences, promoting interaction, and managing. Professional development requirements include internet-based tools, lecturers' technologies for learning, and collaborative technology usage in teaching approaches. However, problems remain, such as the need to master certain abilities such as typing, writing, scanning, and internet reading. Technology adoption is a continuous process that necessitates a learning environment based on adult

education concepts, including seminars, guidance, and cognitive apprenticeship. Collaboration is crucial among educators, researchers, and technologists, with professional development loops serving as effective vehicles for ongoing progress. With the ever-changing landscape demanding teachers to embrace continuous instruction in the 21st century, evaluating the effect of innovations, administrative assistance, and equipment on the advancement, transportation, and evaluation of technology-mediated programs is crucial [13].

2.2 Strength of Previous Studies

2.2.1 Strengths of Interactive and Student-Centred Learning

The development of innovative concepts and the identification of new and unforeseen linkages or elements are all part of creative thinking. One source emphasises the necessity of recognizing and describing problems as a crucial component impacting creative performance, noting that imaginative thinking is about creating innovative methods of considering uncommon correlations or solutions. It is believed that creative people are mindful of the presence of issues, claiming that limited chances to demonstrate creative features appear when there are no problems to address. While acknowledging the problem-solving side of innovation, another contributor emphasises its broader goals and highlights its complex nature. Problem recognition and awareness are frequently related with creativity. Problem recognition and awareness are frequently related with creativity. When comparing creative and critical thinking, features such as the capacity to generate ideas, nurture various perspectives, and fantasise8 are recognized for creative thinking, whereas critical thinking entails assessing concepts, reasoning with logic, and looking for factual validity. Both thinking talents place a premium on new views above rigid obedience to norms or traditional viewpoints. Critical thinking entails analysis, evaluation, decision-making, and rational problem-solving, but creative thinking entails coming up with original ideas and coming up with innovative solutions [14]. The strengths of interactive and student-centred learning are the significance of critical thinking stems from its role as a domain-general ability to think that fosters innovation, self-reflection, and personal perspective justification. Critical thinking merely improves language and presenting abilities by encouraging clear and methodical thinking, but it also necessitates the ability to assess data and real-world challenges beyond mere knowledge. This critical thinking competence helps

asking the proper questions, which leads to greater comprehension and significant connections between individuals. Failure to think properly, referred to as a "mental error," is characterised by a deliberate departure from logic and logical thought, which can be reduced by knowing how the human mind works and employing ways to gain beneficial mental abilities. Critical thinking, regarded as one of the most important cognitive abilities, makes a substantial contribution to growth both personally and professionally. In the context of learning, the twentieth century saw a transition from prioritising the transmission of knowledge to emphasising the development of higher mental processes, notably critical thinking and solving problems, as the primary goals of education [15].

2.2.2 Strength of Technology Integration

The continually changing educational environment provides chances to participate in digital transformation to improve instructional quality through pedagogic innovation. To embrace digital transformation, instructors must analyse the pedagogical benefits of incorporating technology in instruction and learning as crucial agents of educational reform. By upgrading and changing today's classrooms into intelligent educational environments, the right use of technologies has culminated in true learning. Smart learning environments foster creative and student-centred learning experiences that contextualise, socialise, reflect, and engage students. Teachers are crucial in integrating technology into the classroom. According to the journal paper, there must be consistency among the aspects that influence technology integration in education and instruction. These elements include teacher views, knowledge, and objectives. Beliefs influence how teachers choose and prioritise learning goals, as well as how they perceive classroom interactions and make decisions regarding tools to use in the learning process

At a level that is more realistic, access to technology impacts whether teachers will use technology in their classes. Teachers are primarily responsible for the adoption and application of ICT (information and communication technology) in the classroom, and they cannot construct smart environments if they cannot access these tools owing to bad infrastructure or a lack of funds. A lack of ICT expertise is another issue for most educators in this educational drive for technology integration. It is difficult for teachers

who lack technology competence to address technological issues during instruction and learning. ICT expertise is critical because it enables instructors to create and apply technologies that are unique to their learning contexts. The accessibility of technological resources in schools is required for the successful deployment of technological integration in the classroom [16]. The strength of technology integration is in today's educational environment, technology is critical for meeting the requirements of technologically savvy students. Technology improves instruction in languages, assessment, and engagement, which is especially important in EFL contexts. Educators are incorporating technology into subjects to promote authentic language use and to motivate students. Global collaboration is facilitated by computer-assisted communication, which contributes to continued professional development. This is consistent with technology's revolutionary impact on society dynamics.

Technology promotes cooperative study and effective language application in language learning. Computer-assisted tasks allow for quick access to data, promoting continual learning. Recognizing technology's revolutionary function, educators must actively integrate it into language teaching. Technology has become a vital part of the educational experience, necessitating educators' continued education and adaptation of language teaching methodologies to technological advancement [17].

2.2.3 Strength of Professional Development and Continuous Learning

Continuous education and ongoing professional growth are critical components of today's professional landscape, acting as drivers of career durability, flexibility, and overall success. These techniques enable people to learn cutting-edge skills, ensuring their relevance and effectiveness in dynamically changing sectors. For educators, continuing professional development is more than just a tool for improving teaching methods; it is also a means of effectively inspiring and shaping the minds of future generations. The dedication to continual learning extends beyond the pursuit of short-term rewards; it fosters an attitude of interest, resilience, and adaptability. Participating in a variety of learning experiences promotes an in-depth comprehension of one's field, promotes intellectual progress, and aids in the synthesis of fresh information into practical applications. This dedication to development not only accelerates personal and

professional achievement, but it additionally adds to a culture of creativity and superior performance in larger societal contexts [18].

2.3 Limitation of Previous Studies

2.3.1 Limitation of Interactive and Student-Centred Learning

While interactive and student-centred learning approaches have grown in popularity in modern educational paradigms, it is vital to critically assess their limitations and obstacles. These novel approaches to fostering active participation by students and cooperative learning experiences are not without limitations. Understanding the disadvantages of Interactive and Student-Centred Learning is critical for learners and educational officials who want to build efficient and inclusive educational settings. This investigation will shed more light on the constraints and potential difficulties that educators may face while using these innovative teaching methods, providing for a deeper comprehension of their effect on student achievement and overall educational success.

Navigating the terrain of Interaction and Student-centred Learning (ISCL) is like navigating the complexities of resource intensities in financial systems. While resource intensity measures the effectiveness of resource use in manufacturing, ISCL measures educational efficiency. Rather than providing steady educational growth, ISCL implementation faces problems, like the intensity of resources in economic development. Just as scarcity of resources is a worry in environmental economics, students' various learning preferences provide a significant barrier to ISCL's general efficacy [19].

2.3.2 Limitation of Technology Integration

Teachers' use of gadgets within the curriculum or as a complement to individual lessons varies, reflecting variances in their opinions about the utility of technology in education. These ideas, inspired by teachers' student learning philosophies, impact their integration practices. Less computerised utilisation of technology in classrooms is generally connected with teachers who espouse more traditional educational ideals. To effectively integrate computers, educators must transition from an instructor-focused to a student-centred mindset. Difficulties in satisfying individual student requirements and

matching multiple objectives are among the challenges. Despite the growing popularity of constructivist learning theories, teachers may encounter challenges when absorbing technological advances, such as the "dual creativity" problem, in which adopting technology necessitates additional preparation time. Time restrictions, comfort with current lesson plans, and a wide range of technological tools to choose from all contribute to teacher reluctance to integrate technology. Concerns about heavier workloads, pessimism about the efficiency of technological advances, and the effects of administrative choices made without teacher input are raised in teacher forums. To overcome these obstacles, it is necessary to address instructors' concerns and provide support to promote effective technological integration [20].

2.3.3 Limitation of Professional Development and Continuous Learning

To assist educators in their professional growth, teacher follow-up tools such as workshops materials, diaries, self-evaluation questionnaires, and peer coaching were developed. However, while these tactics are beneficial, they have limitations, particularly when it comes to addressing the different and distinct issues that teachers confront. The success of these tactics may be jeopardised in environments with restricted resources, such as a scarcity of skilled peers. The overall barrier is a lack of resources, which prevents the adoption of more intense and tailored support for teachers. To overcome these constraints, it is critical to advocate for more resources and to investigate creative, cost-effective alternatives to professional development [21].

When compared planned allocations for professional growth and continuing learning, a somewhat stronger link appeared when assessing perceived cost constraints among teachers. There was a substantial relationship between the amount to which instructors perceived cost as an obstacle to obtaining greater professional growth and the degree of financial help they got. expense is more likely to be viewed as a significant obstacle in countries where a relatively large number of teachers bear the complete expense of their professional development. For example, this pattern is especially visible in Mexico and Brazil, where roughly 50% of instructors mentioned cost as a factor for not participating in additional growth activities. Furthermore, a sizable fraction of instructors in both nations (18% and 19%, correspondingly) shoulder the whole cost of these types of events. Poland also has among the largest rates of monetary

contributions to teacher expansion, with almost half of reported expenses functioning as a barrier to engaging in higher levels of professional development. This highlights the budgetary constraints that some educators experience and emphasises the importance of equal access to specialised development resources [22].

2.4 Proposed Solutions

2.4.1 Adaptive Learning Platforms

To improve interactive and student-centred learning, adaptive learning platforms must be implemented. By using predictive analytics to evaluate students' performance and learning preferences, these platforms provide activities and content that are specifically tailored to them. Students are actively involved in the process of learning when gamified components are included, such as interactive tests and scenarios involving real-world problem solving. Furthermore, the collaborative tools integrated into these platforms facilitate student interaction, thereby fostering a student-centred environment in which knowledge is jointly constructed. By meeting individual needs and maximising the learning process, adaptive learning makes sure that every student advances at their own speed [23].

2.4.2 Predictive Analytics for Personalized Learning Paths

To develop individualised learning pathways for mathematics subjects, predictive analytics integration with learning administration systems and educational applications is suggested. To forecast future needs, predictive analytics examines learning patterns and past performance of students. Personalised exercises and challenges can then be provided by AI-powered educational apps, which can adjust to each user's unique mathematical strengths and weaknesses. A data-driven approach is enhanced by predictive analytics' real-time feedback and updates on progress, which enable teachers to tailor their teaching methods to each student's particular learning path and act quickly when necessary [24].

2.4.3 Data-Driven Professional Development Programs

It is advised to use a data-driven strategy to address issues with professional development. Teachers can use predictive analytics to pinpoint their own needs and areas for development. Predictive analytics insights can be used to create online

workshops and subjects on technology integration, specifically in mathematics education. Furthermore, it is possible to support peer educational groups and mentorship programs, which foster a cooperative atmosphere in which educators participate in ongoing professional development, exchange optimal methodologies, and jointly tackle issues revealed by data analysis [25].

2.4.4 Comprehensive Support and Training

A thorough support system and training program are necessary to overcome the obstacles related to technology integration, student-centred learning, and professional development. For interactive learning methodologies to be implemented effectively, teachers should be trained in managing diverse learning preferences. To address issues with technology integration, continuous technical assistance is necessary. Professional development constraints can be lessened by arguing for more funding and looking into more affordable options. Teachers can successfully implement innovative teaching methodologies by fostering an environment for learning that empowers them to overcome obstacles with confidence [26].

2.4.5 Continuous Assessment

Using Predictive Analytics A predictive analytics-driven continuous assessment system is suggested to gauge how well teaching approaches are working. This entails getting input on the effects of technology integration, student-centred and interactive learning, and professional development programs from both educators and learners. This feedback can be analysed using predictive analytics to find trends and areas that need work. Frequent data analysis establishes an evolving feedback loop that allows instructional strategies to be continuously improved and refined in response to changing demands and obstacles, ultimately raising mathematics students' academic performance [27].

The next chapter will evaluate and discuss proposed methods or approaches regarding the research.

CHAPTER 3

Proposed Method/Approach

3.0 Introduction

This chapter outlines the proposed research framework and methodologies for investigating the impact of teaching strategies on students' academic performance in mathematics using predictive analytics. The framework is based on the Data Science Life Cycle (DSLC) and aims to identify effective teaching techniques, address inefficiencies in traditional methods, and enhance personalised instruction. The chapter details each step of the DSLC, including problem identification, data investigation, data preprocessing, exploratory data analysis, data modelling and model evaluation to systematically approach the research objectives and provide actionable insights for improving mathematics education.

3.1 Formulation of Research Framework

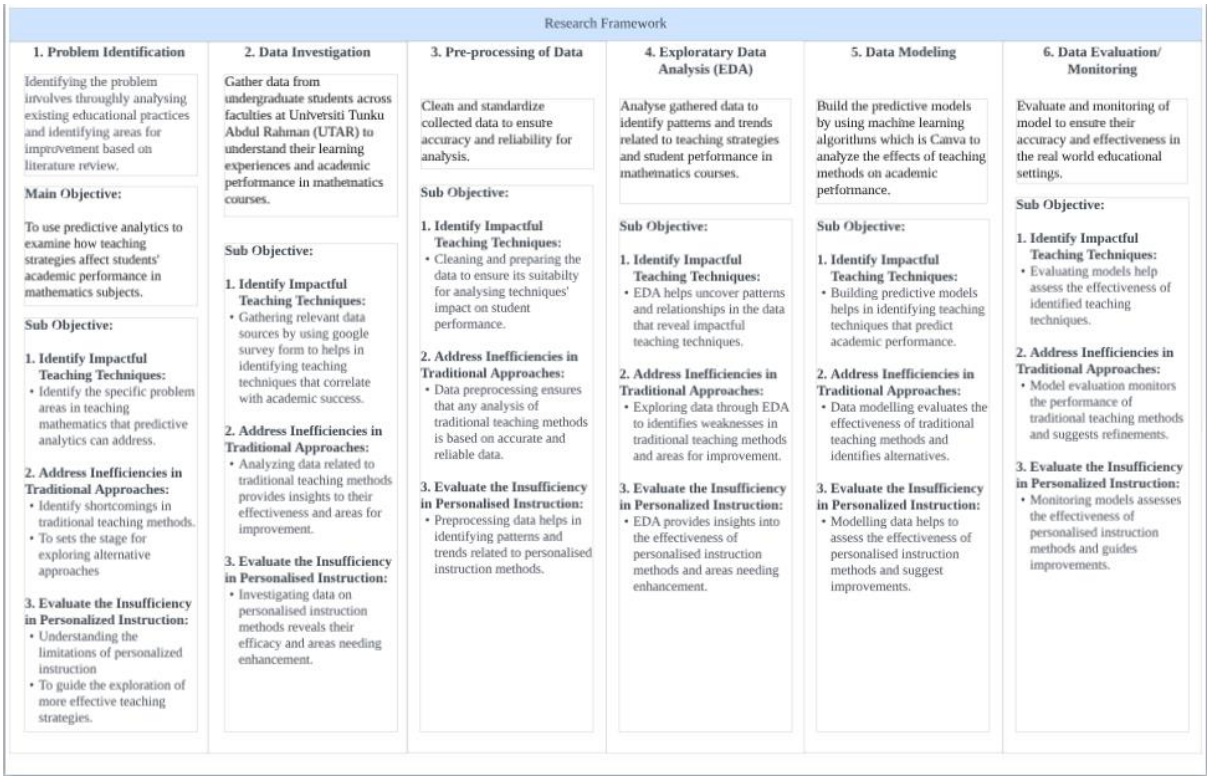

Table 3.1 Research Framework by using Data Science Lifecycle (DSLC)

The table 3.1 shows the diagram of the Research Framework by using the Data Science Lifecycle (DSLC). The research framework utilises the Data Science Life Cycle (DSC) to investigate how teaching strategies affect students' academic performance in

mathematics subjects using predictive analytics. The main objective is to understand this relationship comprehensively. After that, the sub objectives are to identify impactful teaching techniques, address inefficiencies in traditional approaches and evaluate the insufficiency in personalised instruction. In each step, the DSLC meet with these objectives: -

1. **Problem Identification**: To recognise the existing inefficiencies in teaching methodologies and how it can be improved to meet the needs of diverse learners.

2. **Data Investigation**: To use a survey-based approach to gather data from students in Universiti Tunku Abdul Rahman (UTAR).

3. **Pre-processing of Data**: To clean and prepare data the survey response for analysis to ensure accuracy and efficiency.

4. **Exploratory Data Analysis (EDA)**: To analyse the survey data to identify trends between teaching methods and student performance.

5. **Data Modeling**: To represent the relationships and insights derived from the data by using Canva.

6. **Model Evaluation/ Monitoring**: To use the feedback from surveys and expert reviews to evaluate the teaching strategies.

By following this research framework, it aims to provide insights into effective teaching techniques, improve traditional approaches and enhance personalised instruction in mathematics education.

3.2 Methods

The research adapted using the Data Science Life Cycle (DSLC) to its fullest potential. The research revolutionised the teaching of mathematics. Through the use of a systems approach, the aim is to analyse the intricacy of teaching methods and find new

information that has the potential to transform the educational experience for students. The methods of DSLC have: -

3.2.1 Problem Identification

The first step of the research involved identifying issues within the current teaching methods for mathematics, particularly in relation to personalisation and student engagement. Through a review of literature and discussions with educators, the research identifies key problems: -

- Traditional teaching methods often do not cater to the diverse learning needs of students.
- A lack of adaptability in teaching strategies may hinder students' understanding of mathematical concepts.

In this phase, it also considered the perspectives of different stakeholders, including students, educators and institutions. The feedback from these stakeholders provided insights into the areas that needed improvement.

3.2.2 Data Investigation

The second phase involved an in-depth investigation of data sources related to educational strategies and student performance. It included: -

- **Surveys**: A Google Forms survey was distributed to undergraduate students from three faculties: Information and Communication Technology (FICT), Business and Finance (FBF) and Arts and Social Science (FAS). The survey gathered data on students' perceptions of the effectiveness of current teaching methodologies and their openness to more personalized learning approaches.
- **Expert Reviews**: Experts in the field of education provided feedback on the proposed teaching methodologies and instructional strategies.

3.2.3 Pre-processing of Data

The survey data underwent several pre-processing steps to ensure the accuracy and reliability of the results:

- **Data Cleaning**: Removing incomplete or inaccurate responses.
- **Standardization**: Normalizing the data to ensure consistency and comparability across responses.
- **Outlier Detection**: Identifying and handling outliers to prevent skewed results.

This process ensured that the dataset was ready for meaningful analysis in the subsequent stages.

3.2.4 Exploratory Data Analysis

The pre-processed data was analysed using exploratory data analysis techniques to uncover trends and relationships between teaching methodologies and student outcomes. This stage included:

- **Descriptive Statistics**: Summarizing key demographic details and student feedback on the effectiveness of various teaching approaches.
- **Trend Analysis**: Identifying patterns in the data to understand how different teaching strategies influence students' performance in mathematics.

In visual representations, such as pie charts and bar graphs, it were generated to make the results more accessible and easier to interpret.

3.2.5 Data Modelling

In the research, data modelling focuses on structuring and organizing the data collected through surveys in a manner that enables meaningful analysis. Instead of using complex machine learning algorithms, the research utilizes basic statistical methods and visual tools to model the relationships between teaching strategies and student performance in mathematics. The aim is to highlight trends and correlations in the data to support the research objectives.

The key components of the data modelling phase include: -

- **Organizing Survey Data**: Survey responses are grouped by categories such as teaching methods, student demographic data (age, gender, faculty) and academic performance.
- **Creating Visual Models**: Tools such as Canva are used to generate visual representations like bar charts to illustrate the relationships between teaching strategies and student outcomes.
- **Correlation Analysis**: A simple statistical analysis is performed to identify correlations between teaching methodologies and improved academic performance. This helps in identifying which strategies have the most significant impact on student learning.

By this way, the research provides a clear visualization of how different instructional approaches affect students' performance, making the results easy to interpret and apply to real-world educational settings.

3.2.6 Model Evaluation/ Monitoring

The model evaluation involves two key aspects: evaluation the data model and gathering expert feedback. The data model visually represents the relationship between teaching strategies and student performance. Therefore, expert reviews are then collected to validate the model’s accuracy and practicality. Education professionals assess whether the model reflects real-world classroom dynamics and provide suggestions for refining it to ensure its effectiveness in improving student learning outcomes. This continuous feedback ensures the model is robust and applicable in real educational settings.

3.3 Timeline

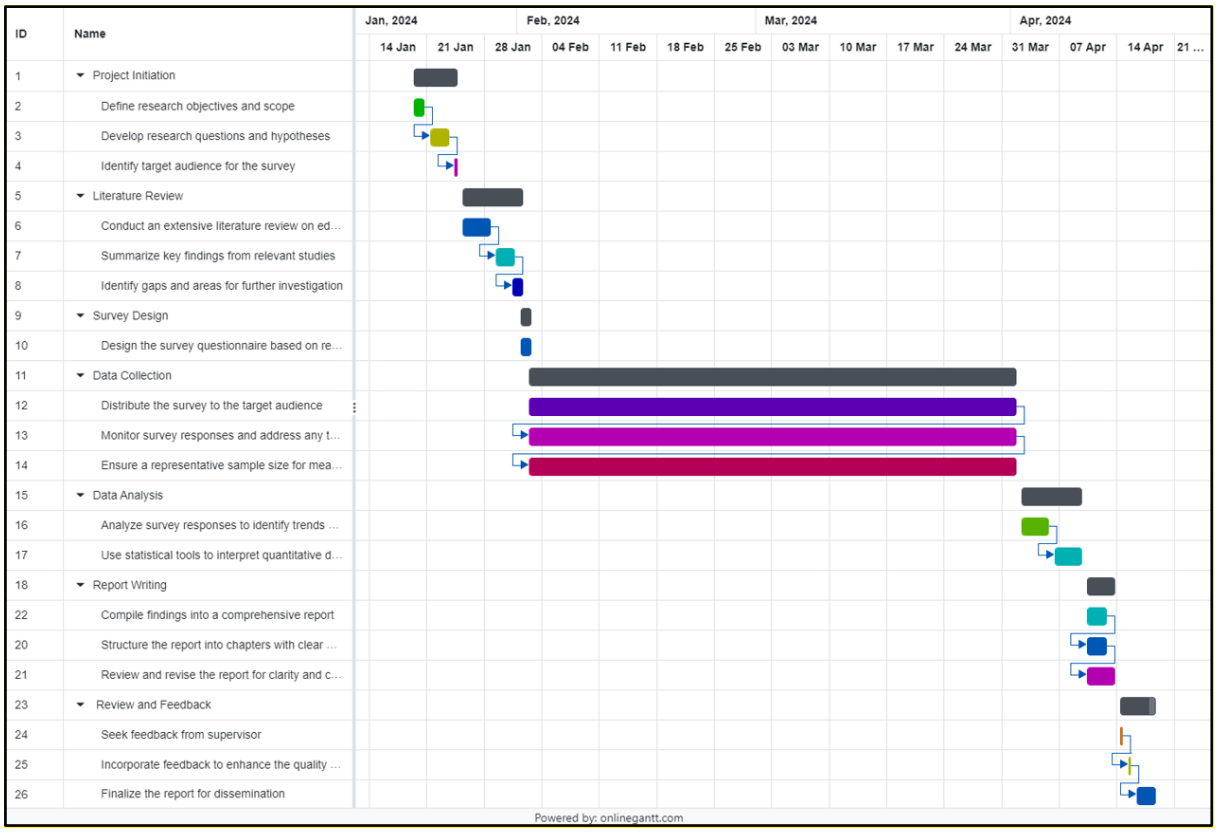

Table 3.3.1 Timeline of Research Project

The next chapter will discuss the preliminary work regarding the research in Chapter 4.

CHAPTER 4

Preliminary Work

4.0 Introduction

In chapter 4, it outlines the preliminary steps taken to identify current challenges in mathematics education and gather data for analysis. The goal was to develop a clear understanding of the weaknesses in current teaching methods and propose solutions that could improve student performance through personalized learning strategies.

4.1 Introduction of Preliminary Work

In this preliminary work, the research outlines the method step-by-step, starting with problem identification. The aim is to identify specific challenges and deficiencies in the current teaching approaches to mathematics. By thoroughly analysing the existing education landscape, this research highlights key areas for improvement in teaching methods. After identifying the problem, the next step involves data investigation, where various educational data sources, such as student performance reports and instructional strategies, are examined. A Google Forms survey is used to collect data from students to gain insights into the effectiveness of current teaching methods.

Once the data is collected, the pre-processing phase begins. This critical step involves cleaning and preparing the data by eliminating inconsistencies or errors. Methods such as data normalization and outlier detection are employed to ensure data accuracy and reliability. After pre-processing, Exploratory Data Analysis (EDA) is conducted, by utilizing statistical and visualization tools to uncover patterns, trends and relationships within the data. This analysis provides valuable insights into how different teaching strategies impact student performance, guiding further research.

Following EDA, the evaluation phase begins, focusing on assessing the effectiveness of various teaching strategies. Tools like Canva are used to visually represent the findings, helping to identify trends in the data. The effectiveness of the proposed teaching methods is continuously reviewed through expert feedback to ensure practical applicability in real-world educational settings.

By following this comprehensive research framework, the aim is to develop innovative solutions that enhance teaching methods in mathematics and improve student outcomes. Each step builds upon the previous to ensure a systematic approach to validating the research findings. Through the processes, this research seeks to address the challenges educators face and create a more engaging and effective learning environment for students.

4.2 Formulation of Research Method

In this step, the research will delve into identifying and defining key issues and challenges in teaching mathematics, drawing insights from the literature review conducted in the previous chapter. The literature review serves as the foundation for understanding existing problems and gaps in current teaching methodologies. It will extract valuable insights from the literature, such as common difficulties faced by students in learning mathematics, the effectiveness of traditional teaching methods and the potential advantages of integrating data-driven technologies like predictive analytics. Additionally, any qualitative and quantitative analyses (QNA) conducted during the literature review are highlighted to provide further depth into the identified issues.

4.2.1 Problem Identification

Once problems are identified through the literature review, it will proceed to investigate relevant data sources pertaining to mathematics education, including gathering feedback from UTAR students via a Google survey form. This step aims to characterise, define and analyse the usefulness of these data sources to gain a comprehensive understanding of the educational landscape. Collaboration with education stakeholders is crucial to ensure that the collected data accurately represents students' educational backgrounds and experiences.

4.2.2 Data Investigation

Upon collecting the data, it is subjected to a thorough investigation to ensure its quality and relevance. This involves selecting pertinent information, integrating datasets, and removing incomplete or irrelevant responses. Techniques such as boxplots and other statistical tools are employed to detect and handle outliers, ensuring data integrity. The

objective is to standardize the data to prepare it for further analysis, ensuring consistency across different respondent groups.

4.2.3 Pre-processing of Data

After the data investigation, pre-processing is carried out to clean and organize the data for meaningful analysis. This includes eliminating any errors or inconsistencies, normalizing the data for comparability and ensuring that only valid and useful data is retained. Pre-processing is essential for ensuring that the dataset is accurate and ready for analysis, setting the foundation for drawing valid conclusions from the research.

4.2.4 Exploratory Data Analysis (EDA)

Following pre-processing, the data is subjected to Exploratory Data Analysis (EDA). This involves using statistical and visualization techniques to uncover patterns, trends and relationships within the data. Tools like Canva are utilized to create visual representations such as bar charts and pie graphs, which help in understanding the distribution of responses and identifying key factors that influence student performance. This stage offers insights into the effectiveness of various teaching strategies and forms the basis for subsequent evaluations.

4.2.5 Data Modelling

The research focuses on modelling data by organizing and categorizing survey results to identify trends in teaching methods and their impact on student performance. The model created from the data analysis represents the relationships between variables such as teaching techniques, student demographics and performance outcomes. This model helps in identifying effective teaching strategies by visually representing how different methodologies affect learning outcomes.

4.2.6 Model Evaluation/ Modelling

The final step involves evaluating the performance of the predictive model developed in the previous step. Ongoing monitoring and evaluation will be conducted to analyse how the model adapts to changes in student behaviour and teaching methods. This includes conducting model drift analysis to assess adaptability to changes in student personality or teaching methods and data drift analysis to examine modifications to

input data. Incremental improvements to the model will be made based on ongoing evaluation to ensure its reliability and effectiveness in improving student outcomes.

The next chapter will evaluate the data analysis and result in Chapter 5.

CHAPTER 5

Data Analysis & Result

5.0 Introduction

The data analysis and results are based on a survey conducted with 80 respondents from UTAR, representing three faculties: FAS, FICT and FBF. The analysis is divided into two main parts which are demographics of the respondents and the findings based on five proposed solutions as survey techniques. The result will show as pie chart with few explanations: -

5.1 Demographic

5.1.1 Age

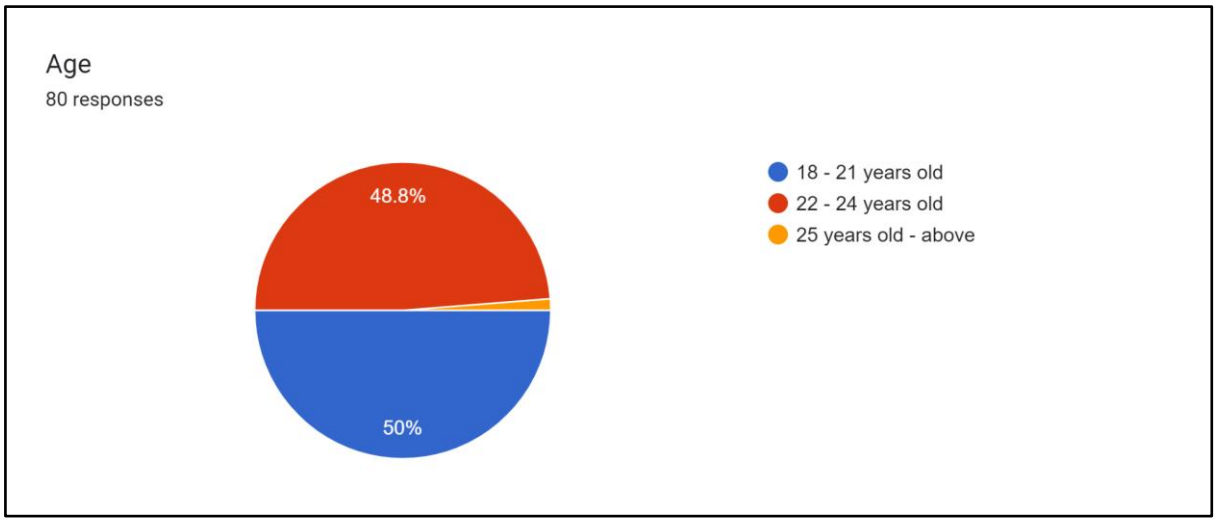

Figure 5.1.1 Age of respondents

Analysis of the demographic data revealed a sample group of 80 respondents, providing valuable insights into age distribution. The majority of participants belonged to the younger age group with 50% (40 people) aged between 18 and 21 years, followed by 48.8% (39 people) aged between 22 and 24 years. Notably, only 1.2% of respondents (1 person) were aged 25 and above. The data highlights the significant concentration of young people between the ages of 18 and 24 in the survey population, suggesting underlying trends or preferences within this demographic group.

5.1.2 Gender

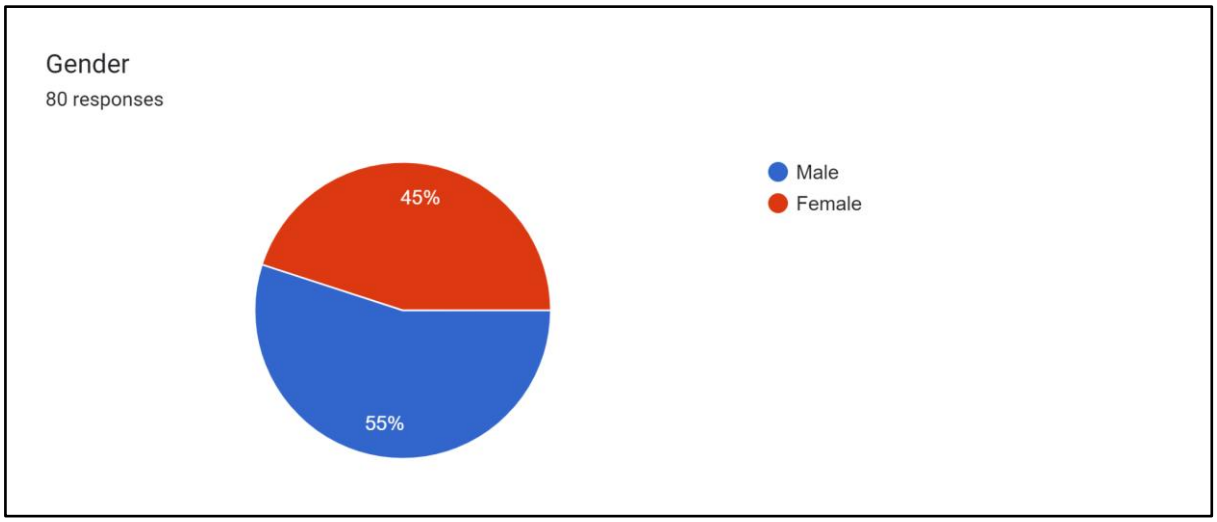

Figure 5.1.2 Gender of respondents

Analysis of the gender distribution of the 80 respondents revealed balanced representation within the sample group. Of these, 55% were male or 44 persons and 45% were female or 36 persons. This near-equal ratio means that both genders are equally represented in the surveyed population, reflecting different perspectives and experiences. This balanced gender distribution is essential to ensure comprehensive insight and understanding of different population groups.

5.1.3 Faculty

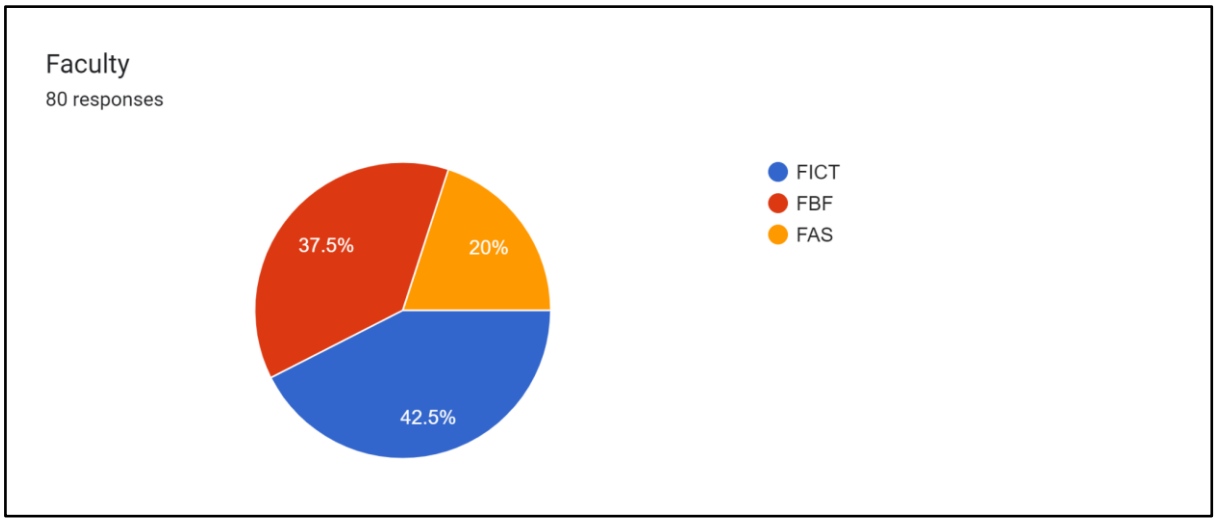

Figure 5.1.3 Faculty of respondents

An analysis of faculty relationships among a sample of 80 respondents reveals different patterns of academic representation. Among the respondents, 42.5% were from the Faculty of Information and Communications Technology (FICT) with a total of 34 people. It is followed by the Faculty of Business and Finance (FBF) with a total of 30 respondents or 37.5%. The Faculty of Arts and Sciences (FAS) comprised the remaining 20% of respondents, representing 16 individuals. This breakdown shows a different distribution across academic departments, indicating the diverse perspectives and backgrounds of those surveyed. This insight into teacher affiliations is critical to understanding the composition of the sample group and tailoring analyses or interventions accordingly.

5.1.4 Current Status

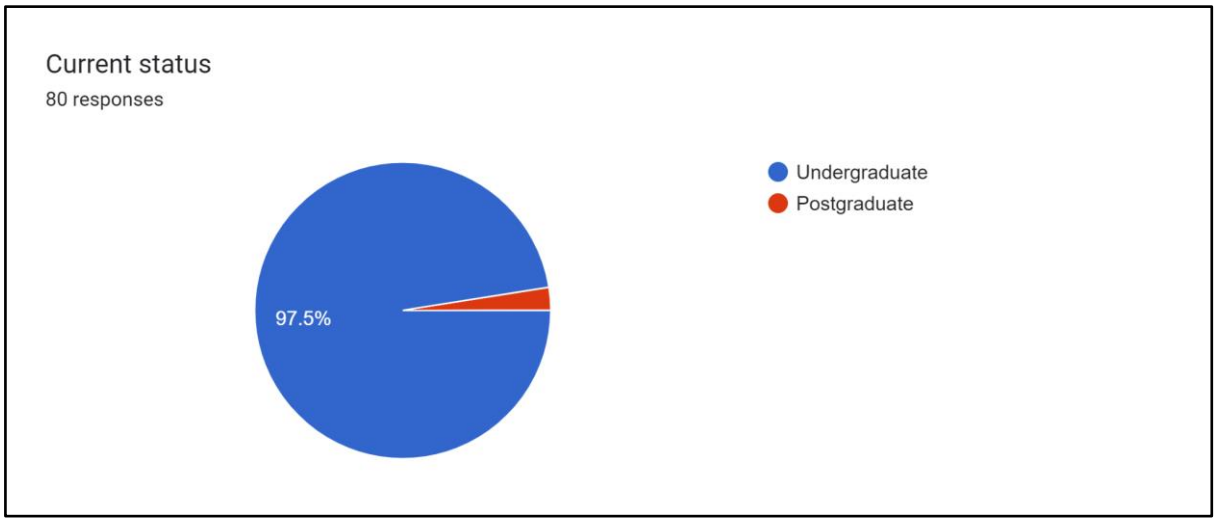

Figure 5.1.4 Current status of respondents

An analysis of the current situation of the 80 respondents provides a clear picture of their educational status. The vast majority (97.5% of the sample group), 78 in total are currently pursuing undergraduate. In comparison, the proportion of postgraduate students is very small, accounting for only 2.5% of the respondents. This distribution highlights the major concerns of undergraduates among the surveyed population, indicating the importance of tailoring any subsequent analysis or intervention to the needs and perspectives of undergraduates.

5.2 Proposed Solutions as Survey Techniques

5.2.1 Adaptive Learning Platforms

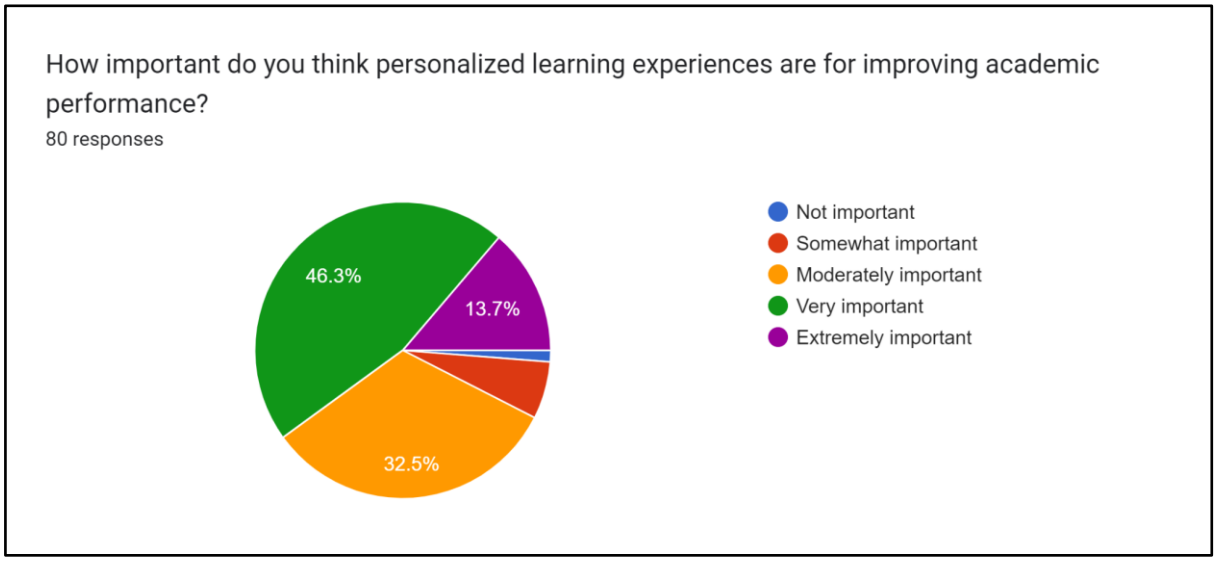

Figure 5.2.1.1 Important of personalised learning experiences for improving academic performance

A data analysis of perceptions of the importance of personalised learning experiences for improving academic performance yielded insightful results. Among the 80 respondents, the majority (46.3%) said that personalised learning experience is very important in this regard. This is closely followed by 32.5% of respondents who consider personalised learning to be quite important. Additionally, 13.7% of participants considered personalised learning extremely important. A small but still significant share of respondents, including 6.3%, rated personalised learning experiences as somewhat important. Interestingly, only 1.3% of respondents believe personalised learning experiences are not important. These findings highlight the strong consensus among the surveyed population regarding the substantial benefits of personalised learning approaches in improving academic performance, emphasising the need for educational institutions to prioritise and implement such strategies accordingly.

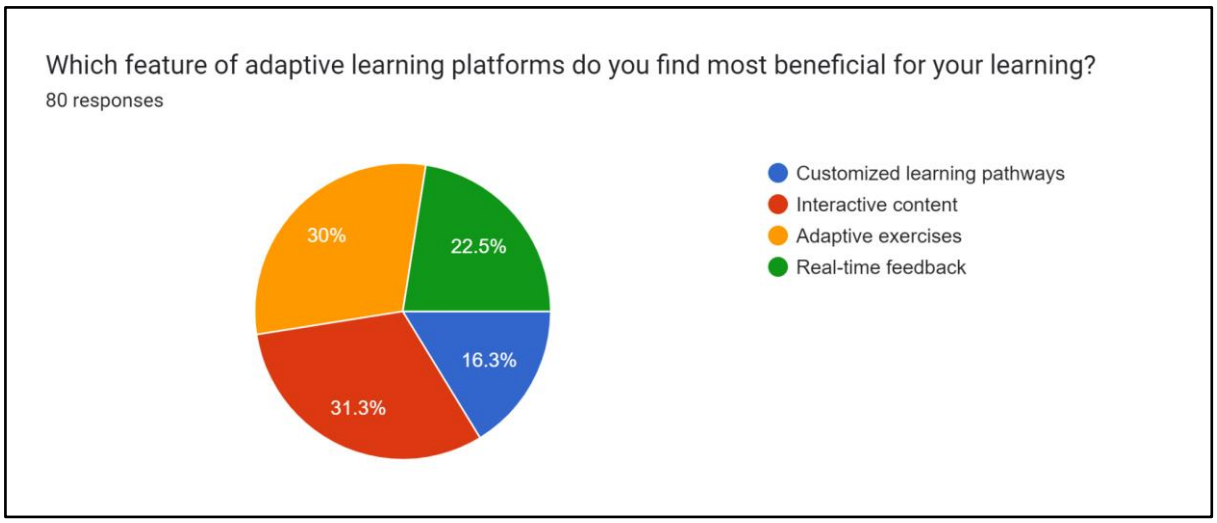

Figure 5.2.1.2 Feature of adaptive learning platforms most beneficial for learning

Analysis of preferred features in adaptive learning platforms reveals valuable insights into the preferences of the surveyed population for learning methods. Interactive content emerged as the most popular feature among 80 respondents, with 31.3% stating that interactive content was beneficial to their learning. This is closely followed by adaptive exercises, favoured by 30% of respondents. Customised learning pathways also proved to be highly valued, with 16.3% of participants finding them beneficial. Real-time feedback, while less popular is still appreciated by 22.5% of respondents. These findings highlight the diverse preferences of the surveyed population and emphasise the importance of incorporating a variety of features into adaptive learning platforms to effectively meet individual learning styles and needs.

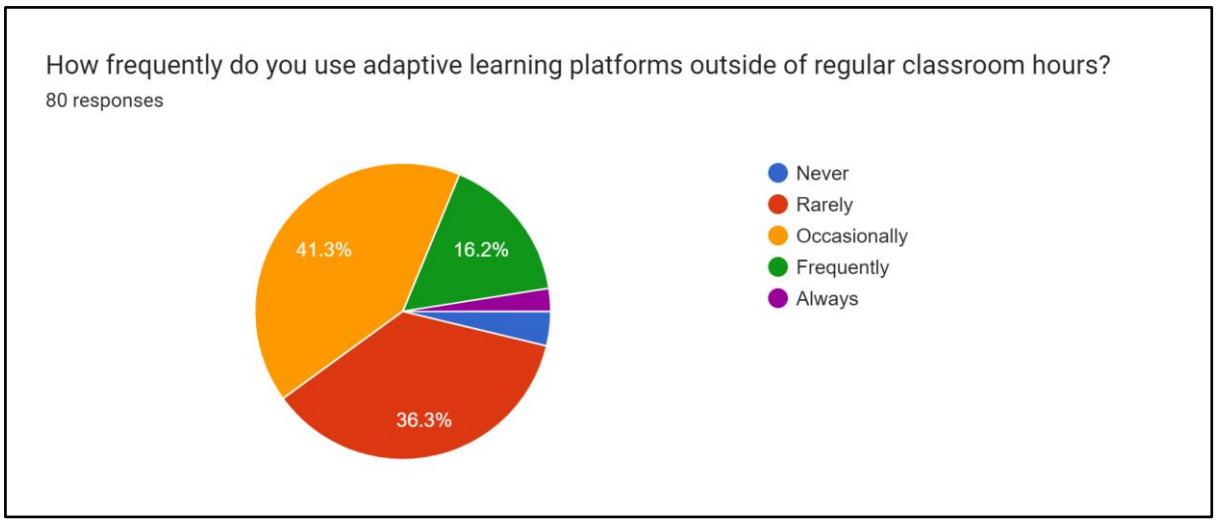

Figure 5.2.1.3 Frequently use adaptive learning platforms outside of regular classroom hours

An analysis of the use of adaptive learning platforms outside of regular classroom time reveals varying levels of engagement among those surveyed. Of the 80 respondents, the majority (41.3%) reported occasional use of adaptive learning platforms. This was closely followed by 36.3% of participants reporting rarely using it outside of regular class time. Additionally, 16.2% of respondents said they regularly use these platforms, while a smaller minority (3.8% total) never use adaptive learning platforms outside of class time. Interestingly, only 2.5% of participants claimed to consistently use these platforms, indicating a relatively low rate of ongoing engagement. These findings highlight the need for further exploration of factors and strategies that influence the use of adaptive learning platforms to encourage more consistent use to enhance learning outcomes.

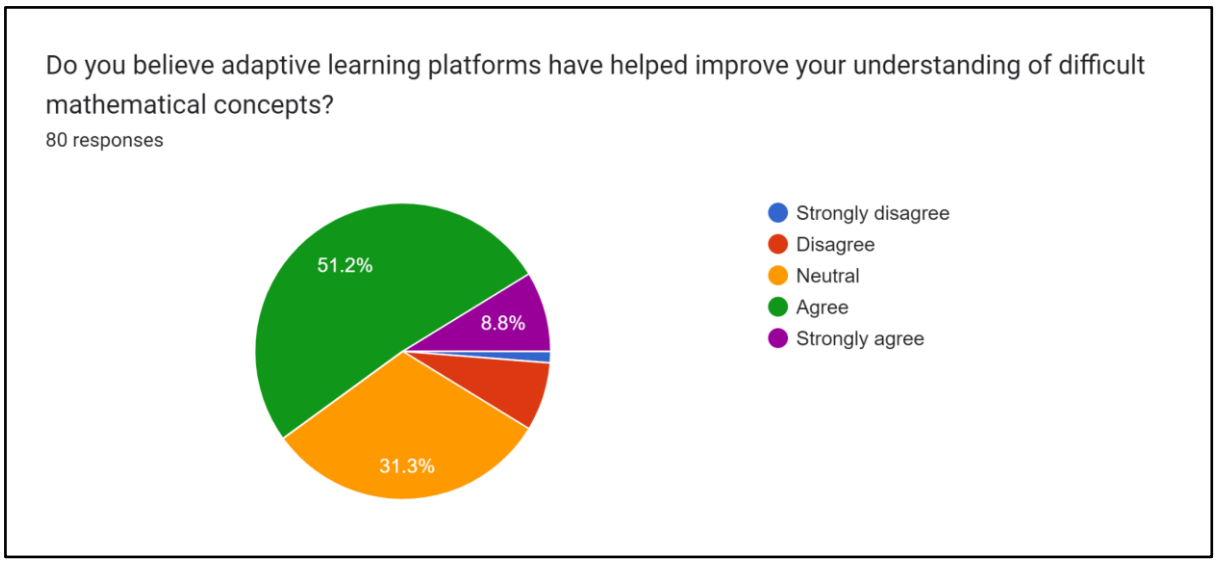

Figure 5.2.1.4 Adaptive learning platform helped improve understanding of difficult mathematical concepts

An analysis of perceptions of the effectiveness of an adaptive learning platform in improving understanding of difficult mathematical concepts provides valuable insights into its impact on learning outcomes. Of the 80 respondents, the vast majority (51.2%) felt that the adaptive learning platform made a positive contribution to their understanding of challenging mathematical concepts. This was followed by 31.3% of participants who expressed a neutral stance on the matter. Additionally, 8.8% of respondents strongly agreed with this statement, indicating strong recognition of the platform's efficacy. In contrast, only a small minority (8.8% total) disagreed or strongly disagreed that adaptive learning platforms help improve their understanding of difficult mathematics concepts. These findings highlight the perceived value of adaptive learning platforms in promoting learning and understanding, particularly in complex subject areas such as mathematics.

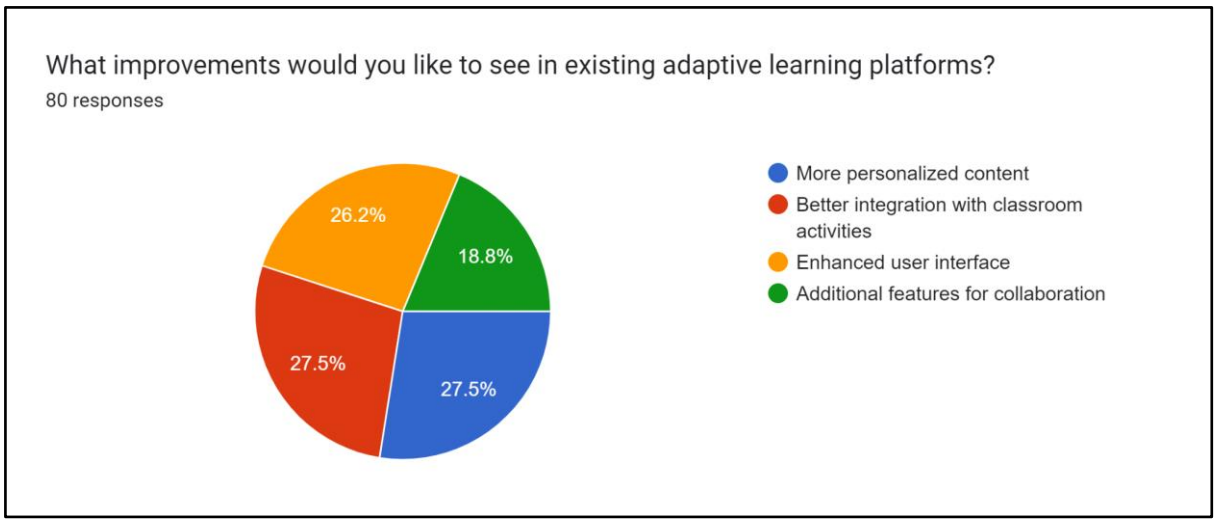

Figure 5.2.1.5 Improvements would like to see in existing adaptive learning platforms

Analysis of the improvements needed to existing adaptive learning platforms highlighted several key areas of concern among those surveyed. The need for more personalised content and better integration with classroom activities was most prominent among the 80 respondents, accounting for 27.5% each. This demonstrates a strong desire for customised learning experiences that seamlessly complement traditional classroom instruction. Additionally, 26.2% of participants considered enhanced user interface important, indicating that the platform needs to be more intuitive and user-friendly. Additionally, 18.8% of respondents expressed interest in additional collaboration features, underscoring the importance of creating an interactive learning environment. These findings provide valuable insights for developers and educators aiming to improve the effectiveness and usability of adaptive learning platforms to better meet the diverse needs of learners.

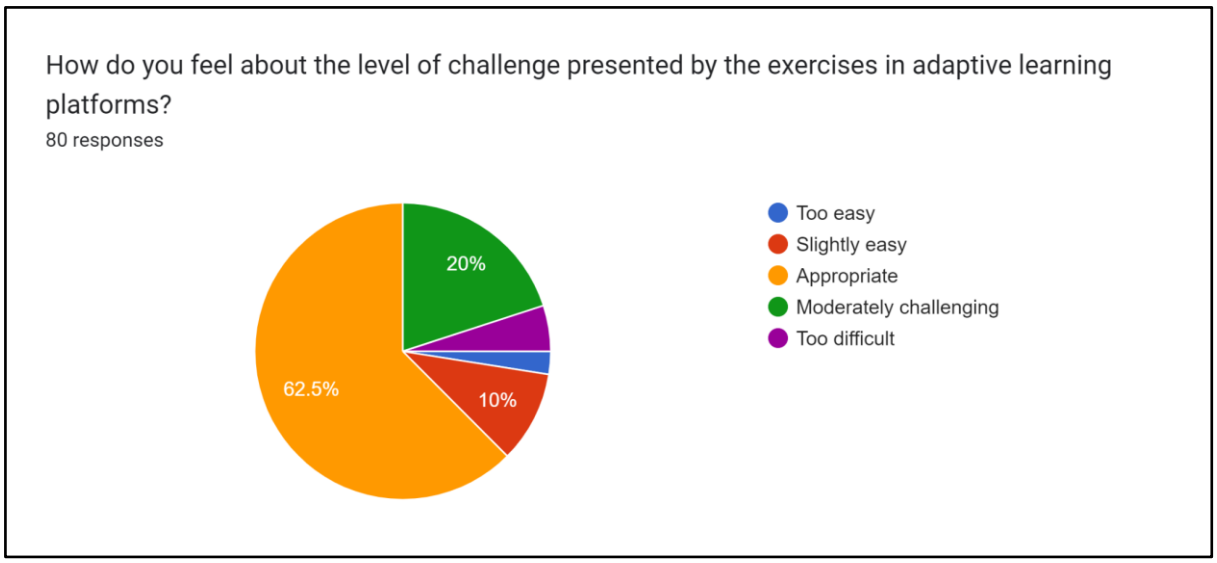

Figure 5.2.1.6 Feeling about level of challenge presented by exercises in adaptive learning platforms

Sentiment analysis of the level of challenge presented by exercises in adaptive learning platforms provides valuable insights into the perceived effectiveness of these platforms in meeting individual learning needs. Of the 80 respondents, the majority (62.5%) found the exercises to be appropriately challenging, indicating a good balance between difficulty and comprehension. Additionally, 20% of participants found the exercises to be moderately challenging, suggesting that the difficulty level is constructive and encourages engagement and growth. Instead, only a small proportion of respondents (7.5% in total) thought the exercises were too easy or slightly easy, while 5% thought they were too difficult. These findings highlight the importance of adjusting exercise difficulty levels to suit different learner abilities and preferences, ultimately increasing the effectiveness of adaptive learning platforms in promoting meaningful skill development and understanding.

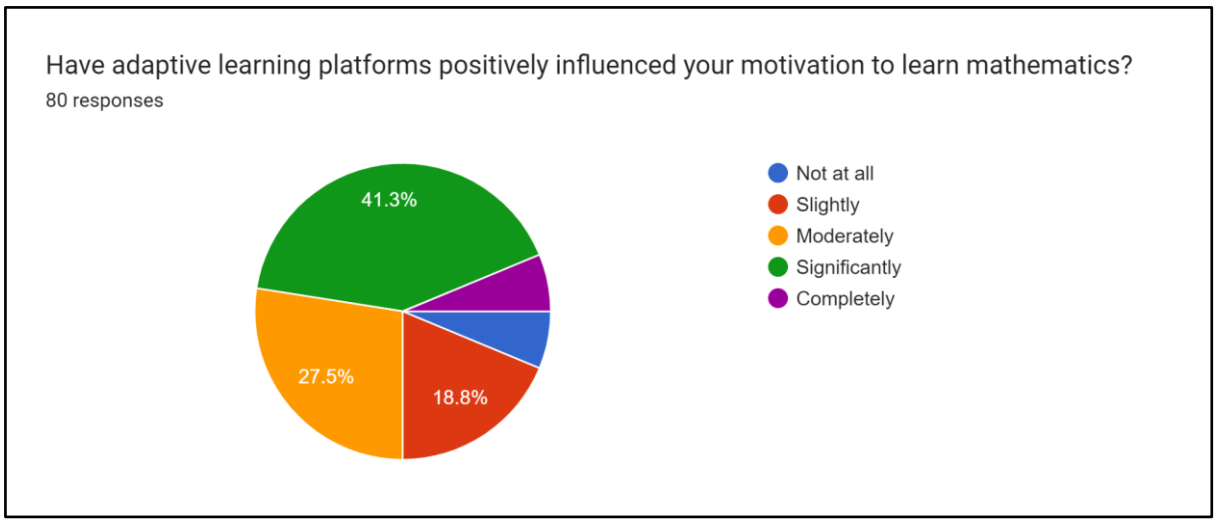

Figure 5.2.1.7 Adaptive learning platforms positively influenced motivation to learn mathematics

Analysis of the impact of adaptive learning platforms on motivation to learn mathematics showed significant positive effects among the population surveyed. A significant 41.3% of the 80 respondents stated that these platforms significantly increased their motivation to engage with mathematical concepts. This was followed by 27.5% of participants reporting an increase in motivation, highlighting the effectiveness of the platform in fostering enthusiasm for learning mathematics. Additionally, 18.8% of respondents felt slightly motivated by adaptive learning platforms, while a smaller proportion (6.3% each) felt completely motivated or not motivated at all. These findings highlight the potential of adaptive learning platforms to motivate and empower learners, ultimately contributing to richer and more fulfilling mathematics learning experiences.

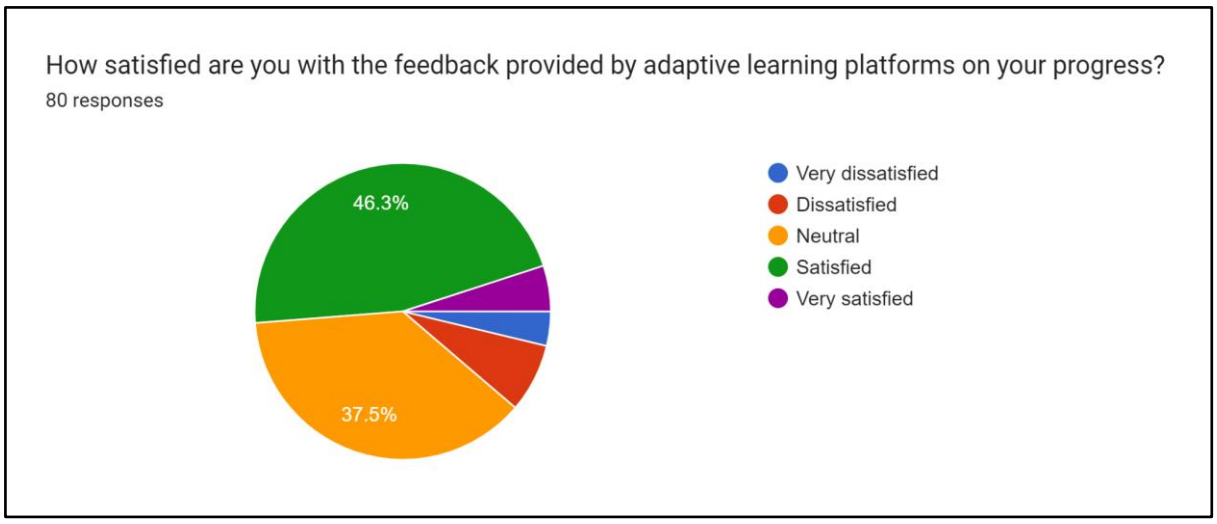

Figure 5.2.1.8 Satisfied with the feedback provided by adaptive learning platforms on progress

An analysis of satisfaction with progress feedback provided by an adaptive learning platform can provide insightful perspectives from the respondent population. A large proportion of the 80 respondents (46.3%) were satisfied with the feedback they received, indicating that the feedback was effective in helping them make progress. Additionally, 37.5% of participants were neutral on the matter, indicating that they had varying views on the adequacy of the feedback provided. On the contrary, a smaller proportion of respondents (a total of 10.3%) expressed varying degrees of dissatisfaction, with 7.5% saying they were dissatisfied and 3.8% saying they were very dissatisfied. However, it is worth noting that only 5% of respondents were very satisfied with the feedback provided. These findings highlight the importance of continuously improving feedback mechanisms in adaptive learning platforms to better meet learners' diverse needs and expectations, ultimately enhancing their learning experiences and outcomes.

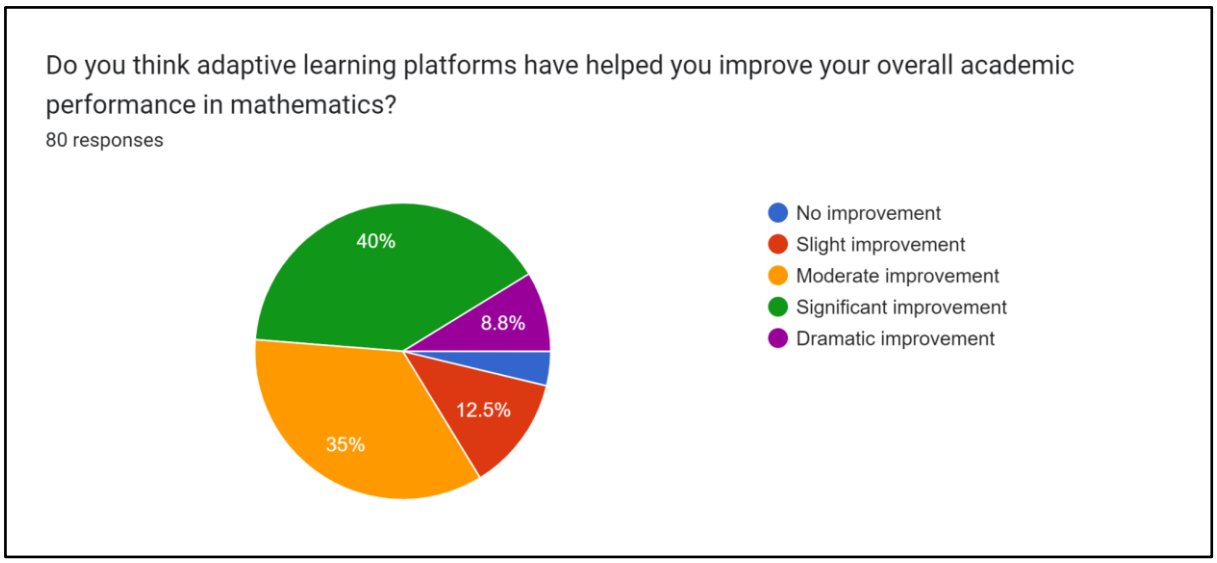

Figure 5.2.1.9 Adaptive learning platforms have helped to improve overall academic performance in mathematics

An analysis of perceptions of the impact of an adaptive learning platform on overall academic performance in mathematics provides valuable insights into its effectiveness in supporting learning outcomes. Of the 80 respondents, the vast majority (88.8%) said their academic performance had improved. Notably, 40% of participants reported a significant improvement, while 35% reported a moderate improvement in performance. Additionally, 8.8% of respondents reported significant improvements, indicating a transformative impact on their mathematics abilities. A small minority of respondents (16.3% in total) felt that their academic performance had improved slightly or not at all, with 12.5% reporting a slight improvement and 3.8% reporting no improvement at all. These findings highlight the positive impact of adaptive learning platforms on improving academic performance in mathematics, highlighting their potential to promote meaningful learning experiences and outcomes for students.

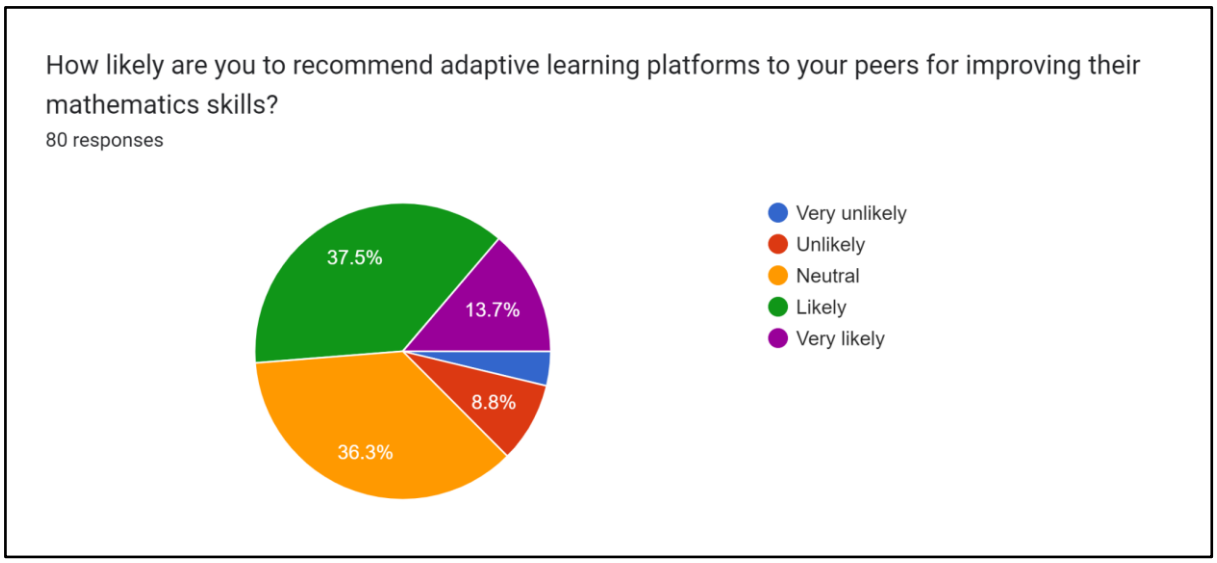

Figure 5.2.1.10 Recommend adaptive learning platform to peers for improving mathematics skills

The analysis of the possibility of recommending adaptive learning platforms to improve the mathematical skills of the surveyed population reveals different perspectives. Of the 80 respondents, a large portion (37.5%) said they would be likely to recommend these platforms to their peers. Additionally, 13.7% of participants indicated a very high likelihood of recommending, indicating a strong endorsement of the platform's effectiveness. Conversely, 12.6% of respondents reported some degree of reluctance, with 8.8% saying they were unlikely to recommend and 3.8% saying they were unlikely to do so. At the same time, a significant number of respondents (36.3% in total) maintained a neutral position on the matter. These findings highlight the importance of further exploring the factors that influence recommendation likelihood and addressing any concerns to maximise the potential of the platform in promoting the development of students' mathematical skills.

5.2.2 Predictive Analytics for Personalized Learning Paths

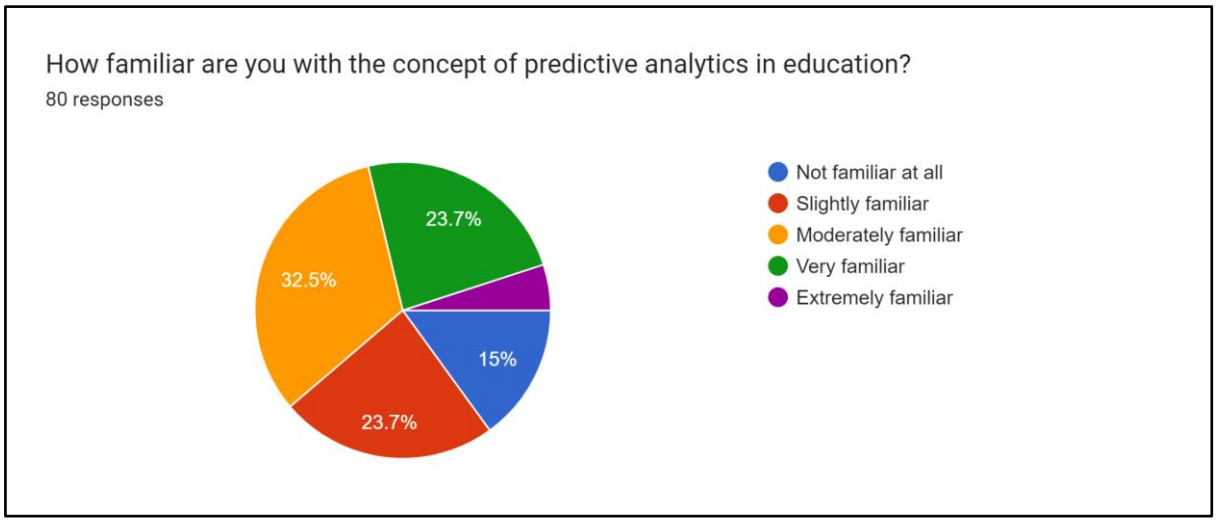

Figure 5.2.2.1 Familiar concept of predictive analytics in education

An analysis of the survey population's familiarity with the concept of predictive analytics in education provides valuable insights into their awareness and understanding of this innovative approach. Of the 80 respondents, a large portion (58.7%) reported varying levels of familiarity with predictive analytics. Notably, 32.5% of participants reported a moderate level of familiarity, indicating considerable awareness of the concept. Additionally, 23.7% of respondents feel both somewhat familiar and very familiar with predictive analytics, indicating a considerable level of understanding among these groups. At the same time, a small proportion of respondents (10% in total) reported not being familiar at all or being very familiar, indicating varying levels of exposure to the concept across the survey population. These findings highlight the importance of increasing awareness and understanding of predictive analytics in education to harness its potential to improve learning outcomes and inform decision-making processes.

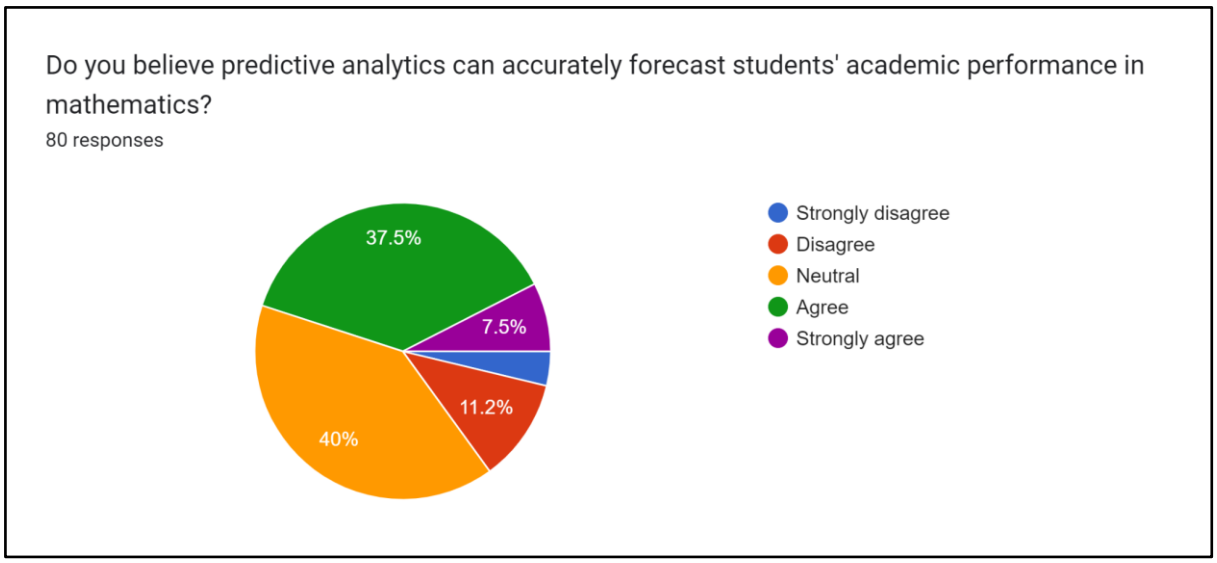

Figure 5.2.2.2 Predictive analytics can accurately forecast students' academic performance in mathematics

An analysis of perceptions of the accuracy of predictive analytics in predicting students' academic performance in mathematics provides valuable insights into the level of confidence the surveyed population has in this innovative approach. Of the 80 respondents, a large majority (37.5%) agreed that predictive analytics can accurately predict mathematics scores. Additionally, 40% of participants took a neutral stance on the matter, indicating a balanced view. Instead, a small minority of respondents (15% in total) expressed varying degrees of disagreement, with 11.2% disagreeing and 3.8% strongly disagreeing with the effectiveness of predictive analytics in this context. Meanwhile, 7.5% of respondents strongly agreed with the accuracy of predictive analytics in predicting academic performance. These findings highlight the mixed emotions surrounding the capabilities of predictive analytics and underscore the need for further research and exploration to maximise its potential in informing educational practice and interventions.

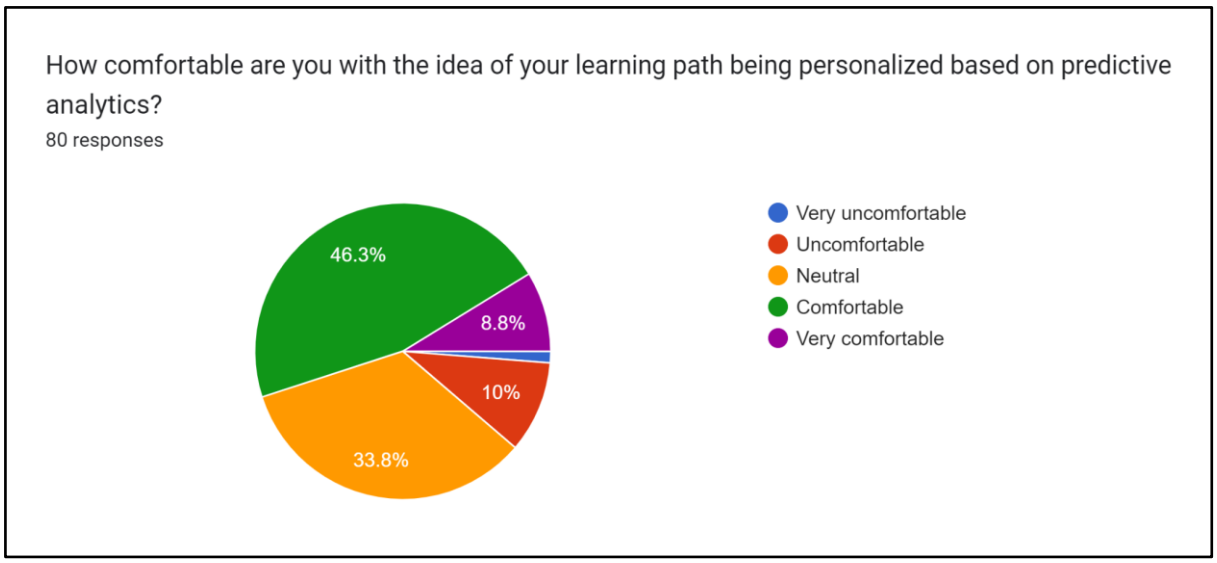

Figure 5.2.2.3 Comfortable with the idea of learning path being personalised based on predictive analytics

An analysis of comfort levels with the idea of personalised learning paths, based on predictive analytics among the surveyed population, provides valuable insights into their receptivity and readiness for this innovative approach. Among the 80 respondents, the vast majority (55.1%) expressed varying degrees of agreement with this concept. Notably, 46.3% of participants said they felt comfortable, with 8.8% saying they were very happy with the idea. In addition, 33.8% of the respondents maintained a neutral stance, indicating a balanced view. Conversely, a small minority of respondents (11.3% in total) expressed dissatisfaction with the concept of personalised learning paths based on predictive analytics, with 10% feeling uncomfortable and 1.3% very uncomfortable. These findings highlight the importance of problem-solving and promoting understanding to promote greater acceptance and adoption of the personalised learning approaches offered by predictive analytics in education.

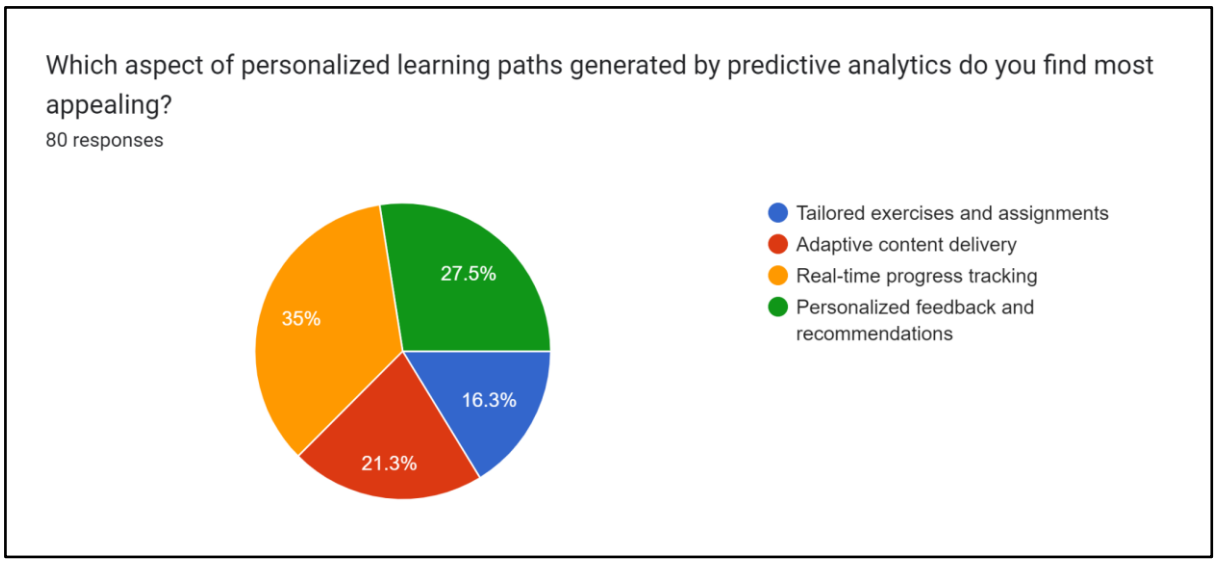

Figure 5.2.2.4 Aspect of personalised learning paths generated by predictive analytics most appealing

Analysis of attractive aspects of personalised learning paths generated by predictive analytics can provide valuable insights into the preferences of the population under investigation. Of the 80 respondents, real-time progress tracking emerged as the most popular aspect, with 35% expressing its appeal. This demonstrates a keen interest in monitoring one's own progress and adjusting learning strategies accordingly. This was closely followed by personalised feedback and advice, which attracted the interest of 27.5% of participants, highlighting the value of personalised guidance and support. Additionally, 21.3% of respondents found adaptive content delivery attractive, indicating that they prefer dynamic and customised learning experiences. Finally, 16.3% of participants appreciated the tailored exercises and assignments, emphasising the importance of targeted practice and application. These findings highlight the diverse preferences of the surveyed populations and underline the multifaceted nature of personalised learning paths facilitated by predictive analytics.

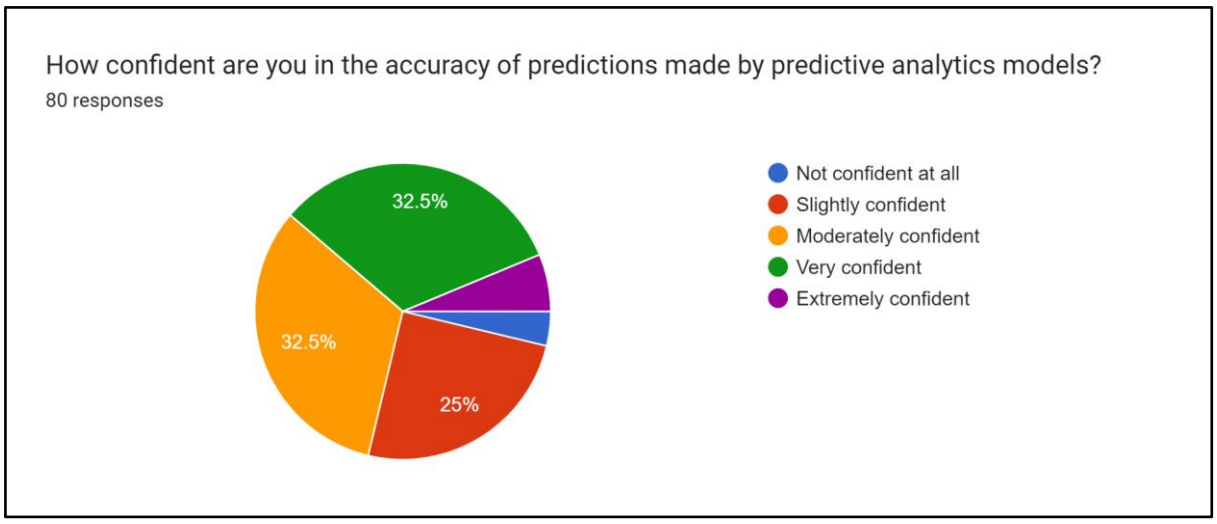

Figure 5.2.2.5 Confident in the accuracy of predictions made by predictive analytics models

An analysis of the confidence in the accuracy of the predictions made by the predictive analytics model among the surveyed population provides valuable insights into the trust and reliability of this innovative approach. Of the 80 respondents, the vast majority (71.3%) expressed varying degrees of confidence in the accuracy of the forecasts. Notably, 32.5% of participants reported feeling moderately and very confident in the predictive capabilities of these models, indicating a high level of trust. Additionally, 6.3% of respondents expressed extremely high confidence, further underscoring the reliability of predictive analytics models. Conversely, a small minority of respondents (28.8% in total) expressed less confidence in the accuracy of the forecasts, with 25% feeling somewhat confident and 3.8% not at all confident. These findings highlight the importance of continuously improving and validating predictive analytics models to increase their effectiveness and enhance trust among users.

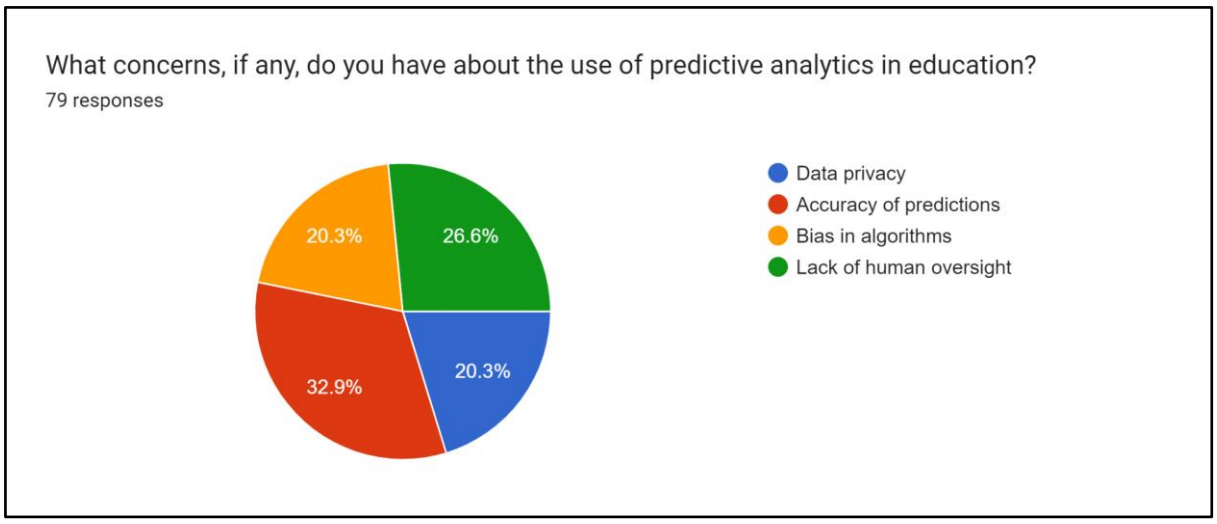

Figure 5.2.2.6 Concerns in use of predictive analytics in education

An analysis of concerns about the use of predictive analytics in education provides valuable insights into potential concerns within the survey population. Among the 79 respondents, several key issues emerged. Notably, forecast accuracy was the top concern, with 32.9% of participants expressing concerns about the reliability of predictive analytics models. This was closely followed by 26.6% of respondents expressing concern about the lack of human oversight in the implementation of these models, highlighting the importance of ethical considerations and human intervention. Additionally, 20.3% of participants identified data privacy and algorithmic bias as significant issues, emphasising the need for strong privacy measures and algorithmic fairness to guard against potential risks and biases. These findings highlight the importance of addressing these issues to promote responsible and ethical use of predictive analytics in education, ultimately fostering trust and acceptance among stakeholders.

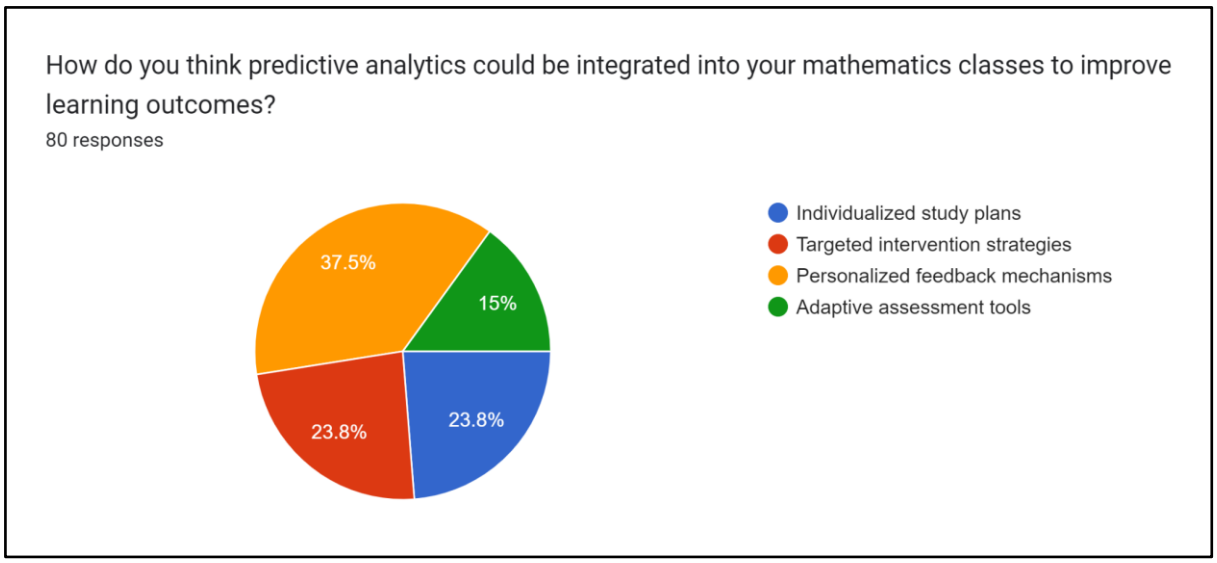

Figure 5.2.2.7 Predictive analytics could be integrated into mathematics classes to improve learning outcomes

An analysis of potential integration methods for predictive analytics in mathematics subjects provides valuable insights into strategies for improving learning outcomes. Personalised feedback mechanisms emerged as the most popular integration method among 80 respondents, with 37.5% indicating its potential to improve learning outcomes. This highlights the value of personalised guidance and support tailored to pupils' specific needs and progress. Additionally, personalised learning plans and targeted intervention strategies both attracted interest from 23.8% of participants, demonstrating recognition of the importance of customised learning experiences and proactive support measures. Meanwhile, 15% of respondents found adaptive assessment tools attractive, suggesting they prefer dynamic and customised assessment methods. These findings highlight the potential of predictive analytics to inform and enhance all aspects of mathematics education, ultimately facilitating personalised learning experiences and promoting improved student outcomes.

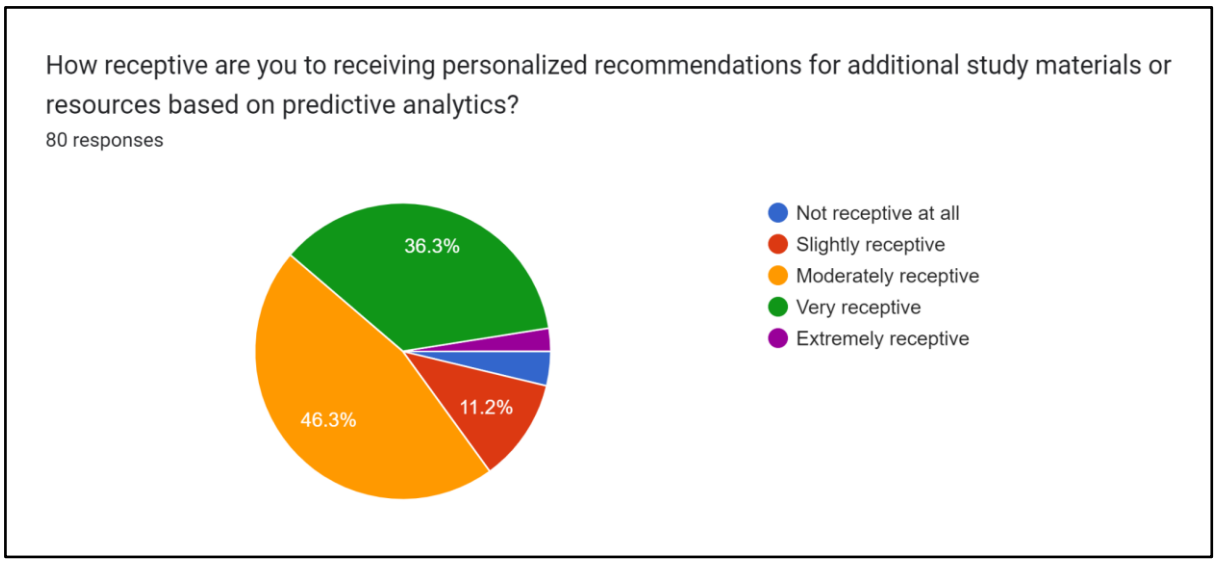

Figure 5.2.2.8 Receptive to receiving personalised recommendations for additional study materials or resources based on predictive analytics

Analysis of the acceptance of personalised recommendations for additional research materials or resources based on predictive analytics provides valuable insights into the survey population's willingness to accept this approach. Among the 80 respondents, the vast majority (82.6%) expressed varying degrees of acceptance of personalised recommendations. Notably, 36.3% of participants reported feeling very receptive, indicating a strong interest in using predictive analytics to guide their learning journey. Additionally, 46.3% of respondents reported a moderate level of acceptance, indicating a willingness to consider personalised recommendations. Conversely, a small minority (15% in total) said they were not very receptive to personalised recommendations, with 11.2% feeling somewhat receptive and 3.8% not receptive to personalised recommendations at all. Meanwhile, 2.5% of respondents expressed very high levels of acceptance, further highlighting the potential appeal of personalised recommendations provided by predictive analytics. These findings highlight the value of leveraging predictive analytics to provide tailored supports and resources that ultimately enhance student learning experiences and outcomes.

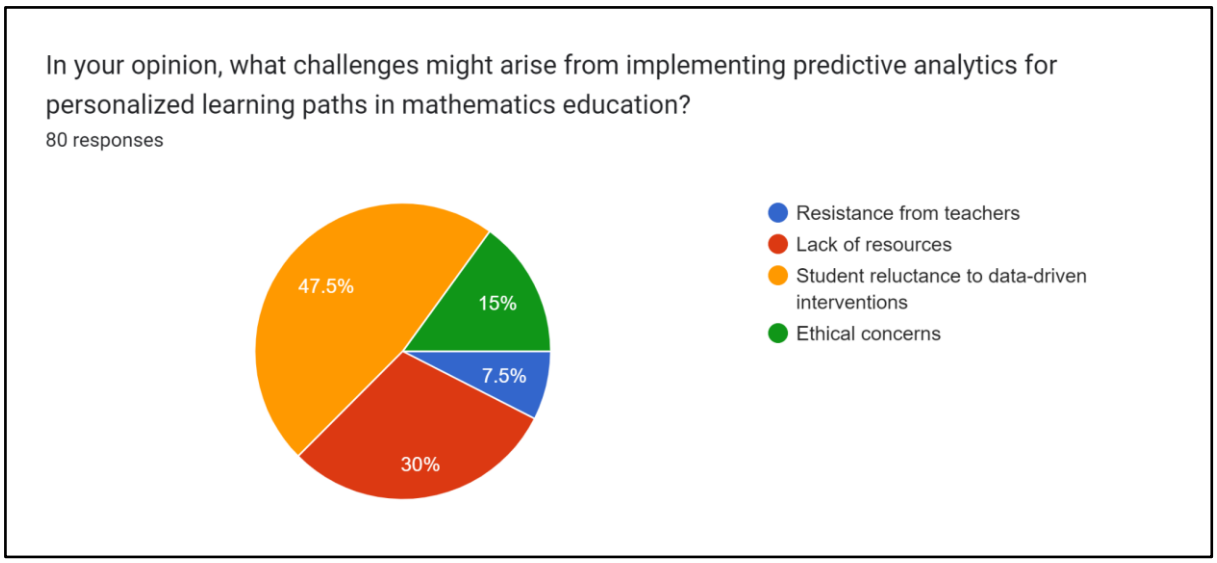

Figure 5.2.2.9 Challenges might arise from implementing predictive analytics for personalised learning paths in mathematics education

An analysis of potential challenges associated with implementing predictive analytics for personalised learning pathways in mathematics education provides valuable insights into barriers that may need to be addressed. Among the 80 respondents, student reluctance to embrace data-driven interventions was the most prominent challenge, with 47.5% expressing concern about potential student resistance. This highlights the importance of increasing student awareness and understanding of the benefits of personalised learning paths offered by predictive analytics. Additionally, lack of resources was a significant challenge, with 30% of participants citing resource constraints as a potential barrier to implementation. This emphasises the need for adequate support and investment in infrastructure and technology to facilitate effective implementation. Meanwhile, 15% of respondents cited ethical concerns, highlighting the importance of addressing ethical issues such as data privacy and algorithmic bias when implementing predictive analytics. Finally, 7.5% of respondents cited faculty resistance, indicating a potential need for professional development and support to ensure faculty buy-in and collaboration when implementing personalised learning pathways. These findings highlight the multifaceted nature of the challenges associated with implementing predictive analytics in mathematics education and underscore the importance of addressing these challenges to maximise the potential benefits of personalised learning approaches.

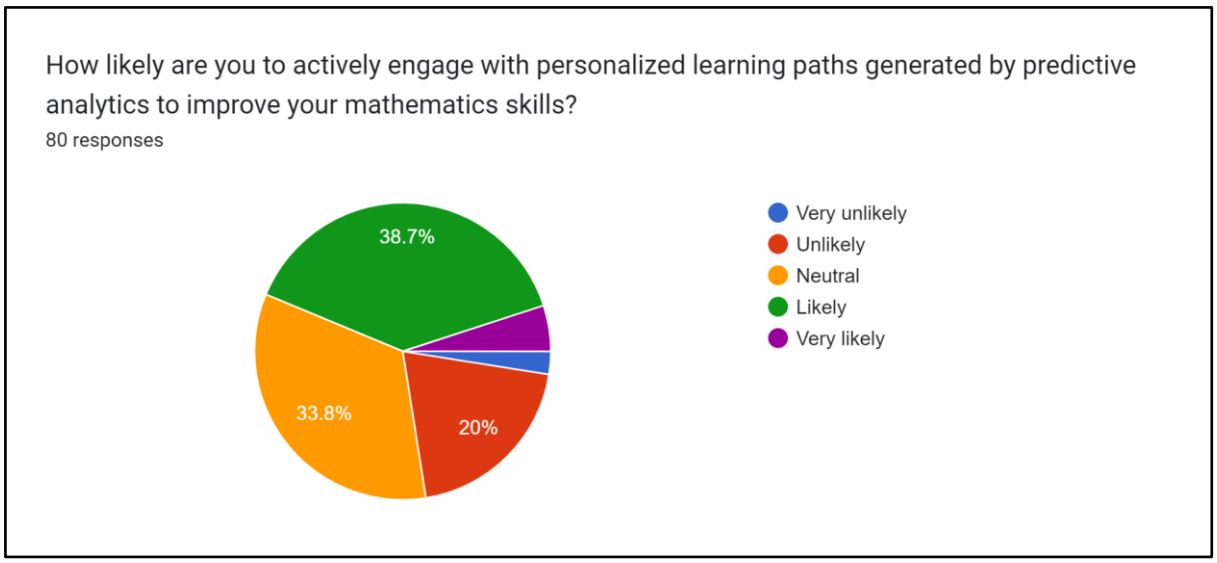

Figure 5.2.2.10 Actively engage with personalised learning paths generated by predictive analytics to improve mathematics skills

An analysis of the likelihood of active participation in personalised learning paths generated by predictive analytics to improve mathematical skills provides valuable insights into the receptiveness of this approach among survey populations. Of the 80 respondents, the vast majority (77.5%) indicated varying degrees of possibility to engage in personalised learning paths. Notably, 38.7% of participants said they were likely to get involved, indicating they are quite interested in using predictive analytics to improve their mathematics skills. Additionally, 33.8% of respondents maintained a neutral stance on the matter, indicating a balanced view. Conversely, a small minority of respondents (22.5% in total) expressed a degree of reluctance, with 20% feeling unlikely and 2.5% unlikely to actively engage in personalised learning paths. Meanwhile, 5% of respondents indicated a very high likelihood of participation, further highlighting the potential appeal of personalised learning paths provided by predictive analytics. These findings highlight the importance of increasing awareness and understanding of the benefits of personalised learning approaches to encourage active student participation and engagement.

5.2.3 Data-Driven Professional Development Program

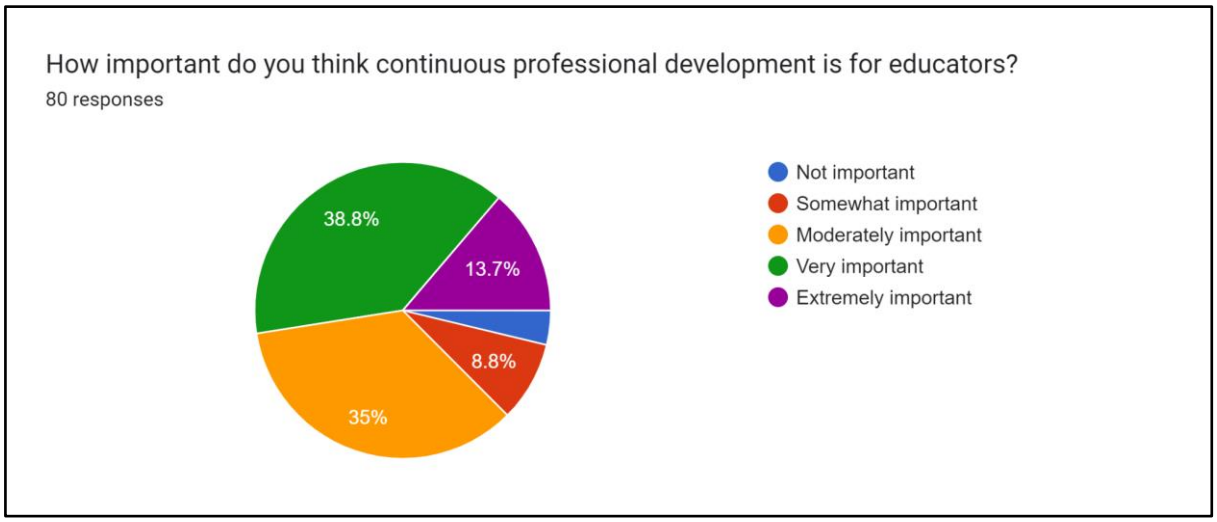

Figure 5.2.3.1 Important of continuous professional development for educators

An analysis of perceptions of the importance of continuing professional development for educators provides valuable insights into understanding ongoing learning and growth in the teaching profession. The vast majority (79.7%) of the 80 respondents expressed varying degrees of emphasis on continuing professional development. Notably, 38.8% of participants considered this very important, indicating that educators strongly recognize the value of continuous learning and skill improvement. Additionally, 35% of respondents considered continuing professional development to be of moderate importance, indicating that its importance is widely recognized. Meanwhile, 11.3% of participants expressed a high level of importance, emphasising the critical role of continuous learning in ensuring educators remain effective and adaptable. Conversely, a small minority of respondents (12.5% in total) said it was not very important, 8.8% said it was somewhat important, and 3.8% said it was not important at all. These findings highlight the importance of investing in continuing professional development programs to support the growth and effectiveness of educators and meet the changing needs of students and educational settings.

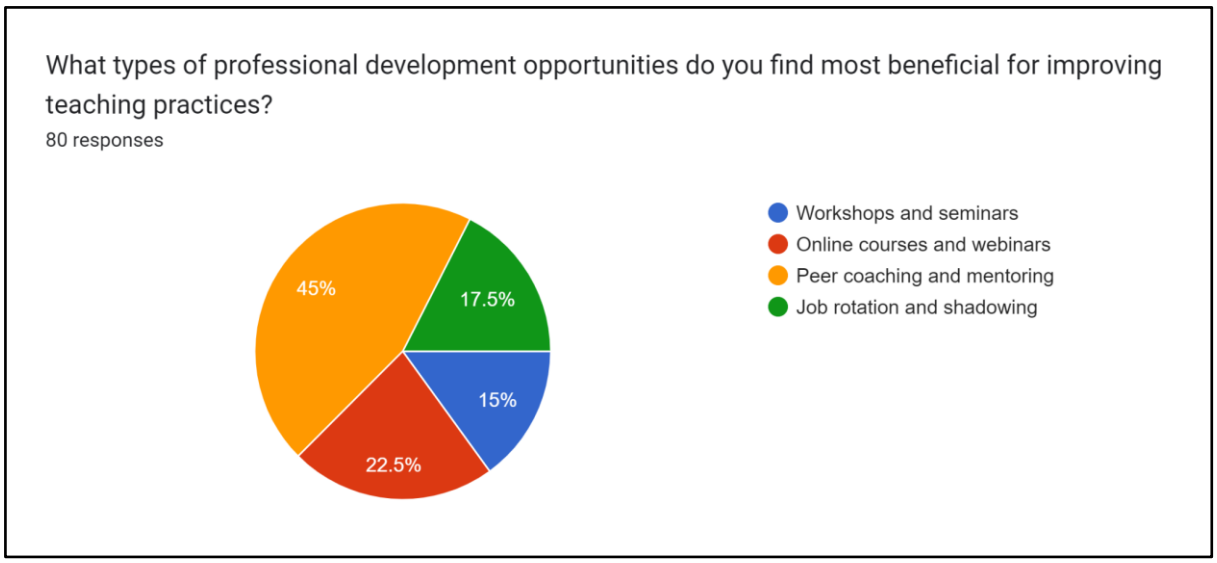

Figure 5.2.3.2 Types of professional development opportunities most beneficial for improving teaching practices

An analysis of the preferred types of professional development opportunities to improve teaching practices provides valuable insights into effective strategies for educator growth and skill enhancement. Peer coaching and mentoring emerged as the most popular opportunity among 80 respondents, with 45% citing its potential benefits. This highlights the value of collaborative learning and colleague support in improving teaching practice. Additionally, 22.5% of participants found online courses and webinars beneficial, indicating recognition of the convenience and accessibility of digital learning resources. Meanwhile, 15% of respondents are interested in workshops and seminars, indicating they prefer interactive and experiential learning experiences. Job rotations and shadowing were also appreciated by 17.5% of participants, indicating a desire for hands-on learning and exposure to different teaching environments. These findings highlight the importance of providing diverse professional development opportunities to meet the diverse preferences and needs of educators, ultimately promoting continued growth and improvement in teaching practice.

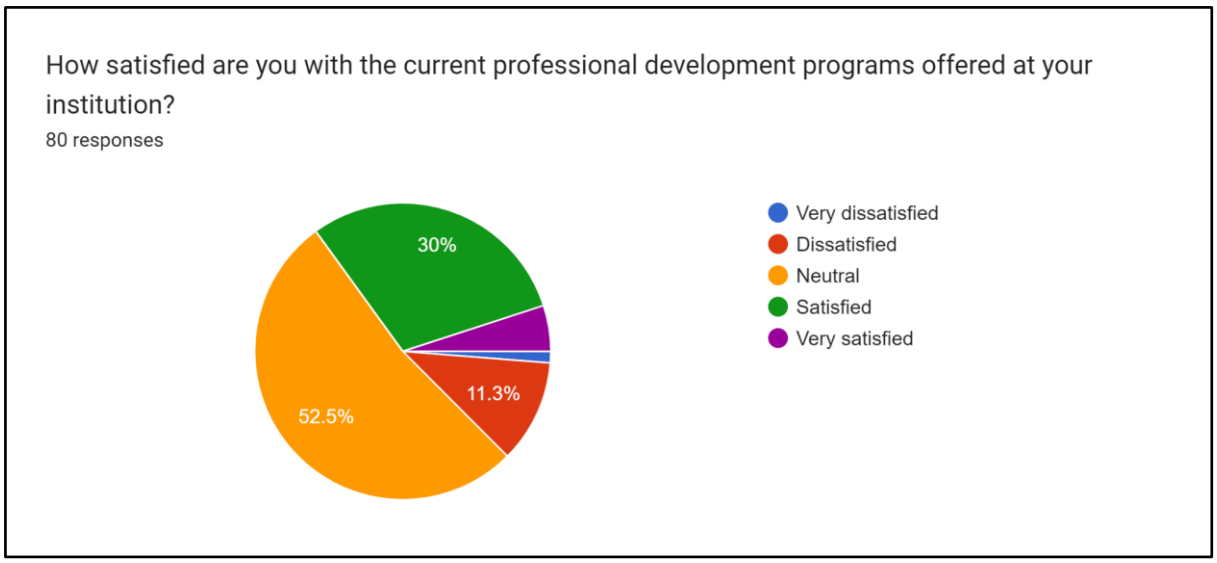

Figure 5.2.3.3 Satisfied with current professional development programs offered at institution

An analysis of satisfaction with professional development programs currently offered by respondents' institutions can provide insight into the effectiveness and adequacy of existing programs. Of the 80 respondents, the majority (82.5%) expressed varying degrees of satisfaction with the plan. Notably, 30% of participants reported being satisfied, indicating a positive perception of the current product. Additionally, 52.5% of respondents maintained a neutral stance on the matter, indicating mixed emotions or a desire for improvement. Conversely, a smaller proportion of respondents (16.3% in total) expressed dissatisfaction, with 11.3% reporting being dissatisfied and 1.3% being very dissatisfied with current career development plans. At the same time, 5% of respondents were very satisfied with these programs, indicating strong recognition of their effectiveness. These findings underscore the importance of continually evaluating and refining professional development programs to better meet the changing needs and expectations of educators, ultimately fostering a culture of continuous growth and improvement in teaching practice.

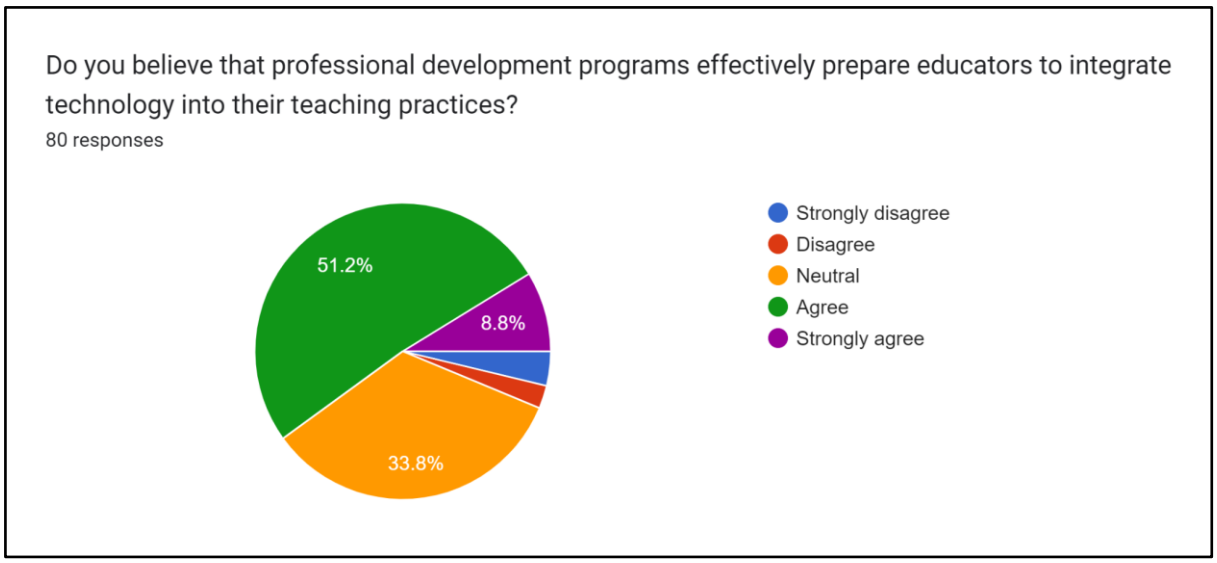

Figure 5.2.3.4 Professional development programs effectively prepare educators to integrate technology into teaching practices

An analysis of perceptions of the effectiveness of professional development programs in helping educators integrate technology into their teaching practices provides valuable insights into the perceived impact of these initiatives. Of the 80 respondents, the majority, including 60% of participants, agreed that professional development programs are effective in preparing educators for technology integration. Specifically, 51.2% of respondents agreed and 8.8% strongly agreed with this statement. Additionally, 33.8% of participants maintained a neutral stance, indicating mixed emotions or the need for further evaluation. In contrast, only a small proportion of respondents (6.3% in total) disagreed, with 2.5% disagreeing and 3.8% strongly disagreeing with the effectiveness of professional development programs in this regard. These findings underscore the importance of ongoing professional development efforts to support educators in effectively using technology to enhance teaching and learning experiences.

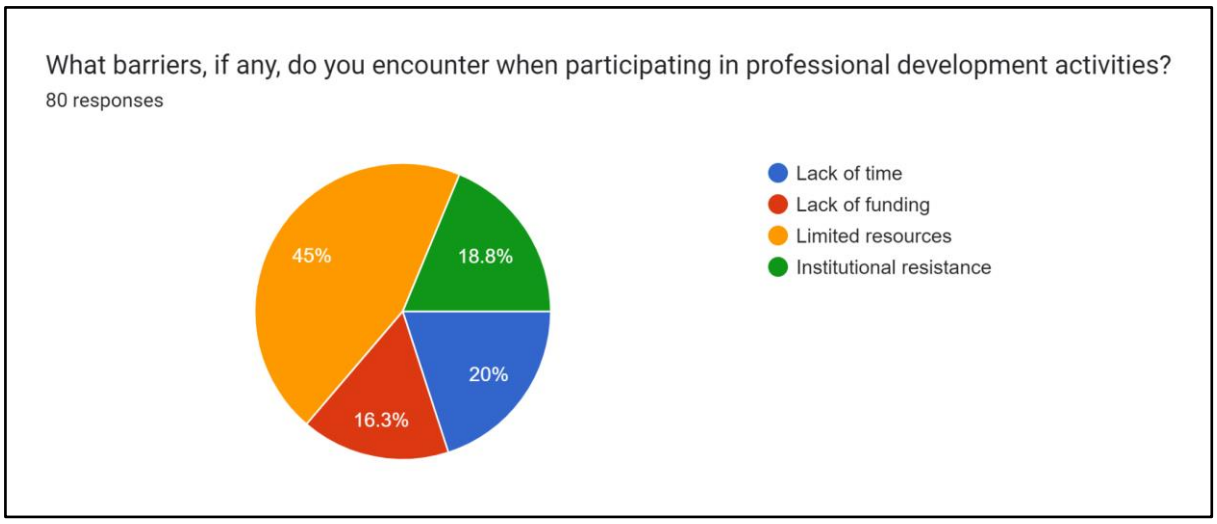

Figure 5.2.3.5 Barriers that encounter when participating in professional development activities

An analysis of barriers encountered when participating in professional development activities provides valuable insights into the challenges educators face in their ongoing learning efforts. Of the 80 respondents, limited resources emerged as the most prominent barrier, with 45% expressing concern about limitations in this area. This highlights the importance of adequate support and investment of resources to facilitate effective professional development initiatives. Additionally, lack of time was a significant barrier, with 20% of participants citing time constraints as a challenge. This emphasises the need for flexible scheduling and time management strategies to accommodate educators' busy schedules. 16.3% of respondents also cited a lack of funding, indicating the need for adequate financial resources to support professional development efforts. Additionally, 18.8% of participants identified institutional resistance as a barrier, indicating challenges related to organisational culture or policies that may hinder participation in professional development activities. These findings highlight the importance of addressing these barriers to ensure educators have equitable access to professional development opportunities and to support educators' continued growth and advancement.

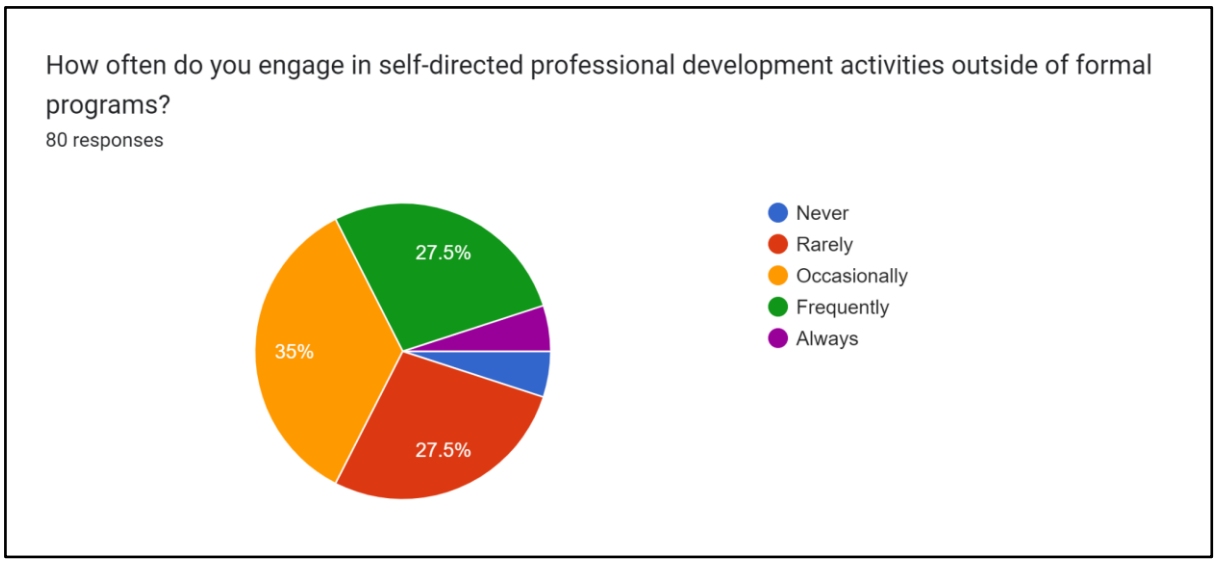

Figure 5.2.3.6 Engage in self-directed professional development activities outside of formal programs

An analysis of self-directed professional development activities outside of formal programs provides insights into educators' active learning practices. Of the 80 respondents, the majority (65% of participants) engaged in self-directed career development to varying degrees. Specifically, 35% of respondents reported occasional participation in self-directed activities, indicating a moderate level of involvement. Additionally, 27.5% of participants regularly participated in self-directed activities, demonstrating a proactive approach to continuous learning and skill enhancement. Conversely, a smaller proportion of respondents (10% total) reported participating less frequently, with 5% reporting rarely participating and a further 5% reporting never participating in self-directed professional development activities. . Meanwhile, 5% of respondents reported always engaging in self-directed activities, underscoring their ongoing commitment to continuous learning outside of formal projects. These findings highlight the importance of fostering a culture of autonomous learning among educators to support continued growth and improvement in teaching practice.

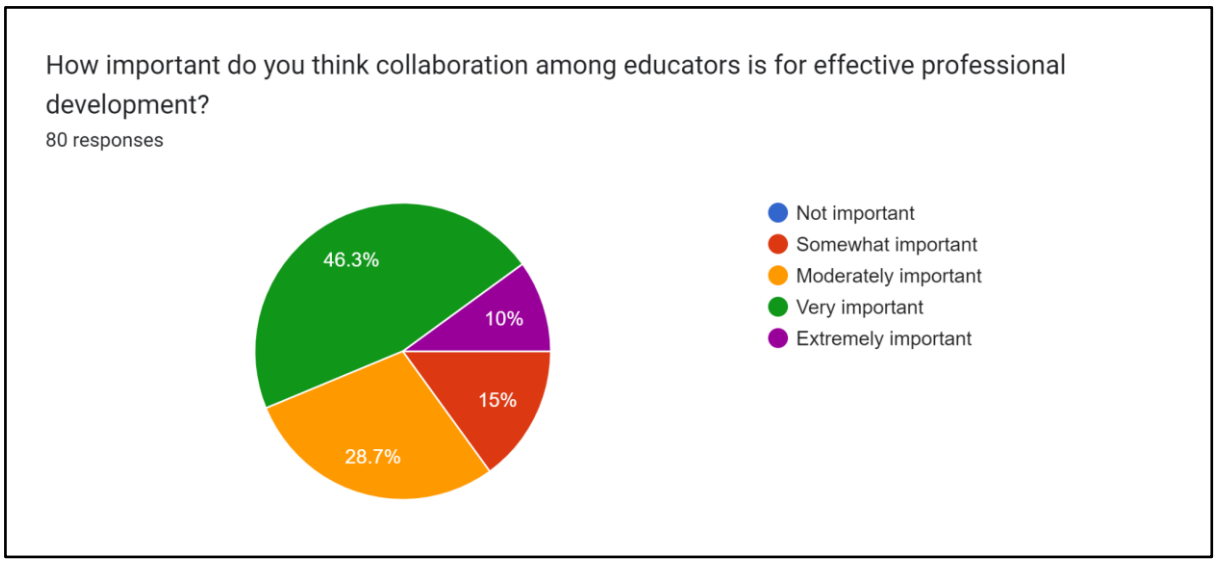

Figure 5.2.3.7 Important of collaboration among educators is for effective professional development

An analysis of perceptions of the importance of collaboration among educators for effective professional development provides valuable insights into collaborative practices that promote growth and advancement. Among the 80 respondents, the vast majority (87.5%) expressed varying degrees of emphasis on collaboration. Notably, 46.3% of participants rated it as very important, indicating a strong endorsement of the value of collaborative efforts in professional development. Additionally, 28.7% of respondents rated collaboration as moderately important, indicating widespread recognition of its importance. Meanwhile, 15% of participants rated collaboration as somewhat important, indicating recognition of its value but perhaps reservations. Conversely, 10% of respondents expressed a very high level of importance, emphasising the critical role of collaboration in supporting ongoing learning and growth among educators. These findings highlight the importance of fostering a collaborative culture within educational institutions to maximise the effectiveness of professional development programs and ultimately improve teaching practices and student outcomes.

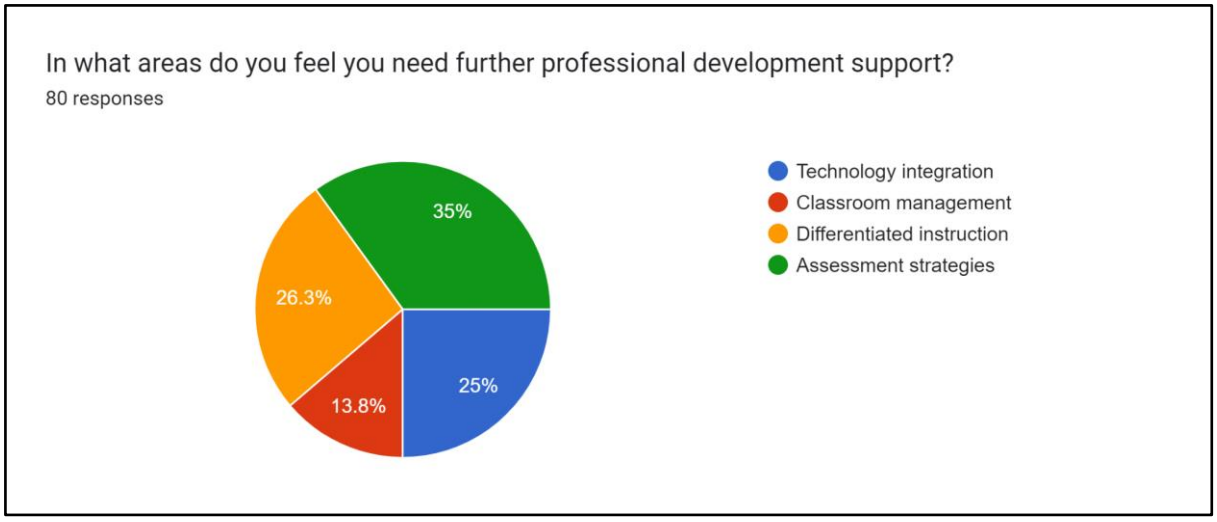

Figure 5.2.3.8 Areas that feel need further professional development support

Analysis of areas where educators believe further professional development support is needed provides valuable insights into specific areas that require focus and growth. Out of 80 respondents, assessment strategies emerged as the most prominent area of need, with 35% expressing a desire for further support in this area. This highlights the importance of effective assessment practices to measure student progress and inform teaching. Additionally, 26.3% of participants mentioned differentiated instruction, indicating the need for strategies to address the needs and abilities of diverse students in the classroom. Technology integration was also considered important, with 25% of respondents expressing a desire for further support in this area, emphasising the importance of using technology to enhance the teaching experience. Meanwhile, 13.8% of participants mentioned classroom management, indicating the need for strategies to maintain a positive and productive learning environment. These findings underscore the importance of targeted professional development efforts that address the needs of specific areas and support educators on their ongoing journey of growth and improvement.

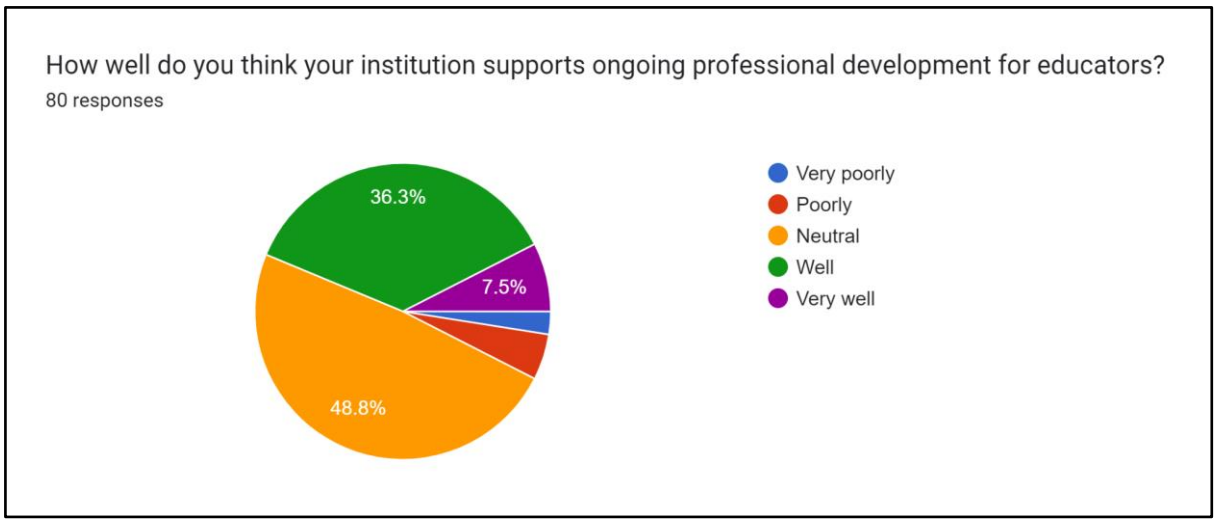

Figure 5.2.3.9 Institution supports ongoing professional development for educators

An analysis of perceptions of institutional support for continuing professional development among educators provides valuable insights into the effectiveness of existing support mechanisms. Among the 80 respondents, the majority (43.8%) expressed varying degrees of satisfaction with institutional support. Specifically, 36.3% of participants felt that continuing professional development was well supported by their institution, indicating a positive attitude towards the level of support provided. Additionally, 7.5% of respondents reported high levels of satisfaction, stating that their institution supports ongoing professional development well. Conversely, a small minority of respondents (7.5% in total) were dissatisfied, with 5% saying their institution's support for continuing professional development was poor and 2.5% saying it was very poor. At the same time, 48.8% of participants maintained a neutral position on this issue, indicating mixed sentiment or the need to further evaluate institutional support mechanisms. These findings highlight the importance of continually evaluating and strengthening institutional support for continuing professional development to ensure that educators have the necessary resources and opportunities to grow and improve in practice.

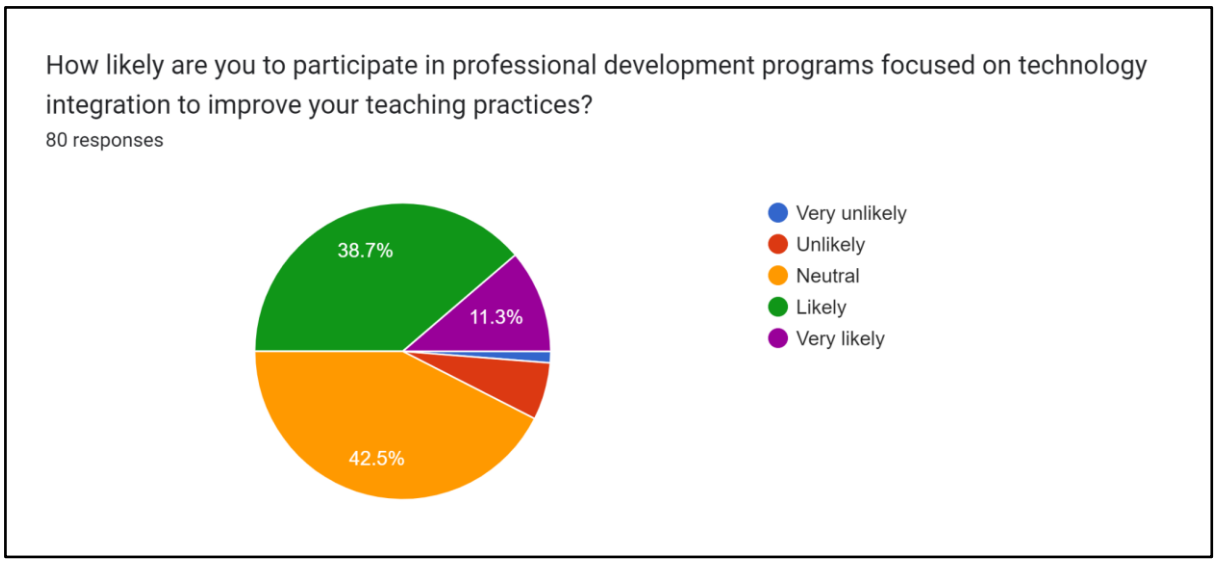

Figure 5.2.3.10 Participate in professional development programs focused on technology integration to improve teaching practices

An analysis of the likelihood of participating in a professional development program focused on technology integration to improve instructional practices provides valuable insights into educators' receptiveness to such initiatives. Of the 80 respondents, the majority (60% of participants) indicated varying degrees of likelihood of participating in these programs. Specifically, 38.7% of respondents indicated a likelihood of participation, indicating a strong interest in enhancing teaching practices through technology integration. Additionally, 11.3% of participants reported a very high likelihood of participating, highlighting a strong recognition of the value of these programs. Conversely, only a small proportion of respondents (7.6% in total) expressed an unwillingness to participate in such a program, with 6.3% feeling unlikely and 1.3% feeling very unlikely. Meanwhile, 42.5% of participants maintained a neutral stance on the matter, indicating mixed emotions or a need for further evaluation of the relevance and effectiveness of these programs. These findings highlight the importance of providing professional development opportunities tailored to educator needs and interests, including targeted support for technology integration, to support continued growth and improvement in teaching practice.

5.2.4 Comprehensive Support and Training

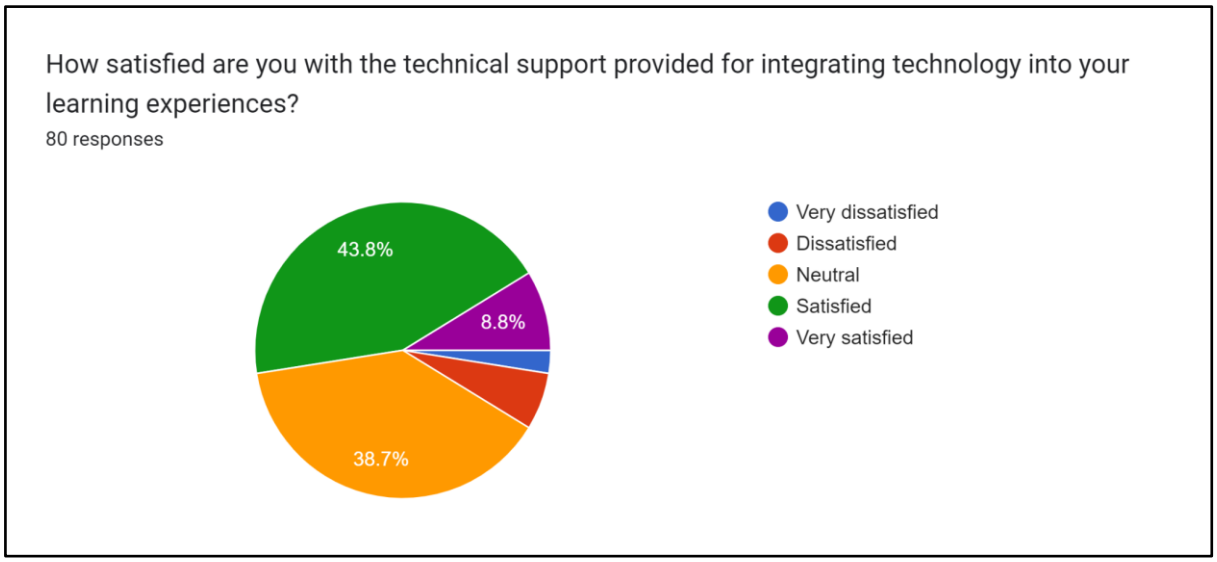

Figure 5.2.4.1 Technical support provided for integrating technology into learning experiences

An analysis of satisfaction with technology support that integrates technology into the learning experience can provide valuable insights into the effectiveness of existing support mechanisms. Among the 80 respondents, the majority (52.6%) expressed varying degrees of satisfaction with the technical support they received. Specifically, 43.8% of respondents reported being satisfied with the technical support provided, indicating a positive attitude toward the assistance they received. In addition, 8.8% of participants expressed great satisfaction with technical support. On the contrary, only a small proportion of respondents (8.7% in total) expressed dissatisfaction, with 6.2% being dissatisfied with the technical support they received and 2.5% being very dissatisfied. At the same time, 38.7% of participants maintained a neutral stance on this, indicating mixed emotions or the need to further evaluate the effectiveness of technical support mechanisms. These findings underscore the importance of continually evaluating and enhancing technology support services to ensure educators have the necessary assistance to effectively integrate technology into the learning experience.

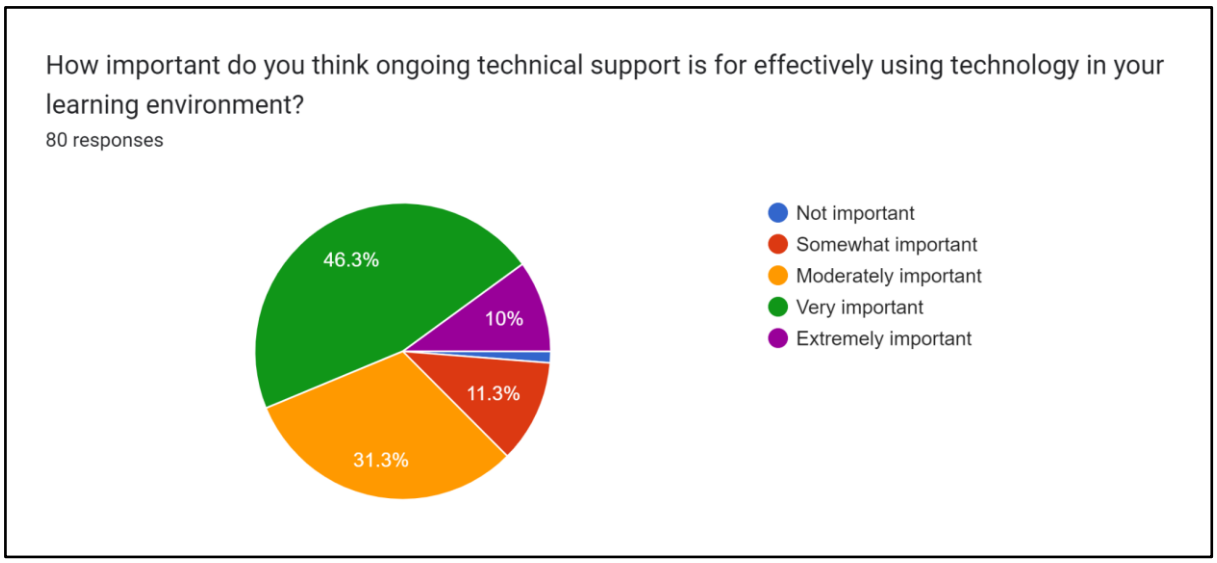

Figure 5.2.4.2 Important of ongoing technical support for effectively using technology in learning environment

An analysis of perceptions of the importance of ongoing technology support for the effective use of technology in learning environments provides valuable insights into the support mechanisms that facilitate technology integration. Of the 80 respondents, the vast majority (87.6% of participants) expressed varying degrees of emphasis on ongoing technical support. Specifically, 46.3% of respondents rated this as very important, indicating a strong recognition of the value of ongoing support in effectively utilising technology. Additionally, 31.3% of participants considered ongoing technical support to be quite important, indicating widespread recognition of its importance. Meanwhile, 10% of respondents expressed a very high level of importance, emphasising the critical role of ongoing technical support in ensuring successful technology integration. Conversely, a small minority of respondents (12.6% in total) said it was not very important, with 11.3% saying it was somewhat important and only 1.3% saying it was not important at all. These findings underscore the importance of investing in ongoing technology support programs to enable educators to effectively use technology to enhance learning experiences and outcomes.

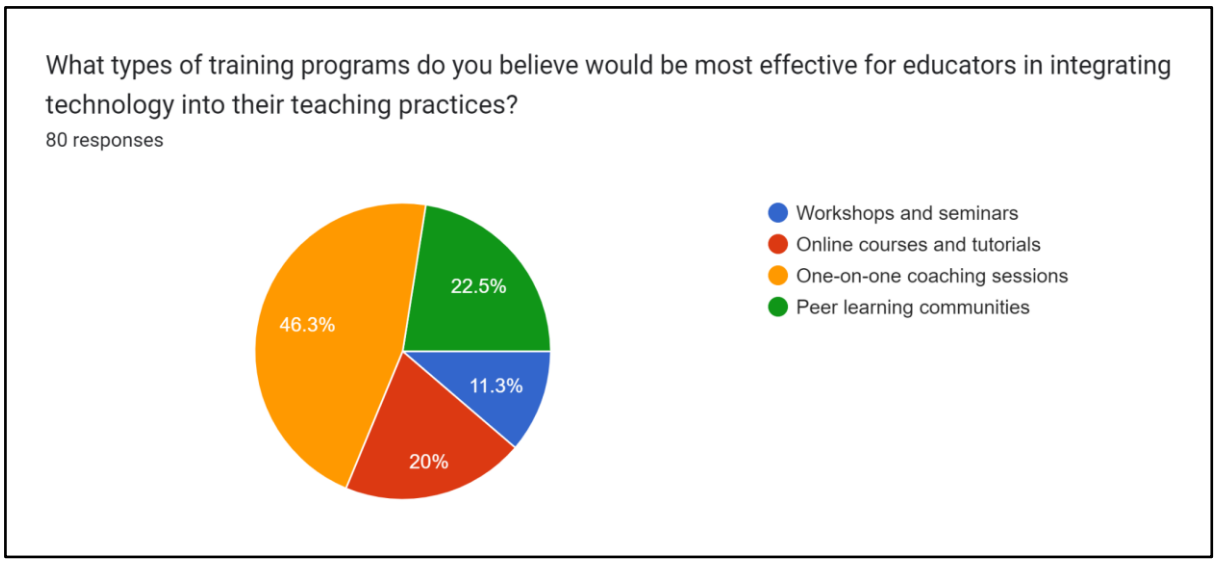

Figure 5.2.4.3 Types of training programs would be most effective for educators in integrating technology into teaching practices

An analysis of the types of training programs preferred by educators to integrate technology into teaching practice provides valuable insights into effective strategies for professional development in this area. Among 80 respondents, one-to-one coaching sessions emerged as the most popular training program, with 46.3% indicating its potential effectiveness. This highlights the value of personalised guidance and support tailored to educators' specific needs and skill levels. Additionally, 20% of participants found online courses and tutorials beneficial, indicating recognition of the convenience and accessibility of digital learning resources. Meanwhile, 22.5% of respondents appreciate peer learning communities, indicating a desire for collaborative learning and sharing of best practices among colleagues. Conversely, 11.3% of participants mentioned workshops and seminars, indicating a preference for more interactive and experiential learning experiences. These findings highlight the importance of providing diverse training programs to meet the different preferences and learning styles of educators, ultimately supporting the effective integration of technology into teaching practice.

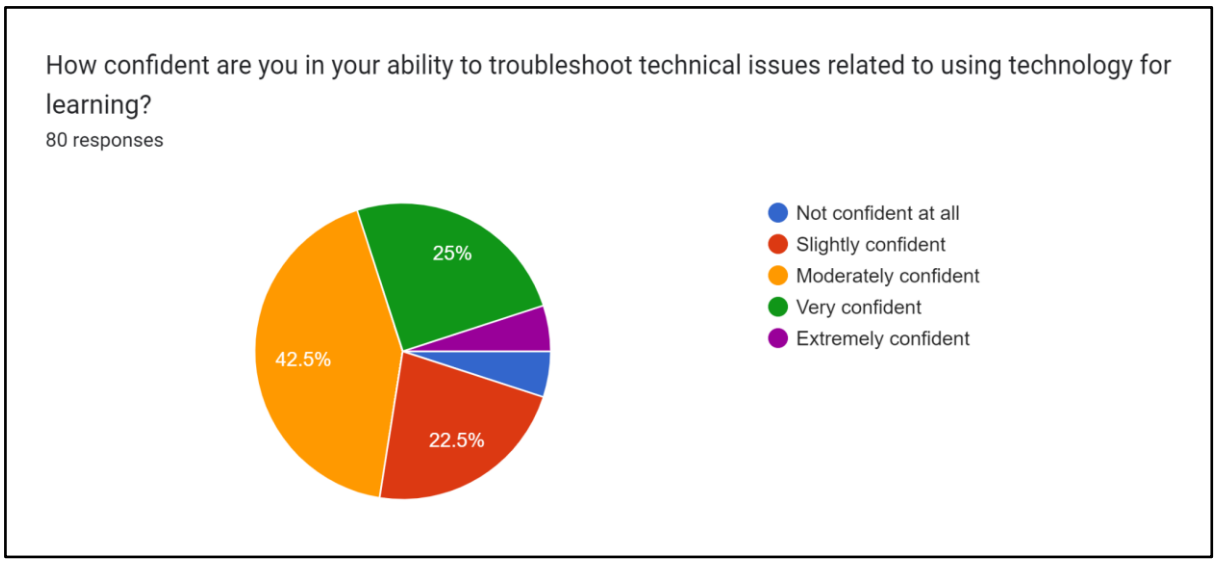

Figure 5.2.4.4 Confident in ability to troubleshoot technical issues related to using technology for learning

An analysis of confidence levels in solving technical problems related to using technology for learning can provide insight into educators' self-assessments of their technology proficiency. A majority (92.5%) of the 80 respondents expressed varying degrees of confidence in their troubleshooting abilities. Specifically, 42.5% of respondents expressed some confidence, indicating they have solid proficiency in solving technical problems. Additionally, 25% of participants expressed high confidence, stating that they were very confident in their troubleshooting abilities. Conversely, a small minority of respondents (10% in total) expressed low confidence, with 5% feeling somewhat confident in their ability to solve technical problems and 5% not feeling confident at all. Meanwhile, 5% of respondents expressed extremely high confidence, underscoring a strong belief in their technical proficiency. These findings highlight the importance of providing ongoing technical support and training to enable educators to effectively use technology for learning while developing the confidence to resolve technology issues as they arise.

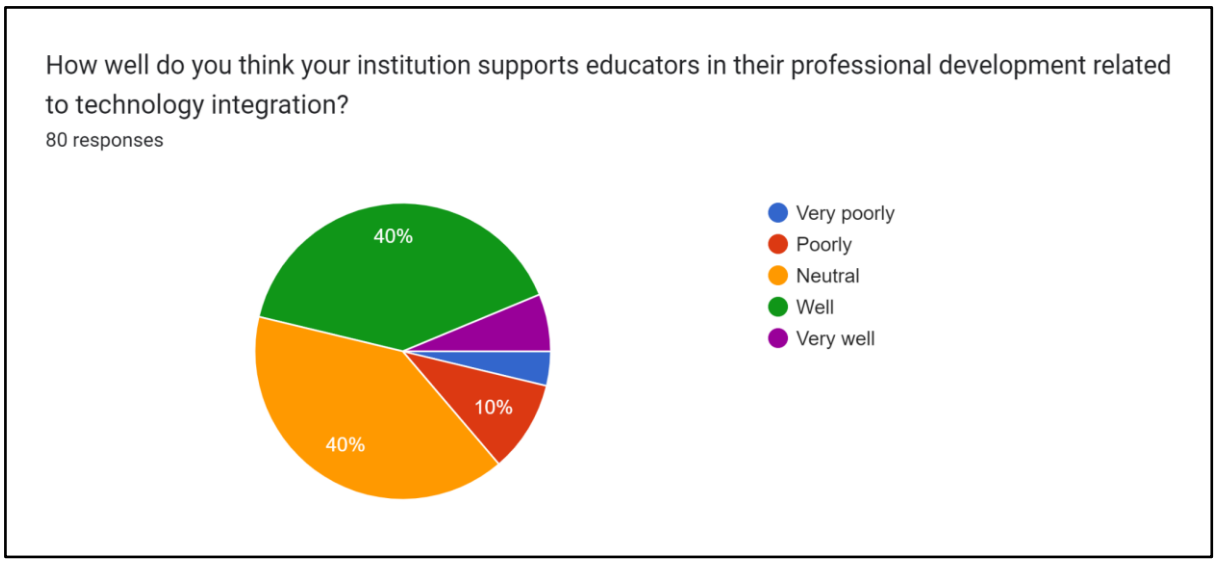

Figure 5.2.4.5 Institution supports educators in professional development related to technology integration

An analysis of educators' perceptions of institutional support for professional development related to technology integration provides valuable insights into the effectiveness of existing support mechanisms. Out of 80 respondents, the majority (86.3%) expressed varying degrees of satisfaction with institutional support. Specifically, 40% of respondents felt that their institution provided good support for educators in terms of their professional development related to technology integration, indicating a positive attitude toward the level of support provided. Additionally, an additional 40% of participants maintained a neutral stance on the matter, indicating mixed emotions or a need for further evaluation of institutional support mechanisms. Conversely, a smaller minority (13.8% total) of respondents were dissatisfied, with 10% saying their institution's support for educators was poor and 3.8% very poor. Meanwhile, 6.3% of participants were very satisfied and said their institution was very supportive of educators. These findings underscore the importance of continually evaluating and strengthening institutional support for professional development related to technology integration for educators to ensure they have the necessary resources and opportunities to effectively integrate technology into instructional practice.

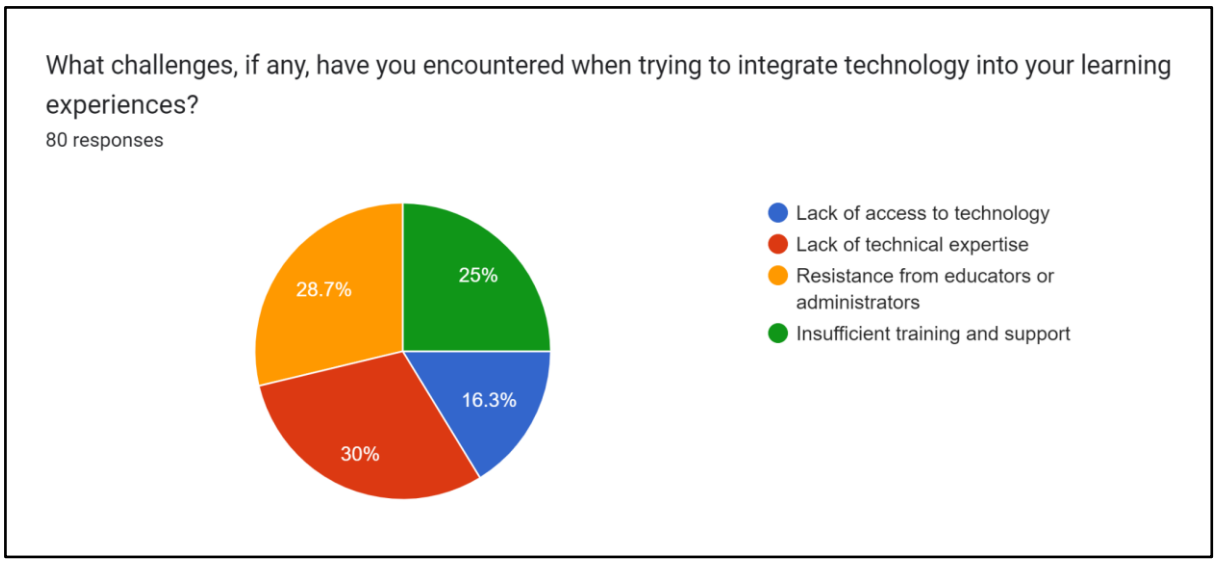

Figure 5.2.4.6 Challenges that encountered when trying to integrate technology into learning experiences

An analysis of the challenges encountered when trying to integrate technology into the learning experience provides valuable insights into the barriers that educators face in using technology effectively. Resistance from educators or administrators emerged as the most prominent challenge among the 80 respondents, with 28.7% expressing concerns about resistance in educational settings. This highlights the importance of fostering a culture of openness to technological innovation and change among all stakeholders. Additionally, 30% of participants reported a lack of technology expertise, indicating the need for ongoing training and professional development to improve educators' digital skills. Twenty-five percent of respondents cited insufficient training and support, underscoring the importance of providing comprehensive support mechanisms to help educators effectively integrate technology into the learning experience. Meanwhile, 16.3% of participants reported a lack of access to technology, highlighting the need for equitable access to technology resources to ensure all students have the opportunity to benefit from digital learning tools. These findings highlight the importance of addressing these challenges through targeted initiatives and support mechanisms to facilitate the successful integration of technology into teaching practice.

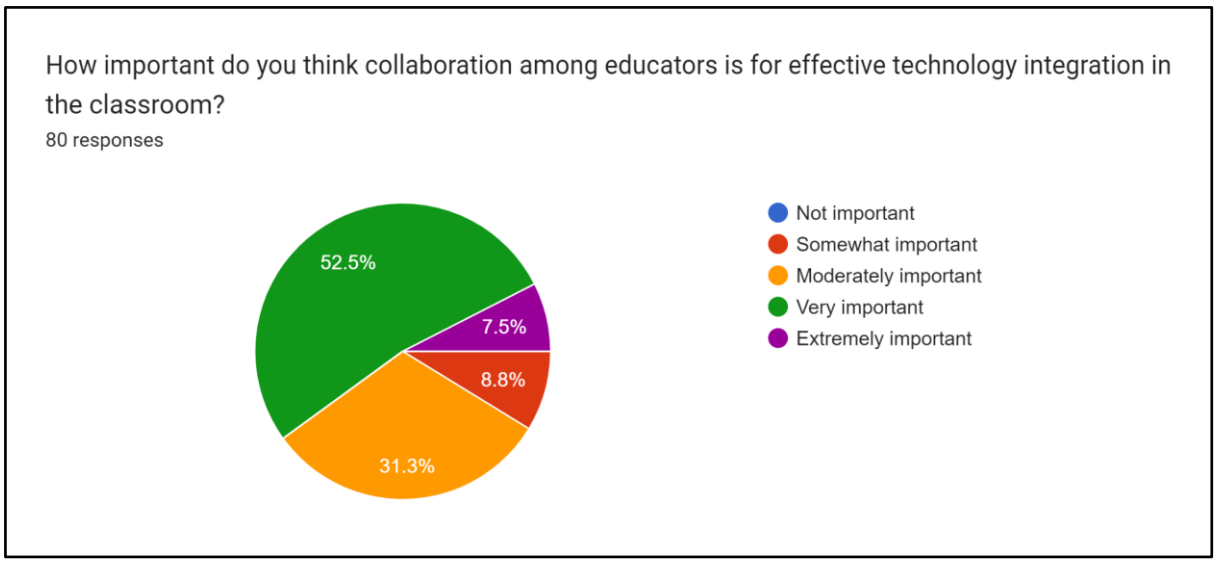

Figure 5.2.4.7 Important of collaboration among educators for effective technology integration in the classroom

An analysis of perceptions of the importance of collaboration among educators for effective technology integration in the classroom provides valuable insights into the role of collaborative practices in enhancing digital learning experiences. Of the 80 respondents, the vast majority (68.8% of participants) expressed varying degrees of importance for collaboration. Specifically, 52.5% of respondents considered it very important, indicating a strong recognition of the value of technology integration collaborative efforts. Additionally, 31.3% of participants considered collaboration to be of moderate importance, indicating widespread recognition of its importance. Meanwhile, 7.5% of respondents expressed a high level of importance, emphasising the key role of collaboration in promoting innovation and best practices in technology integration. In contrast, only a small proportion of respondents (8.8% in total) consider collaboration to be somewhat important. These findings highlight the importance of fostering a collaborative culture within educational institutions to maximise the effectiveness of technology integration efforts and ultimately improve student learning outcomes.

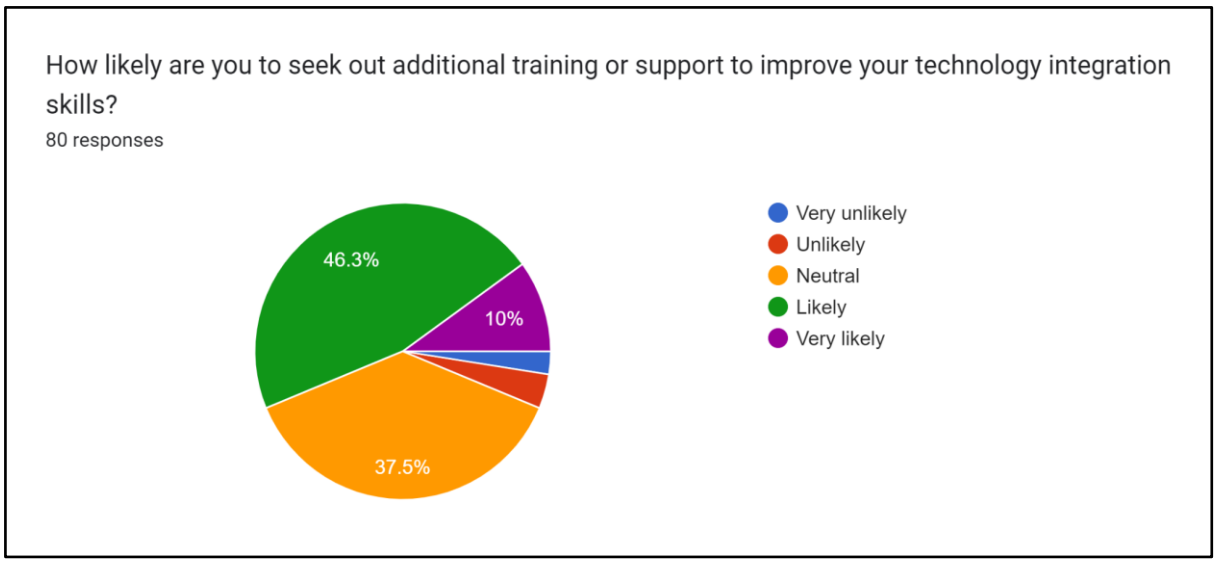

Figure 5.2.4.8 Likely to seek out additional training or support to improve technology integration skills

An analysis of the likelihood of seeking additional training or support to improve technology integration skills can provide insight into educators' readiness to enhance their digital competencies. Of the 80 respondents, the vast majority (94.8% of participants) expressed varying degrees of willingness to seek further training or support. Specifically, 46.3% of respondents indicated that they were likely to seek additional training or support, indicating considerable interest in improving their technology integration skills. Additionally, 10% of participants reported a very high likelihood of seeking further training or support, underscoring their strong commitment to increasing their digital capabilities. Instead, only a small proportion of respondents (6.3% in total) expressed a reluctance, with 3.8% feeling unlikely and 2.5% unlikely to seek additional training or support. Meanwhile, 37.5% of participants maintained a neutral stance on the matter, indicating mixed emotions or a need for further evaluation of available training options. These findings highlight the importance of providing accessible and relevant professional development opportunities to support educators in improving technology integration skills and promoting innovative teaching practices.

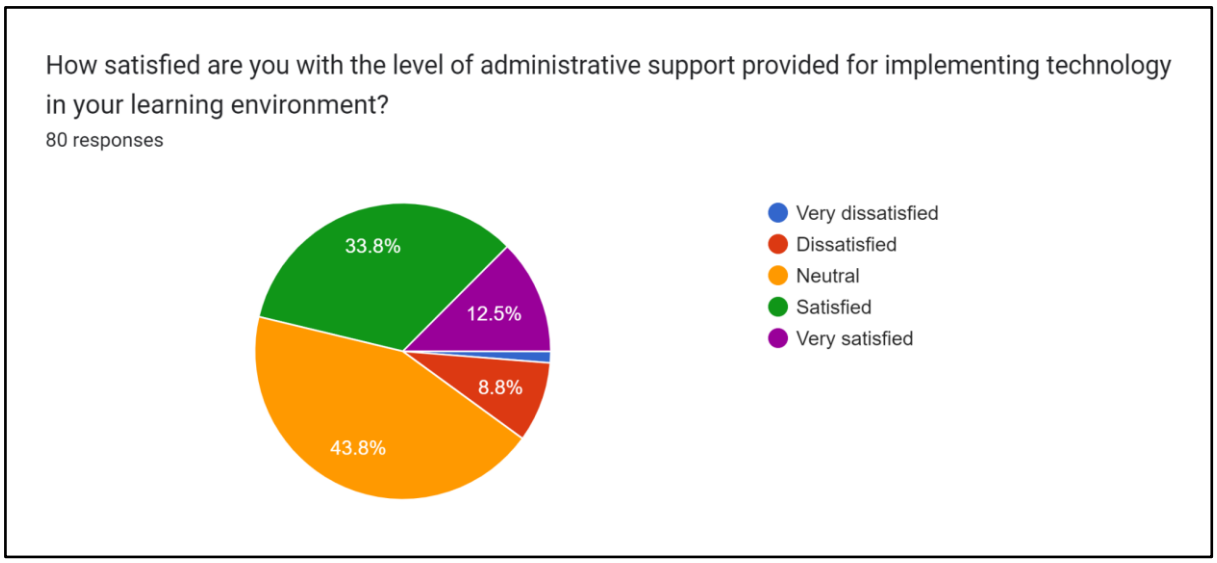

Figure 5.2.4.9 Satisfied with the level of administrative support provided for implementing technology in learning environment

An analysis of satisfaction with the level of administrative support provided by implementing technology in the learning environment provides valuable insights into educators' perceptions of administrative leadership support. Among the 80 respondents, the majority (79.1%) expressed varying degrees of satisfaction with administrative support. Specifically, 33.8% of respondents were satisfied with the level of administrative support, indicating a positive attitude towards the assistance received. Additionally, 12.5% of participants expressed high satisfaction, indicating that they were very satisfied with the administrative support provided. Instead, only a small proportion of respondents (10.1% in total) expressed dissatisfaction, with 8.8% being dissatisfied with the level of administrative support and 1.3% being very dissatisfied. At the same time, 43.8% of participants maintained a neutral stance on this, indicating mixed emotions or the need for further evaluation of administrative support mechanisms. These findings underscore the importance of cultivating strong partnerships among educators and administrative leaders to ensure effective implementation of technology in learning environments and support the achievement of educational goals.

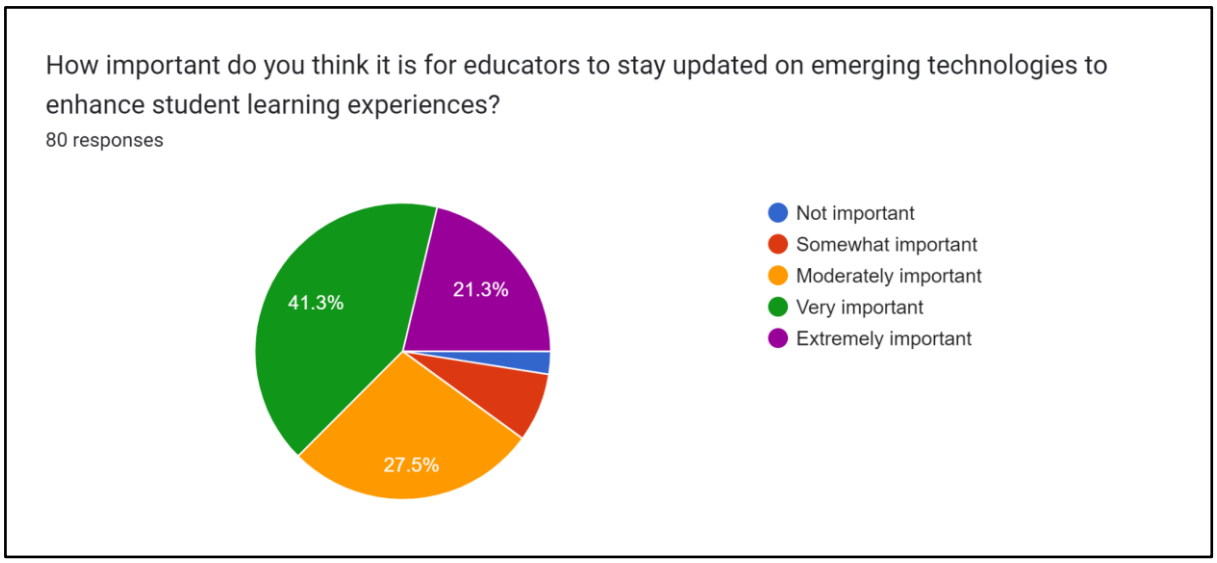

Figure 5.2.4.10 Important for educators to stay updated on emerging technologies to enhance student learning experiences

An analysis of perceptions of the importance of educators staying current on emerging technologies to enhance student learning experiences provides valuable insights into the importance of continuous learning and adaptation. Of the 80 respondents, the vast majority (90.1% of participants) expressed varying degrees of concern about the latest developments in emerging technologies. Specifically, 41.3% of respondents considered this very important, indicating a strong endorsement of the value of keeping up with technological advancements to enrich student learning experiences. Additionally, 21.3% of participants considered this extremely important, highlighting the key role of staying current in promoting innovation and relevance in education. At the same time, 27.5% of the respondents believe that its importance is medium, indicating that its importance is widely recognized. Instead, only a small proportion (10% in total) of respondents considered it somewhat important or not important at all. These findings highlight the importance of fostering a culture of continuous learning and professional development among educators to ensure they are equipped to effectively utilise emerging technologies and improve student learning outcomes.

5.2.5 Continuous Assessment

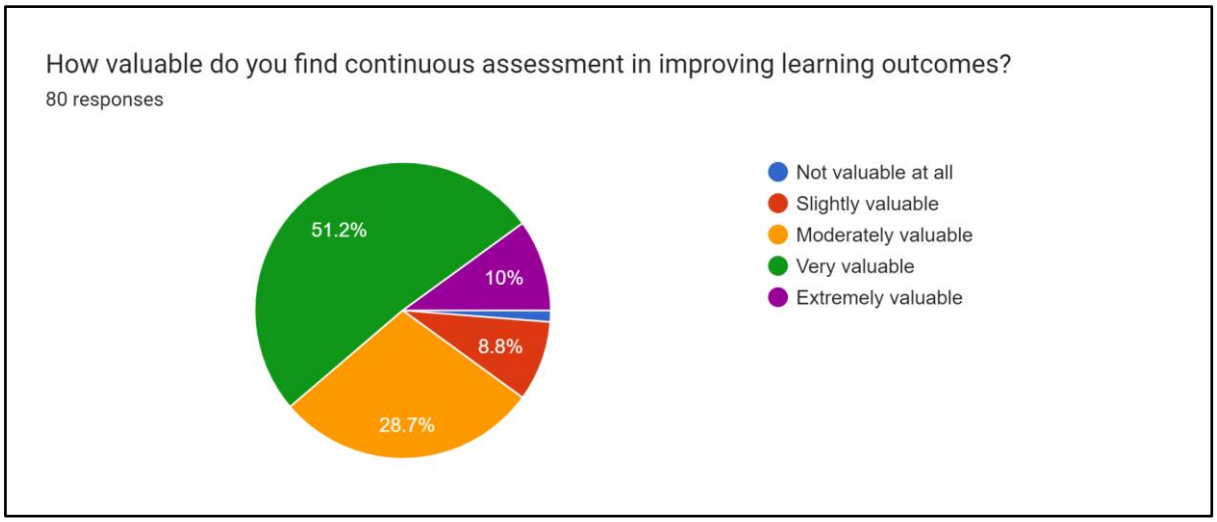

Figure 5.2.5.1 Valuable to find continuous assessment in improving learning outcomes

An analysis of perceptions of the value of continuous assessment in improving learning outcomes provides valuable insights for educators to recognize the importance of continuous assessment and feedback. Of the 80 respondents, the vast majority (91.2% of participants) expressed varying degrees of value for ongoing assessment. Specifically, 51.2% of respondents found it very valuable, indicating strong recognition of the role of continuous assessment in improving learning outcomes. Additionally, 10% of participants found it extremely valuable, highlighting the critical role of ongoing assessment and feedback in supporting student progress and growth. At the same time, 28.7% of the respondents believe that its value is medium, indicating that its importance is widely recognized. In contrast, only a small proportion of respondents (10% in total) believe that continuous evaluation has little or no value. These findings highlight the importance of integrating continuous assessment practices into educational frameworks to ensure effective monitoring of student learning and targeted support for improvement.

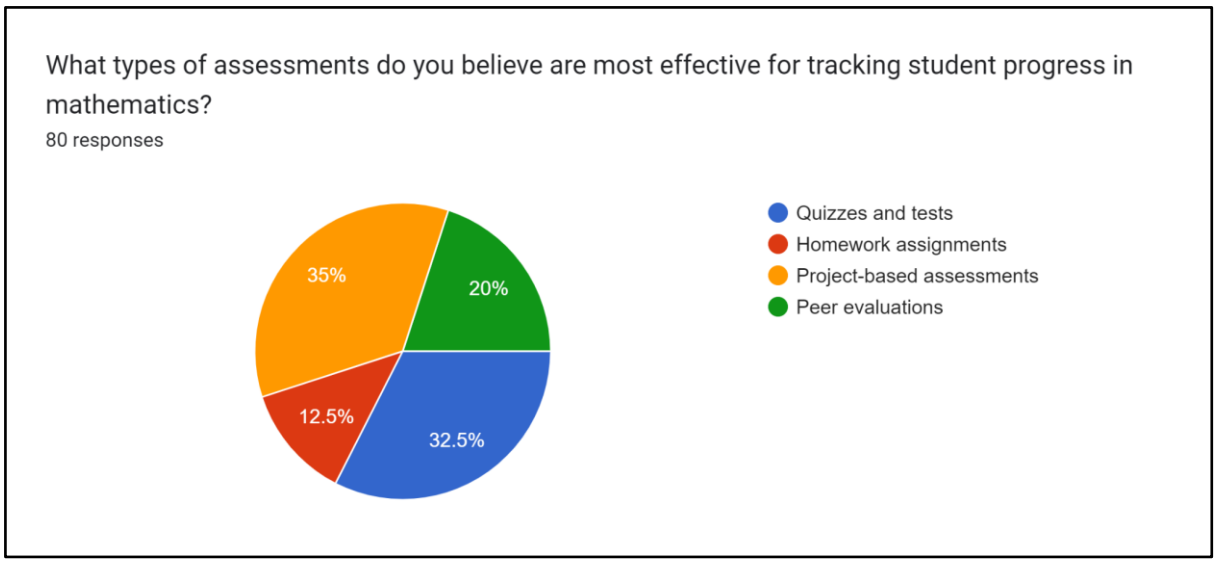

Figure 5.2.5.2 Types of assessments that most effective for tracking student progress in mathematics

An analysis of the preferred types of assessment for tracking student progress in mathematics provides valuable insights into effective assessment strategies. Project-based assessment emerged as the most popular type of assessment among 80 respondents, with 35% indicating its effectiveness. This demonstrates our recognition of the value of hands-on, applied learning experiences in measuring students' understanding and mastery of mathematical concepts. Additionally, 32.5% of participants believed quizzes and tests were effective, demonstrating the importance of traditional assessment methods in measuring knowledge and skills. Meanwhile, 20% of respondents appreciate peer assessment, highlighting the value of collaborative learning and feedback in assessing student progress. In contrast, 12.5% of participants mentioned homework, indicating less emphasis on this type of assessment that tracks students' mathematics progress. These findings highlight the importance of utilising a variety of assessment methods to comprehensively assess student learning and provide meaningful feedback for improvement in mathematics education.

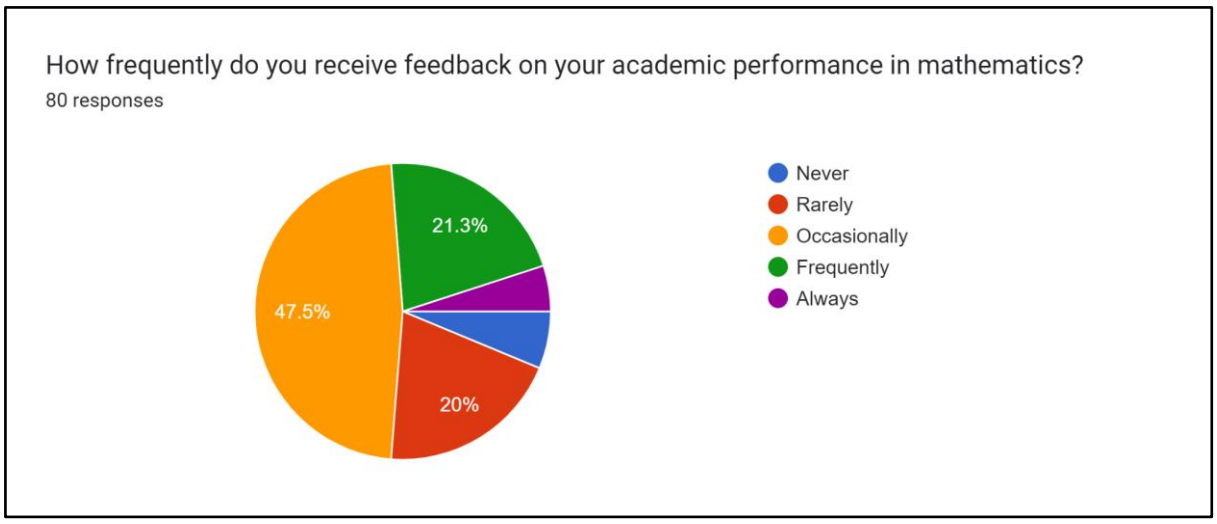

Figure 5.2.5.3 Frequently to receive feedback on academic performance in mathematics

An analysis of the frequency of feedback on academic performance in mathematics can provide insight into the regularity of feedback students receive. Out of 80 respondents, the majority (74.8%) reported varying degrees of feedback frequency. Specifically, 47.5% of respondents reported receiving feedback occasionally, suggesting that feedback is provided regularly but inconsistently. Additionally, 21.3% of participants stated that they received frequent feedback, indicating more consistent feedback on their academic performance. Conversely, a small proportion of respondents (11.3% in total) reported receiving little feedback, indicating few opportunities for feedback. Meanwhile, 5% of participants reported never receiving feedback, highlighting a worrying gap in feedback provision. Conversely, 5% of respondents reported always receiving feedback, indicating a high level of consistency in feedback provision. These findings highlight the importance of regular and timely feedback to support student learning and growth in mathematics.

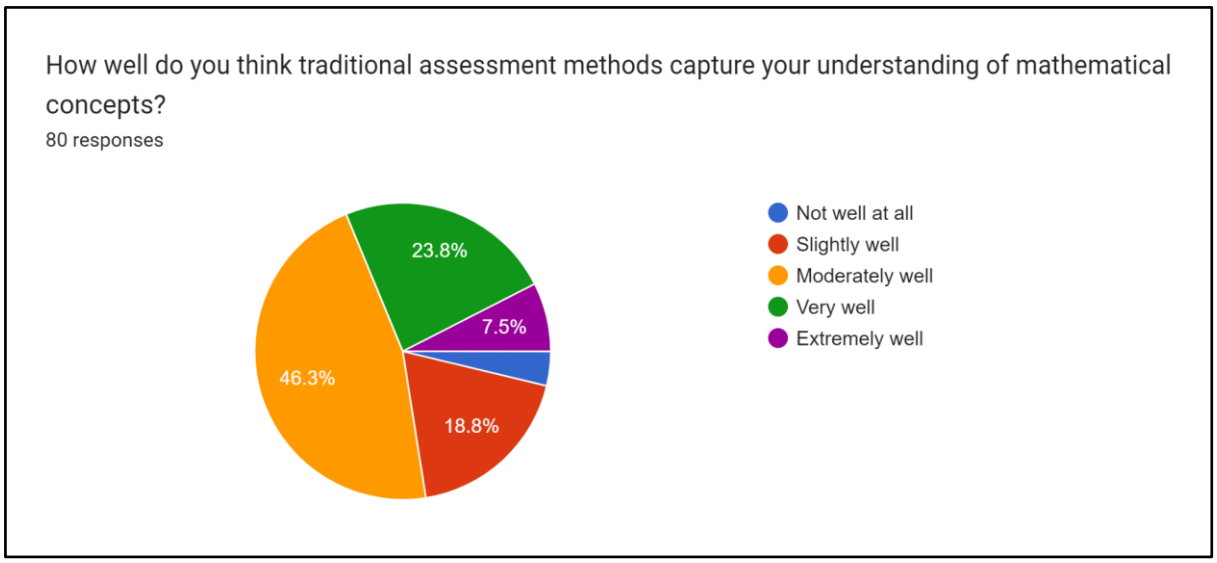

Figure 5.2.5.4 How well of traditional assessment methods capture understanding of mathematical concepts

An analysis of perceptions of the effectiveness of traditional assessment methods in understanding mathematical concepts provides valuable insights into student perceptions of assessment strategies. Of the 80 respondents, the vast majority (91.4% of participants) expressed varying degrees of confidence in traditional assessment methods. Specifically, 46.3% of respondents felt that traditional assessment methods better captured their understanding of mathematical concepts, indicating a strong alignment between assessment and understanding. Additionally, 23.8% of participants felt that traditional assessment methods captured their understanding well, indicating a strong correlation between assessment results and mastery of mathematical concepts. Conversely, only a small proportion of respondents (11.3% in total) expressed less confidence, with 3.8% saying traditional assessment methods do not capture their understanding well at all and 7.5% slightly better. At the same time, 7.5% of participants stated that traditional assessment methods captured their understanding well, highlighting the high degree of alignment between assessment strategies and understanding of mathematical concepts. These findings highlight the importance of utilising a variety of assessment methods to comprehensively assess student understanding and provide meaningful feedback for improvement in mathematics education.

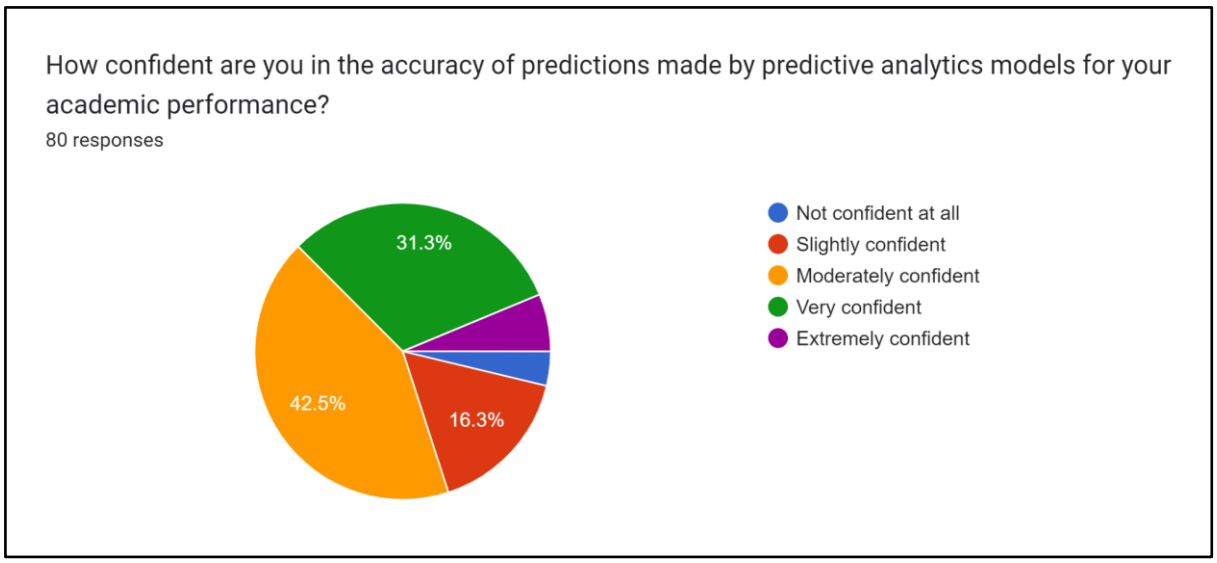

Figure 5.2.5.5 Confident in accuracy of predictions made by predictive analytics models for academic performance

Analysing confidence in the accuracy of predictions made by predictive analytics models of academic performance can provide insight into students' trust in these analytics tools. Of the 80 respondents, the vast majority (80.1% of participants) expressed varying degrees of confidence in predictive analytics models. Specifically, 42.5% of respondents expressed some confidence, indicating a strong level of trust in the predictive capabilities of these models. Additionally, 31.3% of participants felt very confident in the predictive analytics model, indicating a high guarantee of its accuracy. Conversely, only a small proportion of respondents (10.1% in total) expressed little confidence, with 3.8% not at all confident and 6.3% slightly confident in the accuracy of predictive analytics models. Meanwhile, 6.3% of participants reported being very confident, underscoring the strong belief in the reliability of these forecasting tools. These findings highlight the potential of predictive analytics models in predicting academic performance, although levels of confidence vary among students.

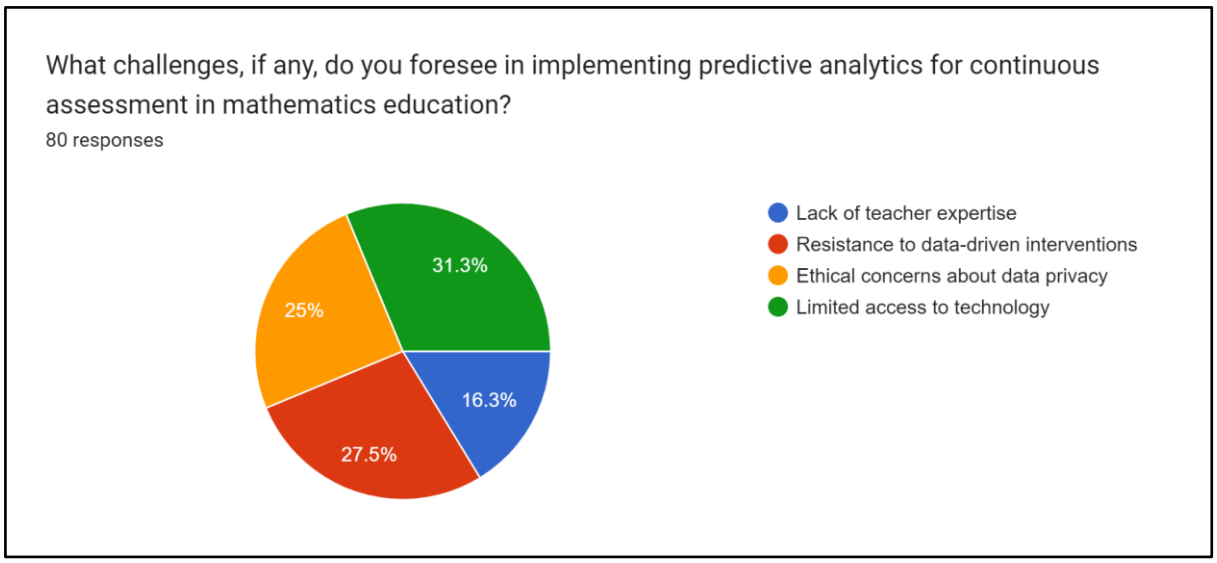

Figure 5.2.5.6 Challenges of foresee in implementing predictive analytics for continuous assessment in mathematics education

An analysis of anticipated challenges in implementing predictive analytics for continuous assessment in mathematics education provides valuable insights into potential barriers that may arise. Across the 80 respondents, a variety of challenges were identified, reflecting the multifaceted nature of implementing predictive analytics in educational settings. Specifically, resistance to data-driven interventions emerged as the most prominent challenge, with 27.5% of respondents anticipating that stakeholders may resist the adoption of data-driven approaches in evaluations. This highlights the importance of problem-solving and fostering an open culture of innovation and data-driven decision-making in education. Additionally, 31.3% of participants cited limited access to technology, which underscores the importance of ensuring equitable access to technology resources to support the implementation of predictive analytics initiatives. Meanwhile, 25% of respondents cited ethical concerns about data privacy, indicating the need for strong privacy policies and safeguards to protect sensitive student data. Conversely, 16.3% of participants reported a lack of teacher expertise, highlighting the importance of providing professional development opportunities to help educators effectively utilise predictive analytics. These findings highlight the importance of addressing these challenges through targeted initiatives and support mechanisms to facilitate the successful implementation of predictive analytics for continuous assessment in mathematics education.

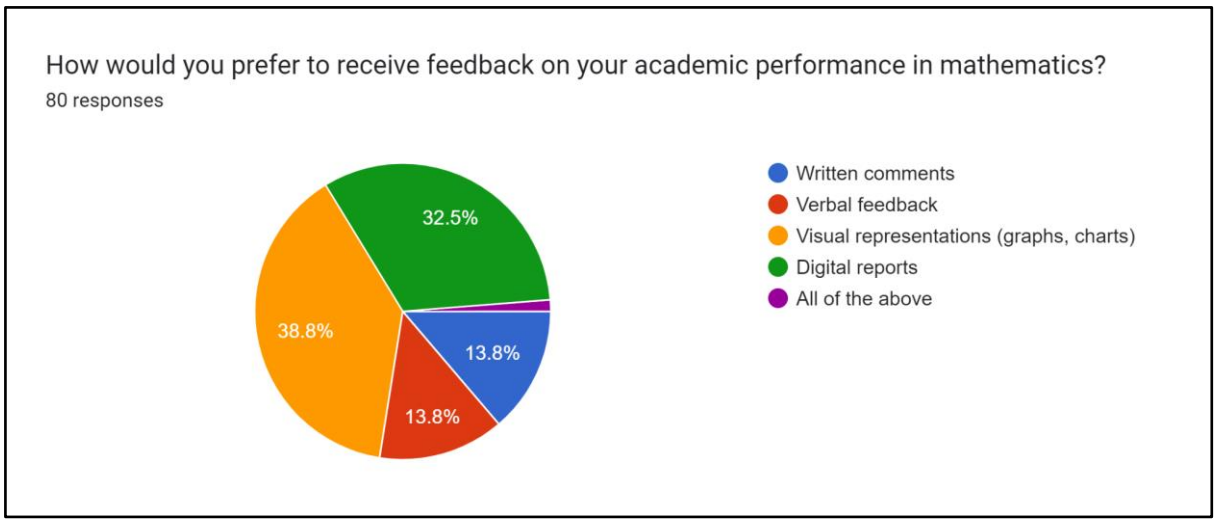

Figure 5.2.5.7 How prefer to receive feedback on academic performance in mathematics

An analysis of preferred feedback methods for academic performance in mathematics provides valuable insights into students' preferences for receiving feedback. Among 80 respondents, visual representations (charts) emerged as the most popular feedback method, with 38.8% indicating a preference for this method. This indicates a strong preference for visual aids in conveying feedback, which can help students better understand their performance and areas for improvement through clear and intuitive representations. Additionally, 32.5% of participants preferred digital reporting, indicating they want comprehensive and easily accessible feedback via digital platforms. Meanwhile, both written comments and verbal feedback are preferred by 13.8% of respondents, highlighting the importance of personalization and direct communication in providing feedback. These findings highlight the importance of providing diverse feedback methods to meet students' different preferences and learning styles, ultimately increasing the effectiveness of feedback in supporting academic growth and mathematical progress.

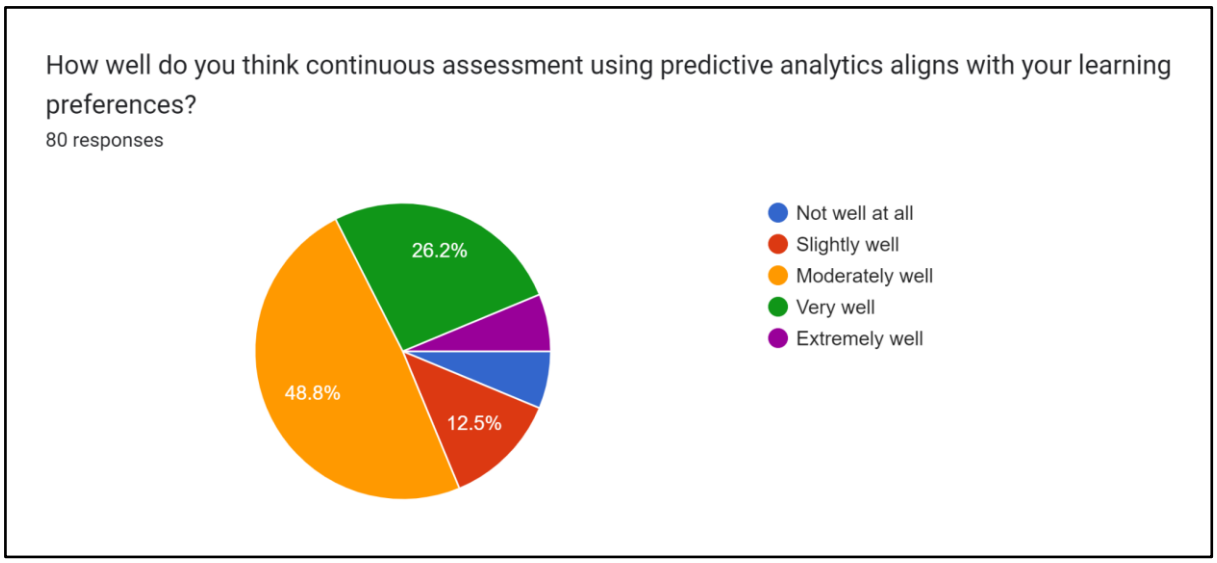

Figure 5.2.5.8 How well continuous assessment using predictive analytics aligns with learning preferences

Analysis of the alignment between ongoing assessment and students' learning preferences using predictive analytics provides valuable insights into the perceived fit between assessment methods and personal preferences. Of the 80 respondents, the majority (87.6% of participants) indicated varying degrees of agreement. Specifically, 48.8% of respondents felt that continuous assessment using predictive analytics was reasonably aligned with their learning preferences, indicating a strong alignment between assessment methods and personal preferences. Additionally, 26.2% of participants rated it as a strong fit, indicating a strong alignment between ongoing assessment and their learning preferences. Instead, only a small minority (18.8% in total) of respondents felt less consistent, with 12.5% feeling slightly more consistent and 6.3% not very consistent at all. Meanwhile, 6.3% of participants reported a strong fit, highlighting the strong resonance between ongoing assessment using predictive analytics and their learning preferences. These findings highlight the importance of considering student preferences and incorporating diverse assessment methods to increase engagement and effectiveness in mathematics education.

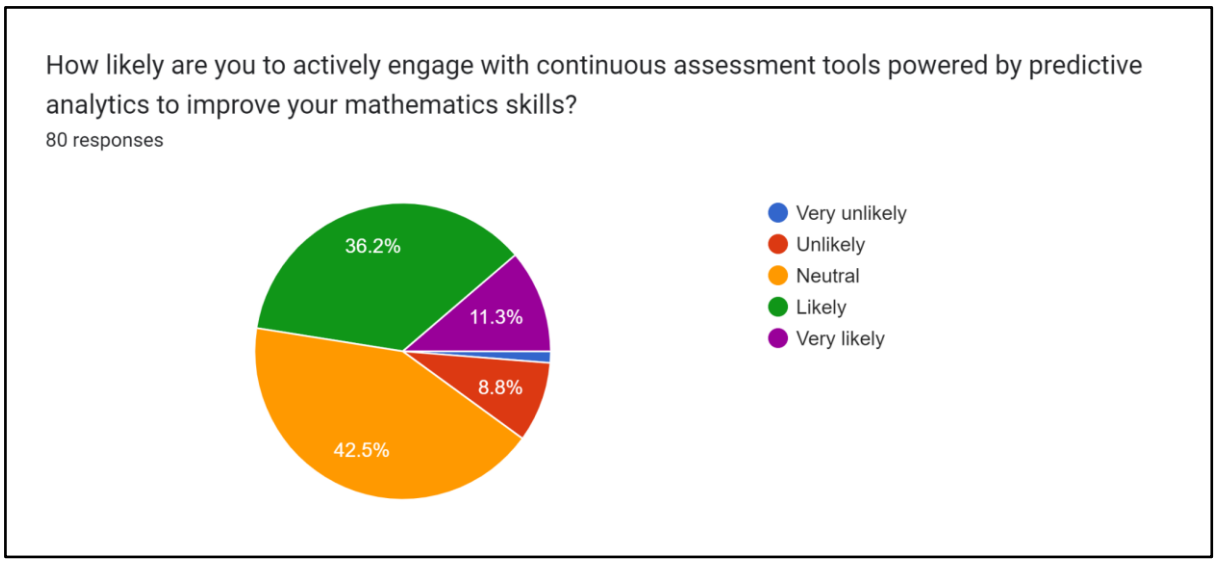

Figure 5.2.5.9 Likely to actively engage with continuous assessment tools powered by predictive analytics to improve mathematics skills

Analysing the likelihood of active use of ongoing assessment tools powered by predictive analytics can provide insight into whether students are ready to take advantage of these innovative tools to improve their skills. Of the 80 respondents, the majority (89% of participants) indicated varying likelihood of actively using continuous assessment tools. Specifically, 42.5% of respondents reported feeling neutral, indicating a balanced stance on the use of predictive analytics-driven assessment tools. Additionally, 36.2% of participants expressed the possibility of participating, indicating an active inclination to utilise these tools to improve their skills. In contrast, only a small proportion of respondents (10.1% in total) indicated a reluctance, with 8.8% feeling unlikely and 1.3% unlikely to actively use continuous assessment tools. At the same time, 11.3% of participants reported a very high likelihood of participating, highlighting the strong motivation to leverage tools powered by predictive analytics to improve mathematics skills. These findings highlight the potential of ongoing assessment tools powered by predictive analytics to support student mathematics education engagement and skill development despite varying student readiness levels.

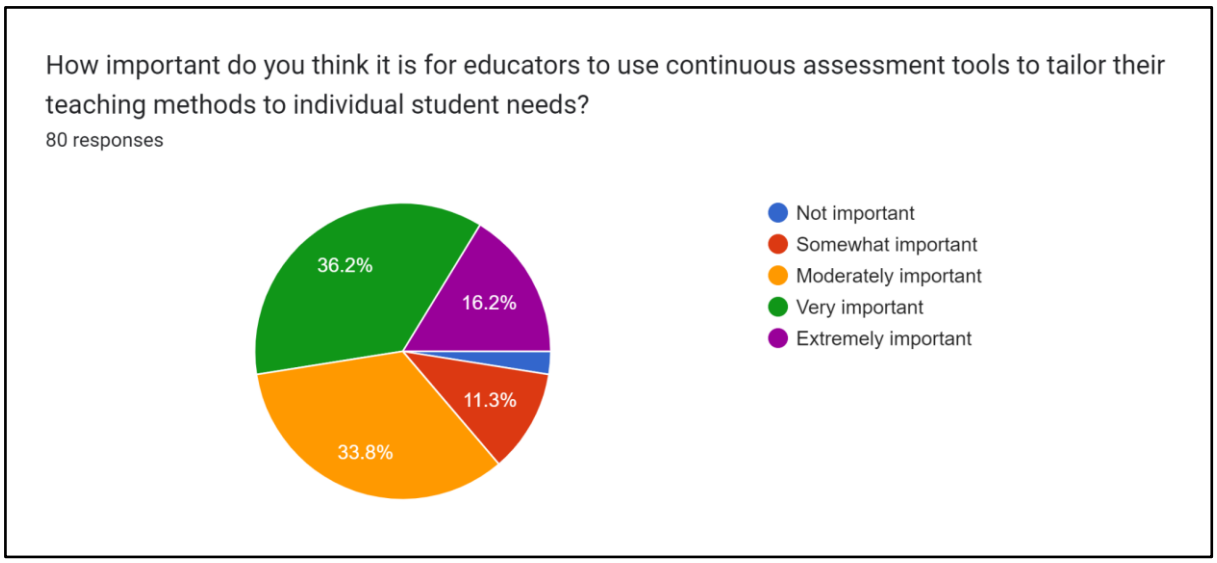

Figure 5.2.5.10 Important for educators to use continuous assessment tools to tailor teaching methods to individual student needs

An analysis of perceptions of the importance of educators using ongoing assessment tools to tailor instructional approaches to individual student needs provides valuable insights for identifying personalised instructional approaches. The majority of the 80 respondents (92.5% of participants) expressed varying degrees of importance to this practice. Specifically, 36.2% of respondents considered this very important, indicating a high level of recognition of the value of using ongoing assessment tools to tailor teaching methods to individual student needs. Additionally, 16.2% of participants rated it as extremely important, highlighting the critical role of personalised instructional approaches in promoting student success and engagement. At the same time, 33.8% of the respondents believe that its importance is medium, indicating that its importance is widely recognized. In contrast, only a small proportion (13.8% in total) of respondents considered it somewhat important or not important at all. These findings highlight the importance of utilising ongoing assessment tools to inform instructional decisions and support customised learning experiences that meet the diverse needs of students in mathematics education.

The next chapter will evaluate and discuss the model development in Chapter 6.

CHAPTER 6

Model Development

6.0 Introduction

This chapter presents the development of the Hierarchical Educational Support and Training (HEST) model, which is designed to enhance mathematics education by equipping teachers with essential resources, strategies and professional development opportunities. The model integrates key components such as Professional Development Workshops, Mentoring and Coaching, Collaborative Planning and Team Teaching, Access to Teaching Resources and Student-Centred Learning Strategies. Additionally, the chapter incorporates the SERVQUAL model to further refine instructional quality through dimensions like reliability, responsiveness, assurance, empathy and tangibles. By aligning these models, the chapter proposes the Integrated Teaching Effectiveness and Achievement (ITEA) model, which leverages data-driven approaches to improve student outcomes and create a more effective and personalised learning environment.

6.1 Comprehensive Support and Training: Key Components and Alignment with SERVQUAL Principles

One of the techniques of Comprehensive Support and Training has garnered the highest level of support, with a significant 76.1% of respondents favouring this approach. This technique is important in mathematics education as it focuses on equipping teachers with the necessary resources, strategies and professional development opportunities to effectively teach mathematical concepts. The key components and sub-techniques of Comprehensive Support and Training include: -

6.1.1 Key Components and Sub-Techniques of Comprehensive Support and Training

- **Professional Development Workshops**

  The regular workshops are held to update teachers on the latest teaching strategies, technological tools and advancements in mathematical content knowledge. The insight of the workshops enables teachers to stay current with

educational trends and research, enhancing their instructional techniques and keeping them engaged with new teaching methods.

- **Mentoring and Coaching**

  The experienced educators or instructional coaches provide one-on-one guidance and feedback to less experienced teachers. The insight of mentoring helps teachers address specific challenges they encounter in the classroom, thereby improving their confidence and teaching effectiveness.

- **Collaborative Planning and Team Teaching**

  The teachers work together to plan lessons, share resources, and occasionally co-teach classes. The insight of this collaboration promotes the sharing of best practices and innovative teaching methods, leading to a more cohesive and comprehensive educational approach.

- **Access to Teaching Resources**

  The teachers are provided with high-quality textbooks, digital tools, and supplementary materials to aid in lesson planning and delivery. The insight of the availability of diverse resources allows teachers to design more engaging and comprehensive lesson plans, thereby improving student understanding and interest in mathematics.

- **Student-Centred Learning Strategies**

  The techniques such as group discussions, peer tutoring, and problem-based learning are implemented to promote active learning. The insight of these strategies encouraged student participation and critical thinking, helping students grasp complex mathematical concepts through collaborative and interactive learning experiences.

6.1.2 SERVQUAL Principles - (Arthur et al., 2021)

On the other hand, one of the authors, (Arthur et al., 2021) proposed a multifaceted approach to improving student achievement and performance in mathematics and focusing on instructional quality through a SERVQUAL perspective [28]. The key components of the technique include: -

- **Mathematics Teaching Reliability**
  It provides reliable and accurate teaching services to enhance students' learning experience.

- **Mathematics Teaching Responsiveness**
  It Provides students with timely help and support to meet their learning needs.

- **Mathematics Teaching Assurance**
  It Demonstrates competence, courtesy, and the ability to express trust and confidence in teaching methods.

- **Mathematics Teaching Empathy**
  It Demonstrates caring and individualised attention to students, understanding their unique needs and challenges.

- **Mathematics Teaching Tangibles**
  It ensures physical facilities, equipment and teaching materials are modern and visually appealing.

6.1.3 Key Components and Sub-Techniques of Comprehensive Support and Training align with SERVQUAL Principles - (Arthur et al., 2021)

Therefore, the technique proposed by (Arthur et al., 2021) aligns well with the strategy and provides a comprehensive approach to enhancing mathematics education. The integration is based on the following principles: -

- **Mathematics Teaching Tangibles and Access to Teaching Resources**
  The comprehensive resource centre will include modern, high-quality instructional materials and digital tools, consistent with Serin's focus on the tangible, making mathematics more engaging and visually appealing for students.

- **Mathematics Teaching Reliability and Professional Development Workshops**

  Professional development workshops will emphasise reliable and effective teaching strategies. Teachers will be trained to provide accurate and reliable educational services, increasing their ability to improve student learning experiences.

- **Mathematics Teaching Responsiveness and Mentoring and Coaching**

  Incorporating responsiveness into the coaching and mentoring technology, experienced educators will provide less experienced teachers with timely support and guidance to help them effectively address specific classroom challenges.

- **Mathematics Teaching Assurance and Collaborative Planning and Team Teaching**

  Collaborative planning sessions will focus on building teacher competency and confidence, aligned with the Assurance component of Serin. Teachers will work together to design reliable and effective lesson plans, ensuring consistent and confident teaching.

- **Mathematics Teaching Empathy and Student-Centred Learning Strategies**

  The student-centred learning strategies will incorporate Serin's emphasis on empathy. Teachers will be trained to understand and meet the unique needs of students through personalised learning plans, small group discussions, and problem-based learning activities.

6.1.4 Similarity or Sub-Techniques of other 4 Techniques to support technique of Comprehensive Support and Training

After that, from the others 4 techniques which are Adaptive Learning Platforms, predictive analytics for Personalized Learning Paths, Data-Driven Professional Development Program and Continuous Assessment also find out with some similarity or sub-components to support the technique of Comprehensive Support and Training to build a meaningful model: -

- **Data-Driven Approach**

  Adaptive Learning Platforms, Predictive Analytics for Personalized Learning Paths, Data-Driven Professional Development Programs and Continuous Assessment all rely on a data-driven approach. It utilises real-time and historical data to adjust content, forecast performance, identify educators' needs and provide ongoing feedback to ensure that educational strategies are continuously refined and optimised based on data insights.

- **Personalization**

  All four techniques emphasise personalization. Adaptive Learning Platforms and Predictive Analytics tailor learning experiences to individual student needs and future performance predictions. Data-Driven Professional Development Programs customise professional development activities for educators based on their specific needs, while Continuous Assessment provides individualised feedback to students to support their unique learning journeys.

- **Improvement of Educational Outcomes**

  The techniques aim to improve educational outcomes. Adaptive Learning Platforms enhance engagement and understanding, Predictive Analytics address anticipated challenges, Data-Driven Professional Development Programs boost teaching effectiveness, and Continuous Assessment ensures timely interventions. All techniques contribute to better academic performance and student success.

- **Integration of Technology**

  Integration of technology is central to all four techniques. Adaptive Learning Platforms use advanced algorithms, Predictive Analytics employ machine learning models, Data-Driven Professional Development Programs leverage digital tools and Continuous Assessment utilises technology for data collection and feedback, making education more interactive and efficient.

- **Feedback and Adjustment Mechanisms**

  Each technique incorporates mechanisms for feedback and adjustment. Adaptive Learning Platforms provide instant feedback and adjust learning paths, Predictive Analytics offer model-based insights for timely adjustments, Data-Driven Professional Development Programs provide feedback on teaching practices, and Continuous Assessment delivers continuous feedback to refine teaching and learning processes.

- **Focus on Individual Growth and Development**

  A focus on individual growth and development is key to all four techniques. Adaptive Learning Platforms cater to diverse learning needs, Predictive Analytics support unique learning journeys, Data-Driven Professional Development Programs address educators' growth needs, and Continuous Assessment provides personalised feedback to foster student development.

6.1.5 Comprehensive Support and Training align with Similarity or Sub-components of the others Four Techniques

To support the techniques of Comprehensive Support and Training, it can align the similarity or sub-components of the others four techniques to support the techniques of Comprehensive Support and Training:

- **Professional Development Workshops supported by Improvement of Educational Outcomes**

  Workshops are primarily aimed at enhancing teaching skills, which directly impact student learning outcomes. It provides educators with the latest pedagogical strategies, improving their effectiveness and consequently, student performance.

- **Mentoring and Coaching supported by Personalization**

  Mentoring and coaching provide tailored support and guidance to individual educators based on their specific needs. The personalised approach helps educators develop their skills in ways that directly address their unique challenges and strengths.

- **Collaborative Planning and Team Teaching supported by Data-Driven Approach**

  Collaborative planning and team teaching often rely on data to inform instructional strategies and lesson planning. Educators use student performance data and other relevant metrics to design effective lessons and teaching approaches collectively.

- **Access to Teaching Resources supported by Integration of Technology**

  Providing access to high-quality teaching resources often includes digital tools and materials. The resources enable educators to integrate technology into their teaching, enhancing the learning experience and making it more interactive and engaging.

- **Student-Centred Learning Strategies supported by Focus on Individual Growth and Development**

  Student-centred strategies emphasise personalising the learning experience to meet the unique needs and growth trajectories of each student. The strategies ensure that each student receives the support and opportunities they need to succeed and grow.

6.2 Model Evaluation

Hierarchical Educational Support and Training (HEST) Model

Figure 6.2.1 Hierarchical Educational Support and Training (HEST) Model

The figure 6.2.1 Shows HEST model built from the techniques of Comprehensive Support and Training has garnered the highest level of support, with a significant 76.1% of respondents favouring this approach. Therefore, the pyramid model visually represents the hierarchical structure of the Comprehensive Support and Training techniques, arranged from the most foundational components at the bottom to the most critical at the top. Each tier of the pyramid builds upon the one below it, demonstrating the interconnected nature of these educational strategies. Here's an explanation of each level of the model from bottom to top: -

- **Access to Teaching Resources (Base Layer)**

  This foundational layer includes providing high-quality textbooks, digital tools and supplementary materials. The resources are essential for effective lesson planning and delivery.

- **Collaborative Planning and Team Teaching**

  Teachers work together to plan lessons, share resources and occasionally co-teach classes. The collaborative approach promotes the sharing of best practices and innovative teaching methods.

- **Mentoring and Coaching**

  Experienced educators or instructional coaches provide one-on-one guidance and feedback to less experienced teachers. The mentoring helps teachers address specific challenges they encounter in the classroom.

- **Professional Development Workshops**

  Regular workshops update teachers on the latest teaching strategies, technological tools and advancements in mathematical content knowledge. The workshops keep teachers engaged with new teaching methods and educational trends.

- **Student-Centred Learning Strategies (Top Layer)**

  Techniques such as group discussions, peer tutoring and problem-based learning are implemented to promote active learning. The strategies encourage student participation and critical thinking.

Therefore, it will have some similarity sub-components from the other four techniques that are used to supported the highest supported technique: -

HEST Model with supported similarity of others four techniques:

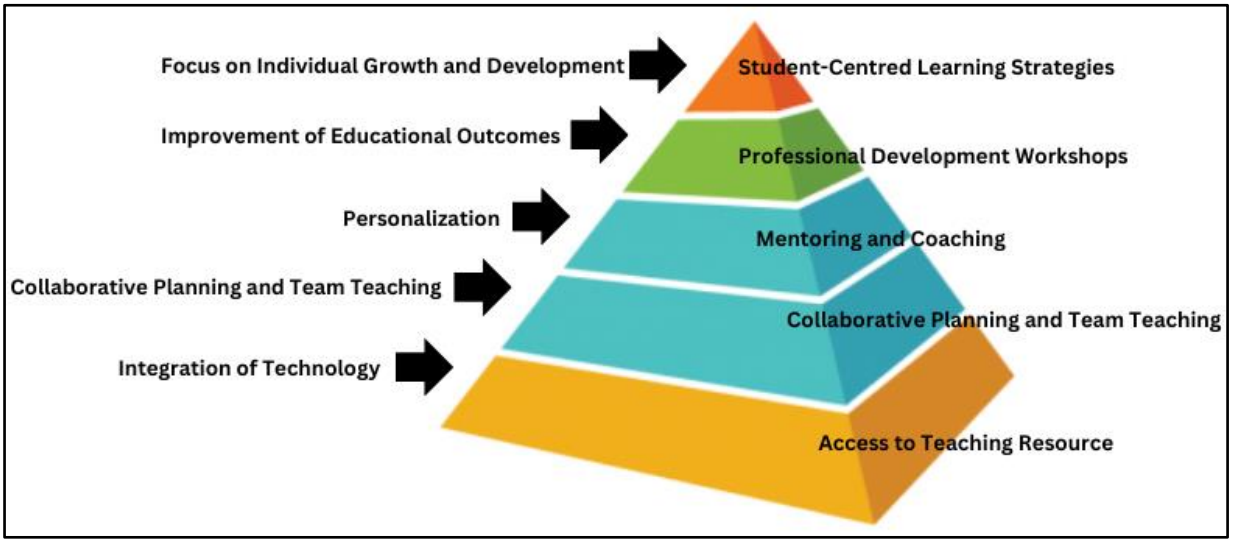

Figure 6.2.2 HEST Model supported by other four techniques similarity sub-components

The above figure 6.2.2 shows the HEST Model supported by other four similarity sub-components: -

- **Access to Teaching Resources (Base Layer)**

  The availability of diverse and high-quality resources allows teachers to design more engaging and comprehensive lesson plans, improving student understanding and interest in mathematics. Integration of technology into these resources enhances the learning experience, making it more interactive.

- **Collaborative Planning and Team Teaching**

  Collaborative planning and team teaching often rely on data to inform instructional strategies and lesson planning. The data-driven approach ensures that lessons are effective and tailored to student needs, leading to better educational outcomes.

- **Mentoring and Coaching**

  Personalised support and guidance from mentors help educators develop their skills in ways that directly address their unique challenges and strengths. Personalization is crucial for building teacher confidence and teaching effectiveness.

- **Professional Development Workshops**

  The workshops are primarily aimed at enhancing teaching skills, which directly impact student learning outcomes. By improving their instructional techniques, teachers can more effectively foster student performance and engagement in mathematics.

- **Student-Centred Learning Strategies (Top Layer)**

  Student-centred strategies emphasise personalising the learning experience to meet the unique needs and growth trajectories of each student. The strategies ensure that each student receives the support and opportunities they need to succeed and grow, making it the most critical component of the model.

SERVQUAL Model (Arthur et al., 2021)

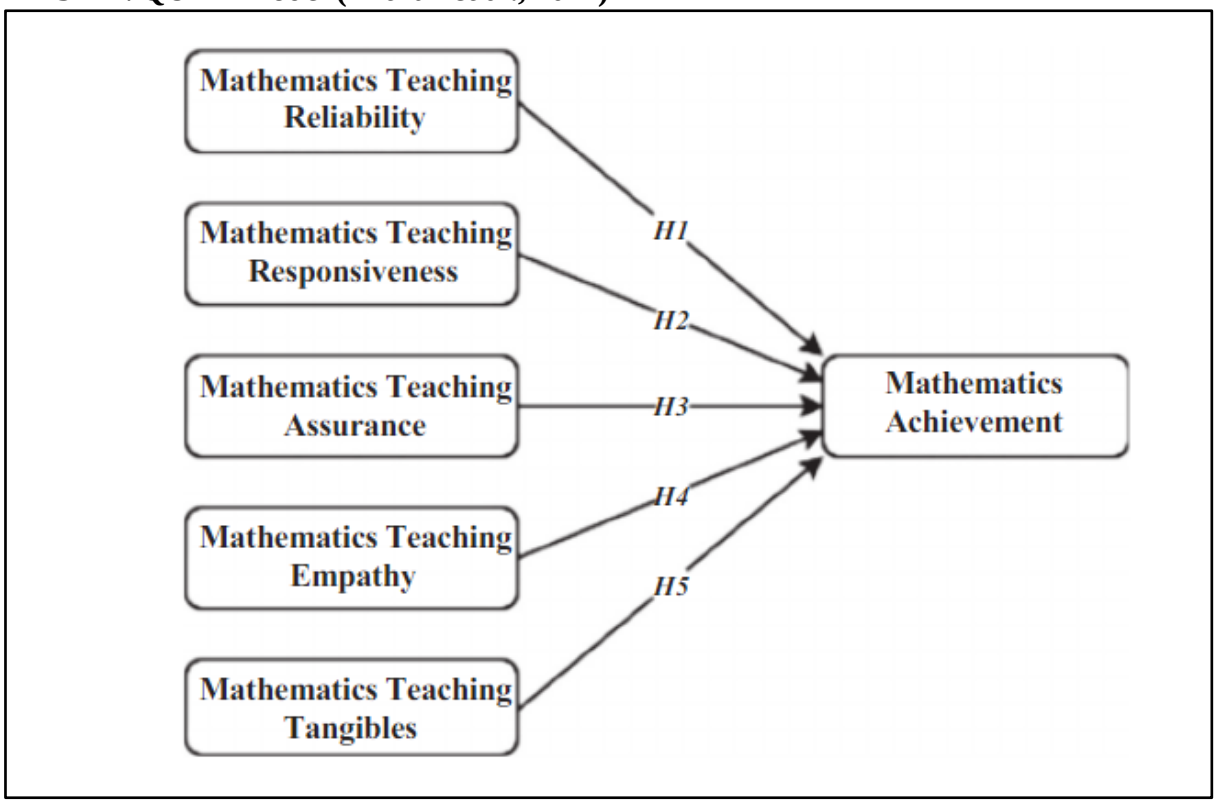

Figure 6.2.3 SERVQUAL Model (Arthur et al., 2021)

The author's model depicted in the diagram is a conceptual framework that explores the relationship between various aspects of mathematics teaching and students' mathematics achievement. This model uses a set of hypotheses (H1 to H5) to illustrate how different teaching dimensions influence students' performance in mathematics. Here is an explanation of each component and their interactions: -

- **Mathematics Teaching Reliability**

  The component refers to the consistency and dependability of the teaching methods. It emphasises the importance of reliable and accurate teaching practices that ensure students receive a stable and predictable learning experience. It posits that increased reliability in mathematics teaching positively influences students' mathematics achievement.

- **Mathematics Teaching Responsiveness**

  The component deals with how quickly and effectively teachers respond to students' needs and questions. It includes providing timely help and support to students, addressing their learning challenges promptly. It suggests that higher

responsiveness in teaching leads to better mathematics achievement among students.

- **Mathematics Teaching Assurance**

  Assurance involves the teacher's ability to inspire confidence and trust in their teaching methods. It includes demonstrating competence, courtesy, and a strong understanding of the subject matter. This hypothesis indicates that greater assurance in teaching methods contributes positively to students' mathematics achievement.

- **Mathematics Teaching Empathy**

  Empathy in teaching refers to the teacher's ability to understand and address the individual needs and emotional states of students. It involves providing personalised attention and support to help students overcome their unique challenges. This hypothesis proposes that teaching with empathy positively impacts students' achievement in mathematics.

- **Mathematics Teaching Tangibles**

  Tangibles refer to the physical and tangible aspects of teaching, such as the quality of teaching materials, classroom environment, and available resources. It includes ensuring that the physical facilities and equipment used for teaching are modern and visually appealing. This hypothesis asserts that better tangibles in the teaching environment enhance students' mathematics achievement.

Finalise model: Integrated Teaching Effectiveness and Achievement (ITEA) Model

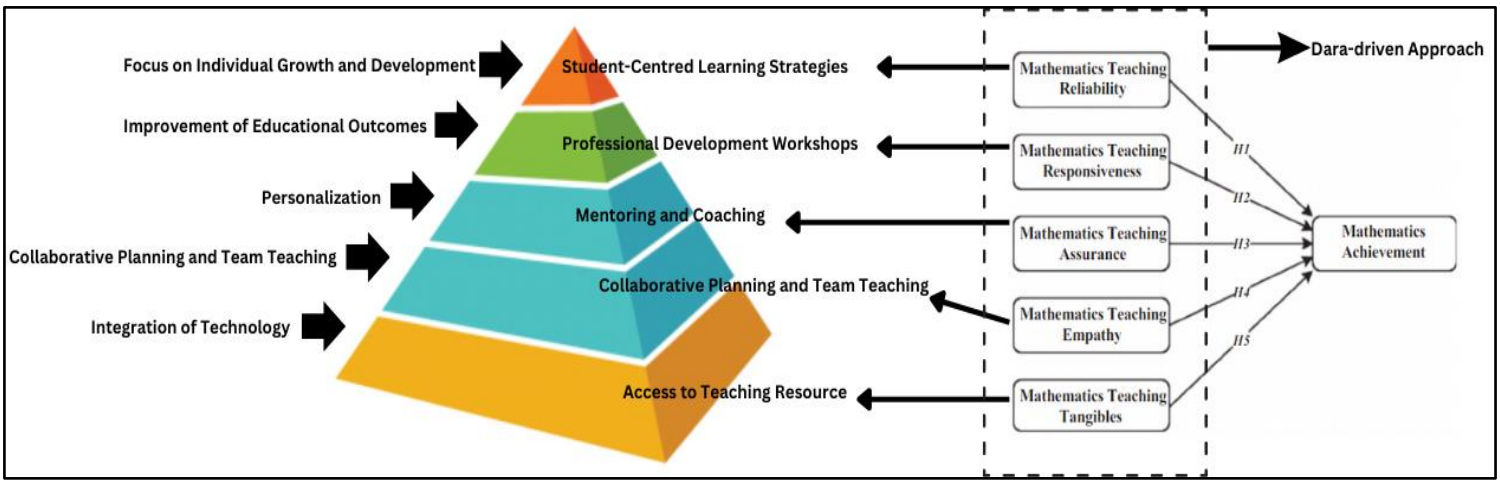

Figure 6.2.4 Finalise model: ITEA Model

The Integrated Teaching Effectiveness and Achievement Model (ITEA) is designed to enhance mathematics teaching quality and improve student achievement by integrating various educational strategies. It begins with providing access to teaching resources, such as modern technology and collaborative planning to facilitate effective instruction. This foundation supports personalised learning and mentoring, empowering teachers through professional development workshops aimed at improving educational outcomes. By focusing on individual growth, student-centred learning strategies are implemented, fostering a responsive, reliable and empathetic teaching environment. SERVQUAL models are also provided to support these efforts. A data-driven approach is employed to continuously monitor and enhance teaching practices and student performance, ensuring informed decision-making and effective implementation of improvements. Ultimately, ITEAM seeks to elevate mathematics achievement through a comprehensive and cohesive strategy that prioritises high-quality education and supports both teachers and students.

To further enhance the model, data-driven approaches are crucial in providing actionable insights that guide the continuous improvement of teaching practices and student performance. By systematically collecting and analysing data on various aspects of the educational process, educators can make informed decisions that enhance the effectiveness of instructional strategies and the overall learning environment. This includes leveraging data to identify areas where students struggle and tailoring interventions to meet their specific needs. Studies have shown that data-driven

decision-making (DDDM) significantly impacts educational outcomes by enabling educators to implement evidence-based practices and refine their teaching methodologies [29].

For instance, integrating adaptive learning technologies that utilise artificial intelligence and machine learning algorithms can dynamically adjust the content and delivery of instruction based on individual student performance and engagement levels. This personalization fosters a more engaging and effective learning experience, as demonstrated in various educational settings where adaptive learning systems have been implemented [30]. The use of data in these systems helps track student progress in real-time, providing immediate feedback and enabling timely interventions that support student success.

Furthermore, professional development workshops grounded in data-driven insights can empower teachers with the skills and knowledge necessary to apply these strategies effectively. By participating in ongoing training that focuses on interpreting and utilising educational data, teachers can enhance their instructional practices and better support student achievement [29]. This continuous professional growth is essential for maintaining a high-quality teaching environment that adapts to evolving educational demands.

In addition, collaborative planning and team teaching are reinforced through data sharing and collective analysis, fostering a culture of continuous improvement and shared responsibility among educators. Data from classroom assessments, student feedback, and other relevant sources can be used to inform collaborative efforts, ensuring that teaching practices are aligned with the goal of improving student outcomes. This collaborative approach not only enhances the quality of instruction but also builds a supportive community of practice among teachers [30].

In summary, the ITEA model's integration of a data-driven approach is vital for elevating mathematics achievement. By harnessing the power of data to inform instructional practices, personalise learning, and support professional development, educators can create a more effective and responsive educational environment. This comprehensive strategy ultimately aims to provide high-quality education that meets the diverse needs of students and supports their academic success.

6.3 Result of Expert Review

After refining the ITEA model, a model validation session was conducted with three experts, as detailed below. These experts were chosen based on their extensive experience in education, instructional design, and predictive analytics. Their insights were crucial for assessing the model's effectiveness, usability, scalability and ethical considerations. Table 6.3.1 presents the demographic profiles of the experts involved in the review.

Expert	Age	Highest Education Level	Gender	Years of Teaching Experience
A	36 years old and above	Master	Female	11 – 15 years
B	36 years old and above	Bachelor	Male	11 – 15 years
C	21 – 25 years old	Bachelor	Male	0 – 5 years

Table 6.3.1 Demographic Profiles

The expert review of the ITEA model included three experts with diverse backgrounds. Expert A is a female expert, aged 36 years and above, holding a Master's degree and possessing 11–15 years of teaching experience. Expert B is a male expert, also aged 36 years and above, with a Bachelor's degree and 11–15 years of teaching experience. Expert C is a younger male expert, aged 21–25, with a Bachelor's degree and 0–5 years of teaching experience. These experts provided valuable feedback across various evaluation dimensions, offering insights from different levels of experience and expertise.

6.3.1 Findings of Expert Review's Result

The experts reviewed the ITEA model across several key dimensions, including visibility, usability, effectiveness, scalability, integration, sustainability and ethical considerations. Each expert rated the model on a Likert scale from 1 to 5, with 1 being "Strongly Disagree" and 5 being "Strongly Agree." The following table summarizes their responses and the mean scores across all dimensions: -

Dimension 1: Visibility

Dimensions	Expert A	Expert B	Expert C
The key components and steps of the ITEA model are clear and understandable.	4	5	3
The ITEA model covers all necessary aspects of the problem it is designed to address.	4	5	3
The processes and outcomes of the ITEA model are visible and easy to track	4	5	3
Total	**12**	**15**	**9**

Table 6.3.1.1 Dimension 1: Visibility

Dimension 2: Usability

Dimensions	Expert A	Expert B	Expert C
The ITEA model is user-friendly for educators and students with varying levels of technical expertise.	4	5	2
The model is easy to navigate, with intuitive pathways and steps.	4	4	2
The ITEA model adapts well to different teaching contexts and student needs.	4	5	3
Total	**12**	**14**	**7**

Table 6.3.1.2 Dimension 2: Usability

Dimension 3: Effectiveness

Dimensions	Expert A	Expert B	Expert C
The ITEA model is effective in improving students' academic performance, particularly in mathematics.	4	4	3
The predictive analytics within the ITEA model are accurate in forecasting student outcomes.	4	4	4
The ITEA model has been successful when implemented in real-world educational settings.	4	4	2
Total	**12**	**12**	**9**

Table 6.3.1.3 Dimension 3: Effectiveness

Dimension 4: Reliability

Dimensions	Expert A	Expert B	Expert C
The outcomes of the ITEA model are consistent across different educational environments.	4	5	3
The ITEA model is reliable in delivering expected results under various conditions.	4	4	4
The ITEA model ensures the accuracy and integrity of the data it processes.	4	4	4
Total	**12**	**13**	**11**

Table 6.3.1.4 Dimension 4: Reliability

Dimension 5: Scalability

Dimensions	Expert A	Expert B	Expert C
The ITEA model can be easily scaled to accommodate larger datasets or more complex educational systems.	4	4	2
The model allows for customization and scaling without compromising its core functionality.	4	4	2
The ITEA model efficiently uses resources when scaled up for larger implementations.	4	5	3
Total	**12**	**13**	**7**

Table 6.3.1.5 Dimension 5: Scalability

Dimension 6: Integration

Dimensions	Expert A	Expert B	Expert C
The ITEA model integrates well with existing educational technologies and platforms.	4	5	3
The model is interoperable with other tools and systems commonly used in educational settings.	4	4	4
The ITEA model supports collaborative efforts among educators, students, and administrators.	4	5	4
Total	**12**	**14**	**11**

Table 6.3.1.6 Dimension 6: Integration

Dimension 7: Sustainability

Dimensions	Expert A	Expert B	Expert C
The ITEA model is sustainable for long-term use in educational institutions.	4	5	2
The maintenance requirements of the ITEA model are manageable and easy to address.	4	4	2
The ITEA model is cost-effective in terms of implementation and ongoing use.	4	5	3
Total	**12**	**14**	**7**

Table 6.3.1.7 Dimension 7: Sustainability

Dimension 8: Ethical Considerations

Dimensions	Expert A	Expert B	Expert C
The ITEA model adequately protects the privacy of students and educators.	4	5	4
The ITEA model is free from biases and ensures fairness across different student groups.	4	4	4
The use of predictive analytics in the ITEA model is ethical and beneficial in the educational context.	4	5	3
Total	**12**	**14**	**11**

Table 6.3.1.8 Dimension 8: Sustainability

6.3.2 Mean Values of Expert Review Validation of ITEA model

Dimensions	Expert A	Expert B	Expert C	Mean
Q1 – Visibility	**12.00**	**15.00**	9.00	12.00
Q2 – Usability	**12.00**	14.00	7.00	11.00
Q3 – Effectiveness	**12.00**	12.00	9.00	11.00
Q4 – Reliability	**12.00**	13.00	**11.00**	11.00
Q5 – Scalability	**12.00**	13.00	7.00	**10.67**
Q6 – Integration	**12.00**	14.00	**11.00**	**12.33**
Q7 – Sustainability	**12.00**	14.00	7.00	**11.00**
Q8 – Ethical Considerations	**12.00**	14.00	**11.00**	**12.33**
Mean (All Experts)	96.00	109.00	72.00	11.42

Table 6.3.2 Mean Values of Expert Review Validation

As shown in Table 6.3.2, the mean values from the expert review reflect an overall positive alignment with the key evaluation criteria. The total mean values from the 8 dimensions evaluated are Expert A (96.00), Expert B (109.00), and Expert C (72.00). The total average value across all 8 dimensions from the three experts is 11.42.

As indicated in the table, all scores for the 8 dimensions are relatively high, with the lowest mean being 10.67 for scalability, suggesting that the model is perceived as generally effective but could improve in adapting to larger or more complex educational contexts. The highest-scoring dimensions were Integration and Ethical Considerations, both with a mean value of 12.33, demonstrating that the model is well-integrated with existing educational technologies and adheres to ethical standards.

The majority of the experts agreed that the ITEA model contains relevant phases and components, follows a logical flow, and is highly usable for development in the education sector. Additionally, the clarity of the model, with a mean score of 12.00, indicates that the model is easy to follow, and the activities are practical and applicable in real-world scenarios.

Finally, experts provided overall comments based on their understanding and perception of the model's clarity, phases, connections, and flow, as shown in Table 6.7. Their feedback suggests that while the model is highly workable and aligned with

educational development needs, improvements in scalability could enhance its overall effectiveness.

6.3.3 Further Comments of ITEA model

Experts	Comments and Suggestions
Expert A	• No comment
Expert B	• No
Expert C	• I personally think that the strategy of this item is not very effective. As a teacher, I personally think that the first is to establish basic concepts. This is because it can ensure that students understand the basic mathematical concepts and operation rules, rather than just memorizing formulas. Let them understand the principles behind them, such as the meaning of addition, subtraction, multiplication and division. Giving teachers extra special training is not training for students. The second thing I would recommend is practical application. For example, connect mathematics with life. Let students apply mathematics in daily life, such as shopping, calculating time, measuring distance, etc., so that they understand the practicality of mathematics.

Table 6.3.3 Further Comments of ITEA model

Based on Table 6.3.3, Expert A and Expert B provided no additional comments or suggestions. On the other hand, Expert C shared constructive feedback, recommending that the focus should be on establishing basic mathematical concepts rather than just training teachers. It emphasized the importance of helping students understand the principles behind mathematical operations instead of merely memorizing formulas. Expert C also suggested incorporating practical applications of mathematics, such as relating concepts to real-life activities like shopping and measuring distances, to enhance students' understanding of the subject's practicality.

6.4 Summary

The chapter 6 outlines the development of the Hierarchical Educational Support and Training (HEST) model, which aims to improve mathematics education by providing teachers with essential resources, strategies and professional development. The model

integrates key components like Professional Development Workshops, Mentoring, Collaborative Planning, Access to Resources and Student-Centred Learning Strategies.

The chapter also incorporates the SERVQUAL (2021) model to enhance instructional quality through dimensions like reliability, responsiveness, assurance, empathy and tangibles. These frameworks are combined to form the Integrated Teaching Effectiveness and Achievement (ITEA) model, which leverages data-driven approaches to improve student outcomes and personalize learning environments.

Lastly, the model evaluation involved a review by three experts, who provided positive feedback on the model's visibility, usability, effectiveness, reliability, integration, sustainability, and ethical considerations. The average score across these dimensions was 11.42, showing overall support for the model, though some improvements were suggested, particularly in terms of scalability and practical application in real-life scenarios. One expert emphasized focusing on teaching fundamental mathematical concepts and applying them in practical, everyday contexts to enhance learning.

CHAPTER 7

Discussion and Conclusion

7.0 Introduction

The chapter evaluates the research objectives, challenges, limitations and future directions for the study based on expert feedback and findings from the predictive analytics approach.

7.1 Achievement of Research Objectives

Objective 1: To Identify Impactful Teaching Techniques for mathematics subjects.

The research was to identify teaching techniques that significantly impact students' performance in mathematics subjects. Based on the survey results and expert reviews, this objective has been **successfully achieved**. The majority of respondents (76.1%) favoured the Comprehensive Support and Training technique, which emphasized providing teachers with necessary resources and professional development. This technique was identified as having the most significant impact on student performance. The expert reviews also supported the findings, with two out of three experts positively rating the clarity and comprehensiveness of the model in highlighting impactful teaching techniques. Therefore, the research successfully identified techniques that can enhance students' mathematics performance.

Objective 2: To develop conceptual model for mathematics subjects.

This stage was to develop a model that integrates impactful teaching techniques using the SERVQUAL framework and data-driven methodologies. The Integrated Teaching Effectiveness and Achievement (ITEA) model was designed to incorporate key components such as tangibles, reliability, responsiveness, assurance and empathy. It alongside adaptive learning platforms, predictive analytics for personalized learning paths and data-driven professional development programs.

The model builds upon the Hierarchical Educational Support and Training (HEST) framework, which emphasizes access to teaching resources, mentoring and student-centred strategies. This layered approach allows for a flexible and adaptive learning environment that can be tailored to the diverse needs of students. By employing predictive analytics, the ITEA model can forecast student performance and

provide continuous feedback to refine instructional practices. This positions the ITEA model as a robust, data-driven framework aimed at enhancing mathematics teaching and improving student outcomes.

Based on the expert reviews, this objective was **partially achieved**. While the majority of experts acknowledged the model's effectiveness in addressing traditional inefficiencies, one expert noted that further refinement is necessary, particularly in terms of usability for educators with lower technical expertise. Overall, the ITEA model made significant progress in addressing the shortcomings of traditional teaching methods, but ongoing enhancements are required to fully resolve these inefficiencies across diverse educational contexts.

Objective 3: To evaluate the ITEA model by using expert review.

The research focused on evaluating the ITEA model through expert reviews to assess its effectiveness in fostering personalized learning environments. The expert review process covered eight key dimensions: visibility, usability, effectiveness, reliability, scalability, integration, sustainability and ethical considerations. The experts generally agreed that the model effectively addressed many of the challenges faced in traditional mathematics instruction. However, usability for educators with lower technical expertise was identified as a limitation. Despite this, the model was deemed scalable and adaptable, with significant potential for enhancing teaching strategies and fostering sustainable instructional practices. As such, this objective was **largely achieved** and though improvements in user-friendliness are recommended for future iterations of the model.

7.2 Challenges and Limitations

The expert review revealed a few challenges, particularly concerning the user-friendliness of the ITEA model. While the clarity and scope of the model were praised, its accessibility for educators with less technical expertise was highlighted as a limitation. Another challenge was the small sample size of experts, which may have affected the comprehensiveness of the feedback. Future studies should consider incorporating a larger group of reviewers from diverse backgrounds.

7.3 Future Work

Based on the expert review results, the following suggestions for future work are made:

1. **Enhancing User-Friendliness**

   As some experts highlighted issues with the model's accessibility for users with lower technical proficiency, future work should focus on refining the interface to make it more intuitive and user-friendly.

2. **Broadening the Evaluation of the Model**

   The study should expand its scope by involving more educators and stakeholders in future reviews to gather a more diverse range of feedback. This will help ensure that the model is adaptable to different teaching environments.

3. **Improving Personalization**

   The model's ability to support personalised instruction needs to be further developed. Future iterations should focus on enhancing its adaptability to cater to a wider variety of learning styles and preferences.

4. **Implement New Dimension: Instructional Strategies**

   The new dimension focused on enhancing instructional strategies to improve the effectiveness of the model. This involves developing features that emphasize foundational understanding by helping students grasp the core principles behind mathematical concepts, rather than merely memorizing formulas. The model should also incorporate practical applications and connecting mathematical theories to real-life scenarios such as budgeting or measurement tasks, thereby demonstrating their relevance and utility. Additionally, supporting educators with resources and training materials to effectively apply these strategies will be crucial. These improvements aim to deepen students' comprehension, increase their engagement by highlighting the practical value of mathematics and provide educators with the tools needed to implement effective teaching practices.

7.4 Conclusion

In conclusion, the research objectives have been largely met, although there are areas that require further development. The ITEA model has successfully identified impactful teaching techniques and addressed some inefficiencies in traditional approaches. However, challenges remain in improving its user-friendliness and personalization capabilities. With continued refinement and broader testing, the ITEA model holds promise for enhancing mathematics education through predictive analytics.

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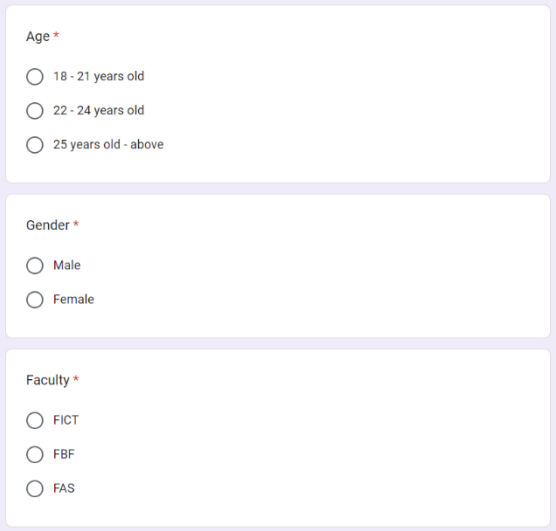
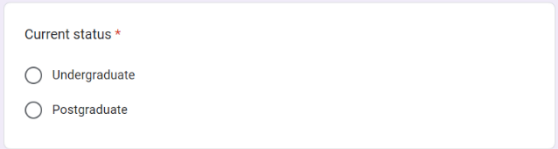
APPENDIX

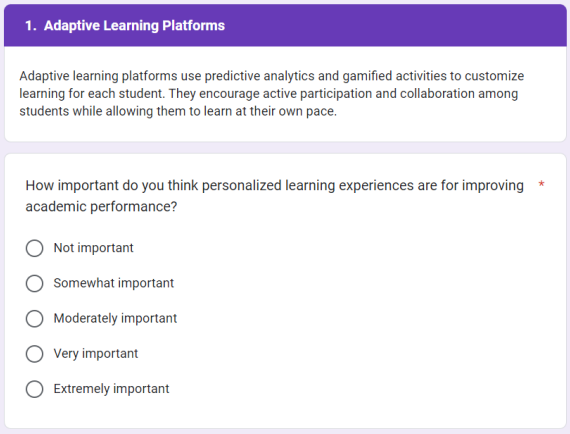
Questionnaire Sample

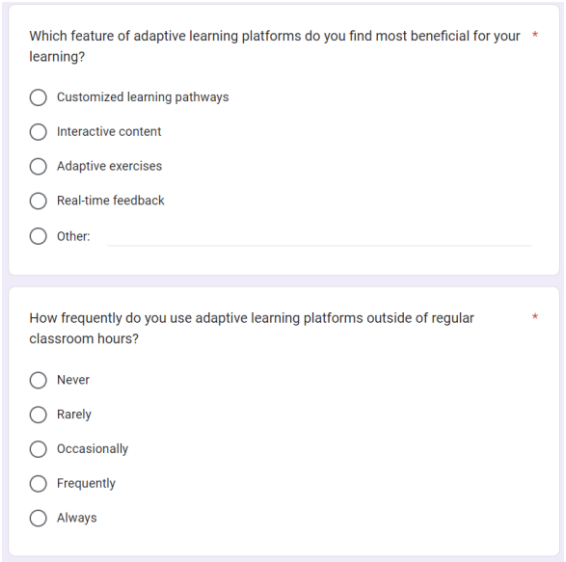
1. Demographic

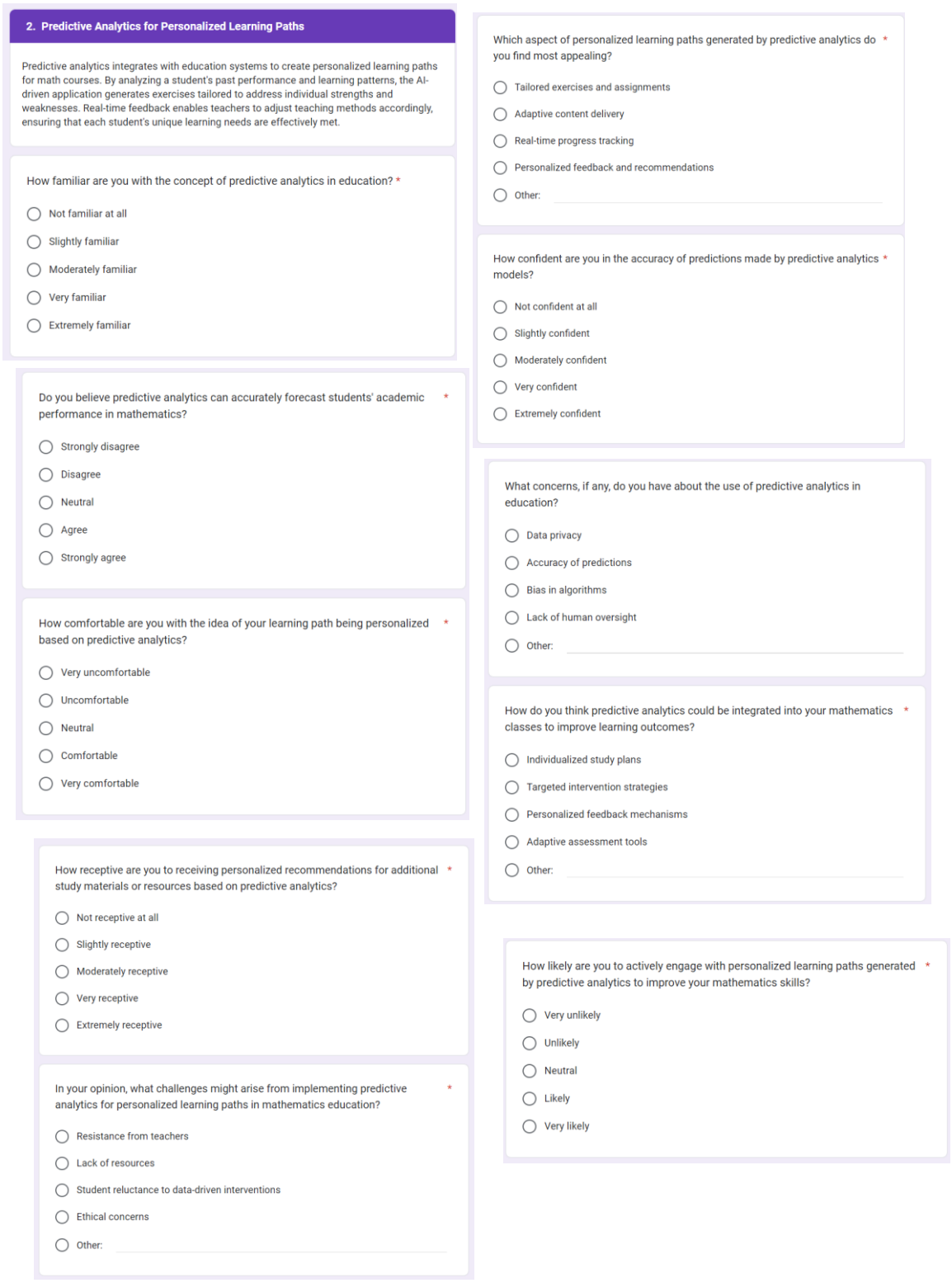




2. Proposed Solutions as Survey Techniques







2. Predictive Analytics for Personalized Learning Paths

Predictive analytics integrates with education systems to create personalized learning paths for math courses. By analyzing a student's past performance and learning patterns, the AI-driven application generates exercises tailored to address individual strengths and weaknesses. Real-time feedback enables teachers to adjust teaching methods accordingly, ensuring that each student's unique learning needs are effectively met.

How familiar are you with the concept of predictive analytics in education? *
- Not familiar at all
- Slightly familiar
- Moderately familiar
- Very familiar
- Extremely familiar

Do you believe predictive analytics can accurately forecast students' academic performance in mathematics? *
- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

How comfortable are you with the idea of your learning path being personalized based on predictive analytics? *
- Very uncomfortable
- Uncomfortable
- Neutral
- Comfortable
- Very comfortable

How receptive are you to receiving personalized recommendations for additional study materials or resources based on predictive analytics? *
- Not receptive at all
- Slightly receptive
- Moderately receptive
- Very receptive
- Extremely receptive

In your opinion, what challenges might arise from implementing predictive analytics for personalized learning paths in mathematics education? *
- Resistance from teachers
- Lack of resources
- Student reluctance to data-driven interventions
- Ethical concerns
- Other:

Which aspect of personalized learning paths generated by predictive analytics do you find most appealing? *
- Tailored exercises and assignments
- Adaptive content delivery
- Real-time progress tracking
- Personalized feedback and recommendations
- Other:

How confident are you in the accuracy of predictions made by predictive analytics models? *
- Not confident at all
- Slightly confident
- Moderately confident
- Very confident
- Extremely confident

What concerns, if any, do you have about the use of predictive analytics in education?
- Data privacy
- Accuracy of predictions
- Bias in algorithms
- Lack of human oversight
- Other:

How do you think predictive analytics could be integrated into your mathematics classes to improve learning outcomes? *
- Individualized study plans
- Targeted intervention strategies
- Personalized feedback mechanisms
- Adaptive assessment tools
- Other:

How likely are you to actively engage with personalized learning paths generated by predictive analytics to improve your mathematics skills? *
- Very unlikely
- Unlikely
- Neutral
- Likely
- Very likely

3. Data-Driven Professional Development Program

Data-driven professional development uses predictive analytics to identify teacher needs. Online courses focus on technology integration in mathematics education. Peer groups and coaching programs promote collaboration for continuous improvement.

How important do you think continuous professional development is for educators? *

- Not important
- Somewhat important
- Moderately important
- Very important
- Extremely important

What types of professional development opportunities do you find most beneficial for improving teaching practices? *

- Workshops and seminars
- Online courses and webinars
- Peer coaching and mentoring
- Job rotation and shadowing
- Other:

How satisfied are you with the current professional development programs offered at your institution? *

- Very dissatisfied
- Dissatisfied
- Neutral
- Satisfied
- Very satisfied

In what areas do you feel you need further professional development support? *

- Technology integration
- Classroom management
- Differentiated instruction
- Assessment strategies
- Other:

How well do you think your institution supports ongoing professional development for educators? *

- Very poorly
- Poorly
- Neutral
- Well
- Very well

Do you believe that professional development programs effectively prepare educators to integrate technology into their teaching practices? *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

What barriers, if any, do you encounter when participating in professional development activities? *

- Lack of time
- Lack of funding
- Limited resources
- Institutional resistance
- Other:

How often do you engage in self-directed professional development activities outside of formal programs? *

- Never
- Rarely
- Occasionally
- Frequently
- Always

How important do you think collaboration among educators is for effective professional development? *

- Not important
- Somewhat important
- Moderately important
- Very important
- Extremely important

How likely are you to participate in professional development programs focused on technology integration to improve your teaching practices? *

- Very unlikely
- Unlikely
- Neutral
- Likely
- Very likely

3. Data-Driven Professional Development Program

Data-driven professional development uses predictive analytics to identify teacher needs. Online courses focus on technology integration in mathematics education. Peer groups and coaching programs promote collaboration for continuous improvement.

How important do you think continuous professional development is for educators? *

- Not important
- Somewhat important
- Moderately important
- Very important
- Extremely important

What types of professional development opportunities do you find most beneficial for improving teaching practices? *

- Workshops and seminars
- Online courses and webinars
- Peer coaching and mentoring
- Job rotation and shadowing
- Other:

How satisfied are you with the current professional development programs offered at your institution? *

- Very dissatisfied
- Dissatisfied
- Neutral
- Satisfied
- Very satisfied

In what areas do you feel you need further professional development support? *

- Technology integration
- Classroom management
- Differentiated instruction
- Assessment strategies
- Other:

How well do you think your institution supports ongoing professional development for educators? *

- Very poorly
- Poorly
- Neutral
- Well
- Very well

Do you believe that professional development programs effectively prepare educators to integrate technology into their teaching practices? *

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

What barriers, if any, do you encounter when participating in professional development activities? *

- Lack of time
- Lack of funding
- Limited resources
- Institutional resistance
- Other:

How often do you engage in self-directed professional development activities outside of formal programs? *

- Never
- Rarely
- Occasionally
- Frequently
- Always

How important do you think collaboration among educators is for effective professional development? *

- Not important
- Somewhat important
- Moderately important
- Very important
- Extremely important

How likely are you to participate in professional development programs focused on technology integration to improve your teaching practices? *

- Very unlikely
- Unlikely
- Neutral
- Likely
- Very likely

5. Continuous Assessment

Use predictive analytics for continuous evaluation. Analyze educator and student feedback on teaching methods. Adapting strategies to trends in improving mathematics student achievement.

How valuable do you find continuous assessment in improving learning outcomes? *

- Not valuable at all
- Slightly valuable
- Moderately valuable
- Very valuable
- Extremely valuable

What types of assessments do you believe are most effective for tracking student progress in mathematics? *

- Quizzes and tests
- Homework assignments
- Project-based assessments
- Peer evaluations
- Other: _____

How frequently do you receive feedback on your academic performance in mathematics? *

- Never
- Rarely
- Occasionally
- Frequently
- Always

How well do you think continuous assessment using predictive analytics aligns with your learning preferences? *

- Not well at all
- Slightly well
- Moderately well
- Very well
- Extremely well

How likely are you to actively engage with continuous assessment tools powered by predictive analytics to improve your mathematics skills? *

- Very unlikely
- Unlikely
- Neutral
- Likely
- Very likely

How well do you think traditional assessment methods capture your understanding of mathematical concepts? *

- Not well at all
- Slightly well
- Moderately well
- Very well
- Extremely well

How confident are you in the accuracy of predictions made by predictive analytics models for your academic performance? *

- Not confident at all
- Slightly confident
- Moderately confident
- Very confident
- Extremely confident

What challenges, if any, do you foresee in implementing predictive analytics for continuous assessment in mathematics education? *

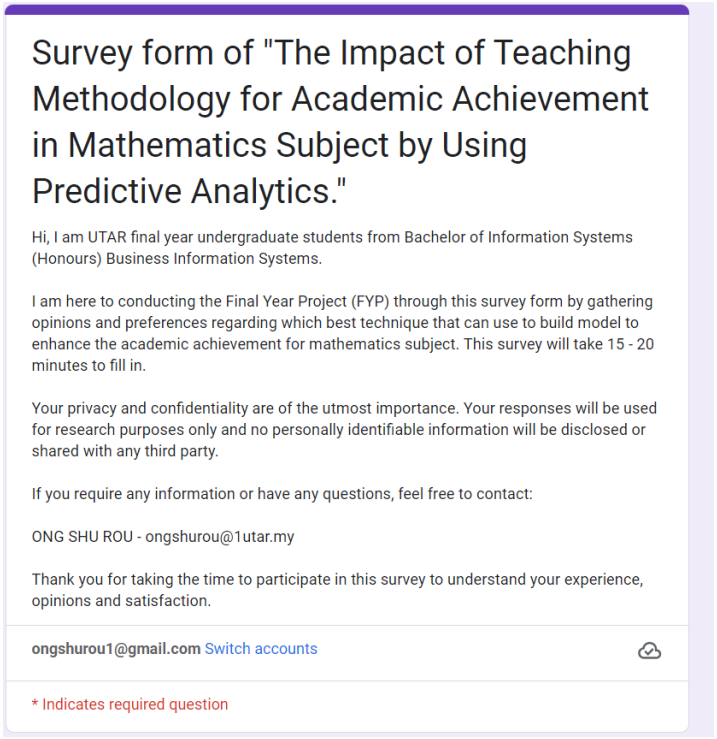
- Lack of teacher expertise
- Resistance to data-driven interventions
- Ethical concerns about data privacy
- Limited access to technology
- Other: _____

How would you prefer to receive feedback on your academic performance in mathematics? *

- Written comments
- Verbal feedback
- Visual representations (graphs, charts)
- Digital reports
- Other: _____

How important do you think it is for educators to use continuous assessment tools to tailor their teaching methods to individual student needs? *

- Not important
- Somewhat important
- Moderately important
- Very important
- Extremely important



Survey form of "The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics."

Hi, I am UTAR final year undergraduate students from Bachelor of Information Systems (Honours) Business Information Systems.

I am here to conducting the Final Year Project (FYP) through this survey form by gathering opinions and preferences regarding which best technique that can use to build model to enhance the academic achievement for mathematics subject. This survey will take 15 - 20 minutes to fill in.

Your privacy and confidentiality are of the utmost importance. Your responses will be used for research purposes only and no personally identifiable information will be disclosed or shared with any third party.

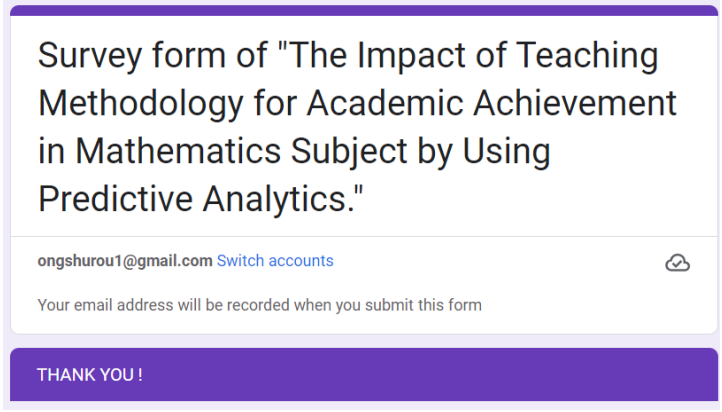
If you require any information or have any questions, feel free to contact:

ONG SHU ROU - ongshurou@1utar.my

Thank you for taking the time to participate in this survey to understand your experience, opinions and satisfaction.

ongshurou1@gmail.com Switch accounts

* Indicates required question



Survey form of "The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics."

ongshurou1@gmail.com Switch accounts

Your email address will be recorded when you submit this form

THANK YOU !

3. Expert Review

- **Google Form for survey**

Expert Review of the ITEA Model for Enhancing Student Academic Performance in Mathematics

Dear Dr, Sir, Ms,

Thank you for agreeing to participate in the expert review of the ITEA (Integrated Teaching Effectiveness and Achievement) model. This model has been developed as part of a Final Year Project 2 (FYP2) at Universiti Tunku Abdul Rahman (UTAR) to explore the impact of predictive analytics on improving students' academic performance, specifically in mathematics.

The ITEA model is designed to integrate advanced teaching strategies with predictive analytics to provide a personalized learning experience for students. It aims to address the inefficiencies of traditional teaching methods by offering adaptive, data-driven solutions that enhance both instructional practices and student outcomes.

Your expertise and insights are crucial in evaluating the effectiveness, usability, scalability and ethical considerations of the ITEA model. Your feedback will help refine the model and ensure its relevance and applicability in real-world educational settings.

Please take a few minutes to complete the following questionnaire. Your responses will be kept confidential and will be used solely for research purposes.

Thank you for your valuable time and contribution.

Best regards,

Ong Shu Rou
Final Year Student, Universiti Tunku Abdul Rahman (UTAR)

Section B: Background of Respondents

Age *

- ○ 21 - 25 years old
- ○ 26 - 30 years old
- ◉ 31 - 35 years old
- ○ 36 years old and above
- ○ Other:

Highest Education Level *

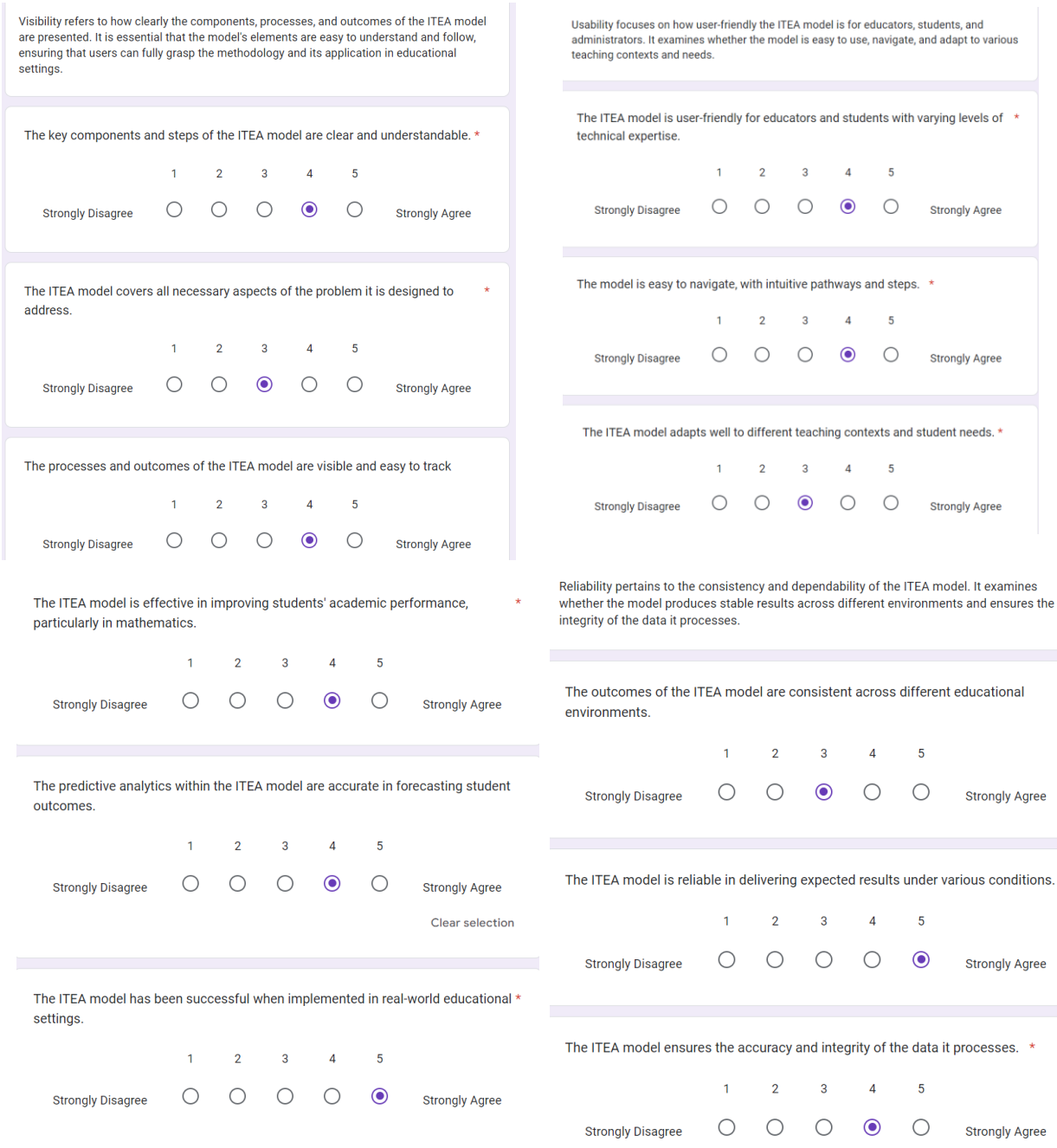
- ○ Bachelor's Degree
- ◉ Master's Degree
- ○ Doctorate (PhD)
- ○ Postdoctoral
- ○ Professional Degree (e.g., MD, JD)
- ○ Other:

Gender *

- ◉ Male
- ○ Female

Years of Teaching Experience *

- ○ 0 - 5 years
- ◉ 6 - 10 years
- ○ 11 - 15 years
- ○ 16 - 20 years
- ○ 25 years and above



Visibility refers to how clearly the components, processes, and outcomes of the ITEA model are presented. It is essential that the model's elements are easy to understand and follow, ensuring that users can fully grasp the methodology and its application in educational settings.

The key components and steps of the ITEA model are clear and understandable. *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ◉ ○ Strongly Agree

The ITEA model covers all necessary aspects of the problem it is designed to address. *

1 2 3 4 5

Strongly Disagree ○ ○ ◉ ○ ○ Strongly Agree

The processes and outcomes of the ITEA model are visible and easy to track

1 2 3 4 5

Strongly Disagree ○ ○ ○ ◉ ○ Strongly Agree

The ITEA model is effective in improving students' academic performance, particularly in mathematics. *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ◉ ○ Strongly Agree

The predictive analytics within the ITEA model are accurate in forecasting student outcomes.

1 2 3 4 5

Strongly Disagree ○ ○ ○ ◉ ○ Strongly Agree

Clear selection

The ITEA model has been successful when implemented in real-world educational settings. *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ◉ Strongly Agree

Usability focuses on how user-friendly the ITEA model is for educators, students, and administrators. It examines whether the model is easy to use, navigate, and adapt to various teaching contexts and needs.

The ITEA model is user-friendly for educators and students with varying levels of technical expertise. *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ◉ ○ Strongly Agree

The model is easy to navigate, with intuitive pathways and steps. *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ◉ ○ Strongly Agree

The ITEA model adapts well to different teaching contexts and student needs. *

1 2 3 4 5

Strongly Disagree ○ ○ ◉ ○ ○ Strongly Agree

Reliability pertains to the consistency and dependability of the ITEA model. It examines whether the model produces stable results across different environments and ensures the integrity of the data it processes.

The outcomes of the ITEA model are consistent across different educational environments. *

1 2 3 4 5

Strongly Disagree ○ ○ ◉ ○ ○ Strongly Agree

The ITEA model is reliable in delivering expected results under various conditions. *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ◉ Strongly Agree

The ITEA model ensures the accuracy and integrity of the data it processes. *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ◉ ○ Strongly Agree

Scalability addresses the ITEA model's ability to be expanded and adapted to larger datasets or more complex educational systems. It also considers the model's flexibility and resource efficiency when scaled.

The ITEA model can be easily scaled to accommodate larger datasets or more complex educational systems. *

	1	2	3	4	5	
Strong Disagree	○	○	○	◉	○	Strong Agree

The model allows for customization and scaling without compromising its core functionality. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	◉	○	Strongly Agree

The ITEA model efficiently uses resources when scaled up for larger implementations. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	◉	Strongly Agree

Integration explores how well the ITEA model works with existing educational technologies and platforms. This section assesses the model's compatibility, interoperability, and support for collaboration among educators and students.

The ITEA model integrates well with existing educational technologies and platforms. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	◉	○	Strongly Agree

The model is interoperable with other tools and systems commonly used in educational settings. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	◉	Strongly Agree

The ITEA model supports collaborative efforts among educators, students, and administrators. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	◉	○	Strongly Agree

Sustainability examines the ITEA model's long-term viability and ease of maintenance. It considers whether the model can be effectively used over time and how cost-effective it is for educational institutions.

The ITEA model is sustainable for long-term use in educational institutions. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	◉	○	Strongly Agree

The maintenance requirements of the ITEA model are manageable and easy to address. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	◉	○	Strongly Agree

The ITEA model is cost-effective in terms of implementation and ongoing use. *

	1	2	3	4	5	
Strongly Disagree	○	○	◉	○	○	Strong Agree

Ethical Considerations focus on the moral and ethical implications of using the ITEA model. This includes data privacy, fairness, and the ethical use of predictive analytics in educational contexts.

The ITEA model adequately protects the privacy of students and educators. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	◉	Strongly Agree

The ITEA model is free from biases and ensures fairness across different student groups. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	◉	○	Strongly Agree

The use of predictive analytics in the ITEA model is ethical and beneficial in the educational context. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	◉	○	Strongly Agree

APPENDIX

Please provide the following details about your institution. This information will help us understand the context of your responses and ensure that feedback is accurately attributed.

Institution *

xx

Phone Number (Example: 012-1111111) *

011

Email (Example: ongxx@gmail.com) *

xxx

Address of Institution (Example: Jalan Universiti, 31900 Kampar, Perak) *

xxx

SECTION E: VALIDATION BY EXPERT (The ITEA Model)

In this section, it invite you to provide your expert evaluation of the ITEA Model. Your insights and feedback are crucial in validating the model's effectiveness, usability and applicability in educational settings. Please assess the following aspects of the model based on your expertise.

I hereby certify and validate that the "**Integrated Teaching Effectiveness and Achievement (ITEA) Model**" produced by the researchers from Universiti Tunku Abdul Rahman (UTAR) is suitable to be used as a conceptual model for enhancing student academic performance in mathematics through predictive analytics. It has been reviewed, and the general comments are as follows: *

General Comments:

Your answer

- **Expert Review introduction model document**

Dear Dr, Sir, Ms,

EXPERT REVIEW OF INTEGRATED TEACHING EFFECTIVENESS AND ACHIEVEMENT (ITEA) MODEL

I am Ong Shu Rou and currently I am doing my Final Year Project 2 (FYP2) at Universiti Tunku Abdul Rahman (UTAR). I am excited to inform you that you have been selected to contribute to my research.

My FYP2 research proposes the **Integrated Teaching Effectiveness and Achievement (ITEA) Model** which investigates the impact of predictive analytics on students' academic performance in mathematics. The purpose of this study is to explore the relationship between teaching strategies, mathematics proficiency and the use of predictive analytics to enhance student learning. As part of this research, I have developed a model that requires expert evaluation on several dimensions as outlined in the attached review form.

Your expertise, experiences and insights are invaluable to this research. Also, I would greatly appreciate it if you could take the time to complete the evaluation. Please rest assured that your responses will be treated with the utmost confidentiality and will only be used for research purposes. The findings may be reported anonymously in academic publications.

Should you have any questions or require further clarification, please do not hesitate to contact me at my email (ongshurou@1utar.my) or my supervisor, Dr. Shakiroh binti Khamis (shakiroh@utar.edu.my).

Thank you for your time and assistance.

Best Regards,

Dr. Shakiroh binti Khamis

Ong Shu Rou

SECTION A: MODEL OVERVIEW AND EXPLANATIONS

The ITEA Model is designed to improve mathematics education by integrating best practices from educational research and theory. Below are the key components of the model:

1. **Access to Teaching Resources**: High-quality resources like textbooks and digital tools.
2. **Collaborative Planning and Team Teaching**: Emphasizing collaboration among educators.
3. **Mentoring and Coaching**: Personalized support for educators.
4. **Professional Development Workshops**: Regular updates on teaching strategies.
5. **Student-Centred Learning Strategies**: Promoting active learning and engagement.
6. **Data-Driven Decision-Making**: Using data to continuously improve teaching practices.

Instructions:
Please review the components above and provide your evaluation in the subsequent sections.

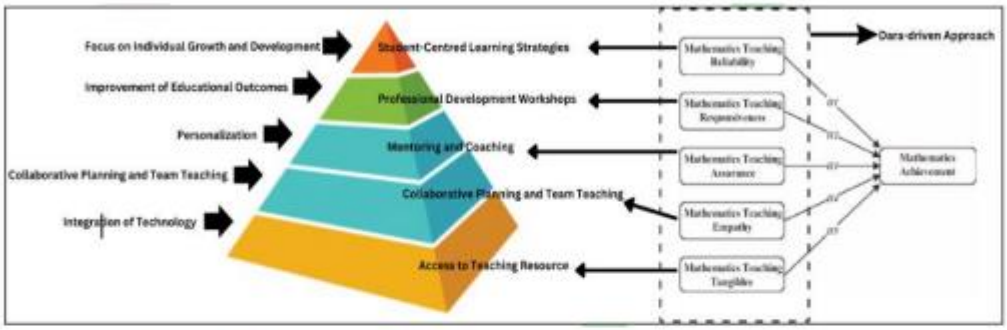
INSTRUCTIONS FOR EXPERTS

This Google Form (https://forms.gle/eqUta2SmpMU6DfTz8) is structured to guide you through the evaluation process of the ITEA Model. It will offer a detailed overview and explanation of the ITEA Model. Also, it will provide instructions for experts on how to complete the form. It contains the Evaluation Form with questions aimed at validating the ITEA Model. Your feedback in this section will assess the model across various dimensions.

- **SECTION B**: Collects Background of Respondents to help us contextualize your feedback and ensure that responses are accurately attributed.
- **SECTION C**: Provides Evaluation Form to let respondents to answer. It contains 8 sections with 3 sub-questions in both section which are visibility, usability, effectiveness, reliability, scalability, integration, sustainability and ethical considerations.
- **SECTION D**: Collects Institutional Information of respondents. The information will help to understand the context of respondent's responses and ensure that feedback is accurately attributed
- **SECTION E:** Validation by Expert regarding ITEA model. It invites to provide expert evaluation of the ITEA Model. The insights and feedback are crucial in validating the model's effectiveness, usability and applicability in educational settings.

Please ensure that you complete each section thoroughly. Your insights are crucial in validating and refining the ITEA Model.

SECTION A: INTEGRATED TEACHING EFFECTIVENESS AND ACHIEVEMENT (ITEA) MODEL



The ITEA Model is designed to address the challenges faced in traditional mathematics education by providing a structured approach that incorporates the best practices from educational research and theory. The model is organized into several key components, each of which plays a critical role in improving teaching effectiveness and student outcomes.

Key Components of the ITEA Model

1. **Access to Teaching Resources:**
    - At the foundation of the ITEA Model is the provision of high-quality teaching resources, including textbooks, digital tools and supplementary materials. These resources are essential for effective lesson planning and delivery, ensuring that educators are well-equipped to engage students and facilitate learning.
2. **Collaborative Planning and Team Teaching:**
    - The model emphasizes the importance of collaboration among educators. Teachers work together to plan lessons, share resources and co-teach classes, fostering a culture of continuous improvement and innovation in teaching practices.
3. **Mentoring and Coaching:**
    - Personalized support through mentoring and coaching is provided to educators, particularly those who are less experienced. This guidance helps teachers overcome classroom challenges and enhances their professional development, leading to more effective teaching strategies.
4. **Professional Development Workshops:**

- Regular workshops are a key feature of the ITEA Model, designed to keep educators updated on the latest teaching strategies, technological advancements and educational trends. These workshops ensure that teachers continue to grow professionally and are able to implement the most effective teaching practices.

5. **Student-Centred Learning Strategies:**
    - At the top of the model, student-centred learning strategies are implemented to promote active learning and engagement. Techniques such as group discussions, peer tutoring and problem-based learning are used to encourage critical thinking and personalized learning experiences.

Data-Driven Decision-Making

A critical aspect of the ITEA Model is its reliance on data-driven approaches to continuously monitor and improve teaching practices and student performance. By systematically collecting and analysing data, educators can make informed decisions that enhance instructional effectiveness and address the specific needs of their students. This approach not only supports real-time adjustments in teaching but also contributes to long-term educational improvements.

Theoretical Foundations

The development of the ITEA Model is grounded in well-established research and theories, including:

- **SERVQUAL Model by Hamdi Serin et al. (2021):** This model informs the dimensions of reliability, responsiveness, assurance, empathy and tangibles within the ITEA framework.
- **Knowledge Data Discovery Process (KDD):** This process supports the model's data-driven decision-making by providing a structured approach to extracting meaningful insights from educational data.
- **Adaptive Learning Technologies:** Insights from research on adaptive learning systems, which personalize instruction based on individual student performance are integrated into the model to enhance student engagement and success.

Practical Application and Continuous Improvement

The ITEA Model is designed for practical implementation in educational settings. It supports continuous professional development, encourages collaborative planning and integrates adaptive technologies to ensure that teaching practices remain effective and responsive to the needs of students. The model also emphasizes the importance of continuous evaluation and refinement, ensuring that it evolves to meet the changing demands of education.

Conclusion

It believes that the ITEA Model offers a robust and adaptable framework for improving mathematics education. By combining theoretical insights with practical strategies, the model provides a comprehensive approach to enhancing teaching effectiveness and student achievement. Therefore, your expert feedback on the model is invaluable in helping us refine and validate its components and applications.

It invites you to review the ITEA Model carefully and provide your insights on its effectiveness, usability and potential impact in educational settings through google form (https://forms.gle/eqUta2SmpMU6DfTz8).

VALIDATION BY EXPERT

Signature : _____

Name : _____

Experience in teaching: _____

Qualification: _____

Name and address of Institution/University:

_____

_____

_____

_____

Institution stamp (if applicable): Date: _____

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: S2, Y3	**Study week no.: 3**
Student Name & ID: ONG SHU ROU 22ACB00520	
Supervisor: DR. SHAKIROH BINTI KHAMIS	
Project Title: The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Chapter 1,2,3,4,5

2. WORK TO BE DONE

- Discuss Chapter 6.1 Model Evaluation

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

- Work done in self's expectation
- Work under control

shurou

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: S2, Y3	**Study week no.: 4**
Student Name & ID: ONG SHU ROU 22ACB00520	
Supervisor: DR. SHAKIROH BINTI KHAMIS	
Project Title: The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Discuss Chapter 6.1 Comprehensive Support and Training

2. WORK TO BE DONE

- Discuss Chapter 6.2 Model Evaluation

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

- Work done in self's expectation
- Work under control

shurou

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: S2, Y3	**Study week no.: 5**
Student Name & ID: ONG SHU ROU 22ACB00520	
Supervisor: DR. SHAKIROH BINTI KHAMIS	
Project Title: The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done Chapter 6.2 Model Evaluation

2. WORK TO BE DONE

- Finalise model in Chapter 6.2
- Chapter 6.3 Summary

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

- Work done in self's expectation
- Work under control

Supervisor's signature

shuron

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: S2, Y3	**Study week no.: 6**
Student Name & ID: ONG SHU ROU 22ACB00520	
Supervisor: DR. SHAKIROH BINTI KHAMIS	
Project Title: The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done build finalise model in Chapter 6.2
- Done Chapter 6.3 Summary

2. WORK TO BE DONE

- Build expert review question

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

- Work done in self's expectation
- Work under control

Supervisor's signature

shuron

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: S2, Y3	**Study week no.: 7**
Student Name & ID: ONG SHU ROU 22ACB00520	
Supervisor: DR. SHAKIROH BINTI KHAMIS	
Project Title: The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done build expert review question

2. WORK TO BE DONE

- Share expert review question to 3 lecturer or teacher in UTAR or outside UTAR

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

- Work done in self's expectation
- Work under control

shuron

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: S2, Y3	**Study week no.: 8**
Student Name & ID: ONG SHU ROU 22ACB00520	
Supervisor: DR. SHAKIROH BINTI KHAMIS	
Project Title: The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

2. WORK TO BE DONE

- Share expert review question to 3 lecturer or teacher in UTAR or outside UTAR

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

- Work done in self's expectation
- Work under control

shuron

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: S2, Y3	**Study week no.: 9**
Student Name & ID: ONG SHU ROU 22ACB00520	
Supervisor: DR. SHAKIROH BINTI KHAMIS	
Project Title: The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

2. WORK TO BE DONE

- Share expert review question to 3 lecturer or teacher in UTAR or outside UTAR

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

- Work done in self's expectation
- Work under control

shuron

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: S2, Y3	**Study week no.: 10**
Student Name & ID: ONG SHU ROU 22ACB00520	
Supervisor: DR. SHAKIROH BINTI KHAMIS	
Project Title: The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done share expert review question to 3 lecturer or teacher in UTAR or outside UTAR

2. WORK TO BE DONE

- Chapter 7 Discussion and Conclusion

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

- Work done in self's expectation
- Work under control

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: S2, Y3	**Study week no.: 11**
Student Name & ID: ONG SHU ROU 22ACB00520	
Supervisor: DR. SHAKIROH BINTI KHAMIS	
Project Title: The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics.	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done Chapter 7 Discussion and Conclusion

2. WORK TO BE DONE

- Compile whole document

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

- Work done in self's expectation
- Work under control

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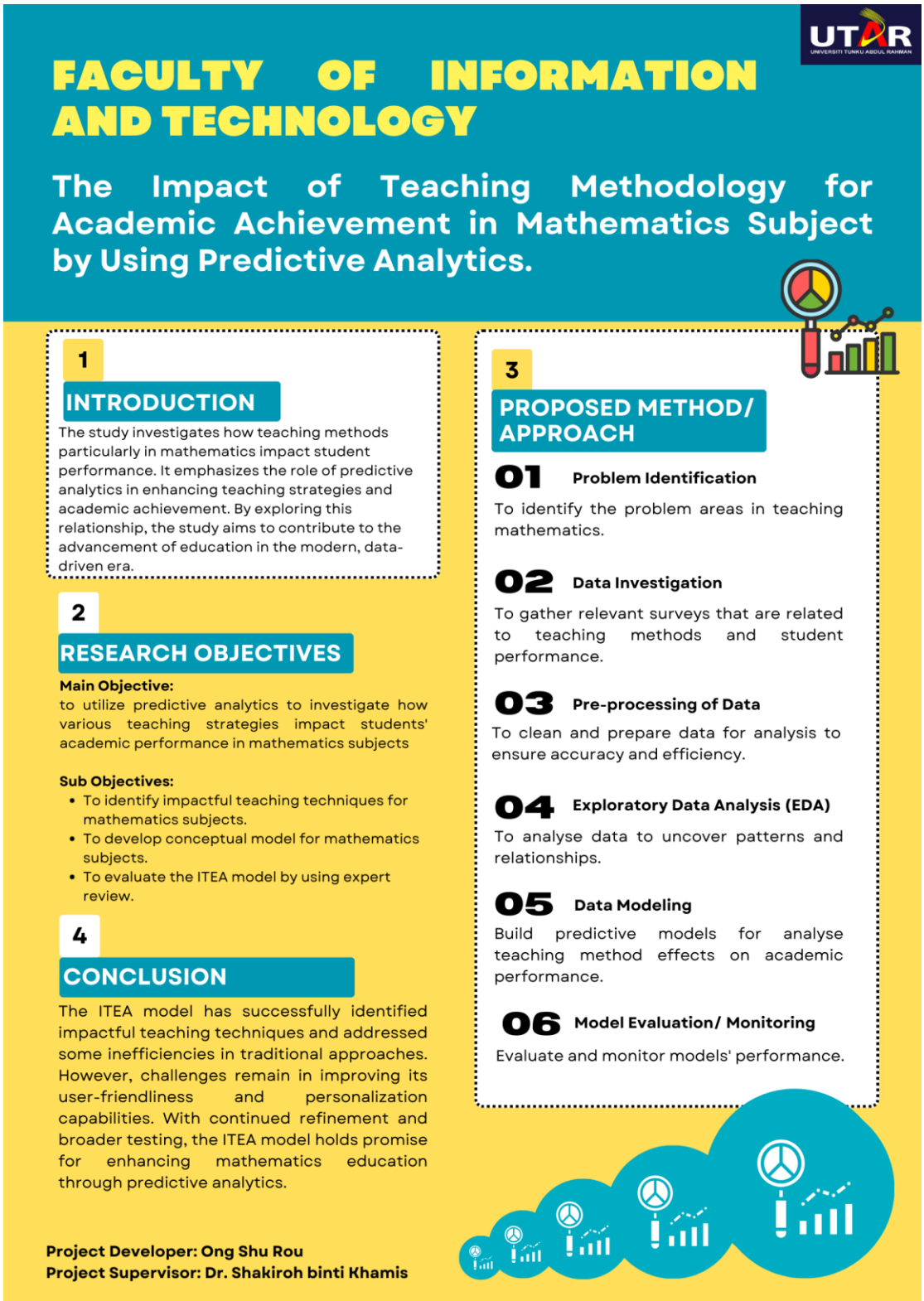
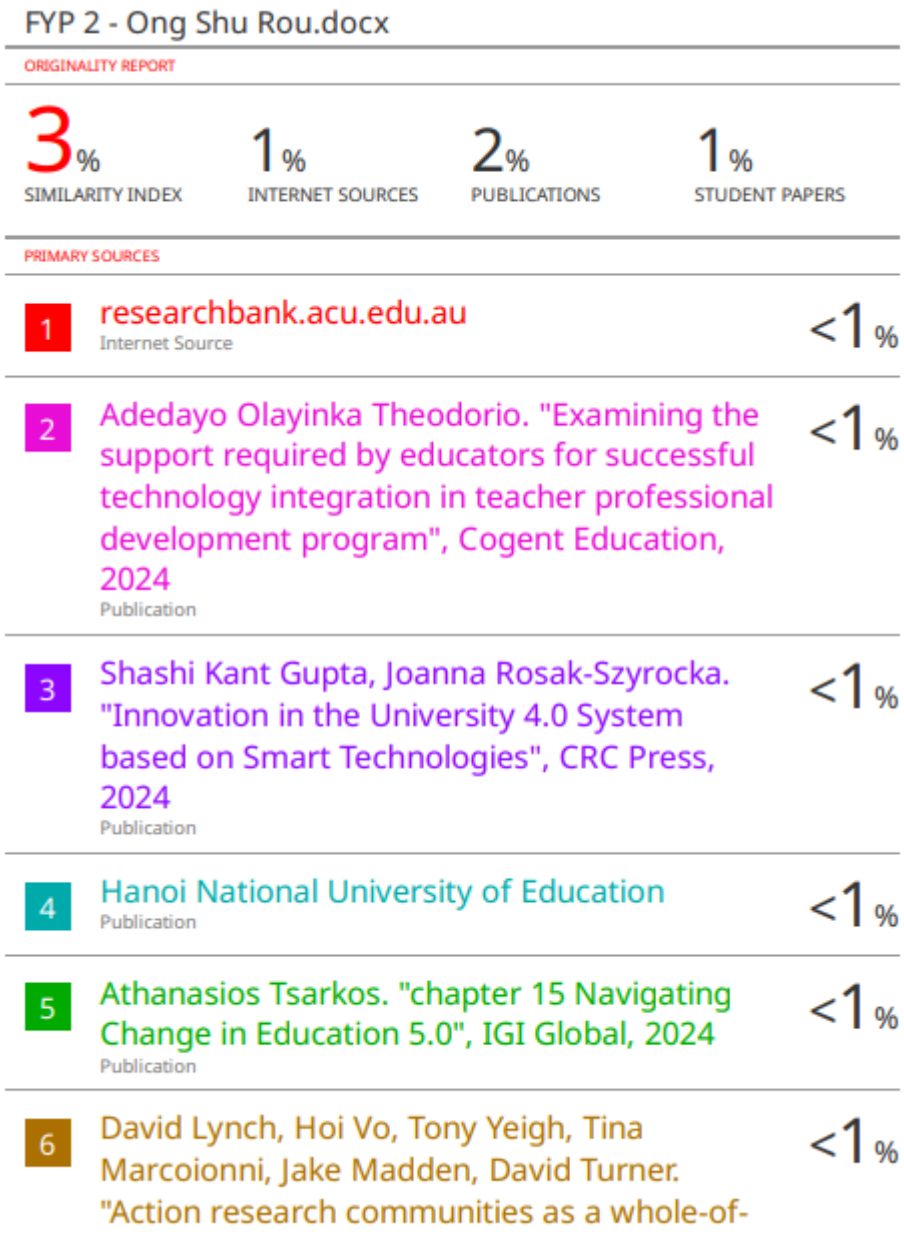

FACULTY OF INFORMATION AND TECHNOLOGY
The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics.
1
INTRODUCTION
The study investigates how teaching methods particularly in mathematics impact student performance. It emphasizes the role of predictive analytics in enhancing teaching strategies and academic achievement. By exploring this relationship, the study aims to contribute to the advancement of education in the modern, data-driven era.
2
RESEARCH OBJECTIVES
Main Objective:
to utilize predictive analytics to investigate how various teaching strategies impact students' academic performance in mathematics subjects
Sub Objectives:
• To identify impactful teaching techniques for mathematics subjects.
• To develop conceptual model for mathematics subjects.
• To evaluate the ITEA model by using expert review.
4
CONCLUSION
The ITEA model has successfully identified impactful teaching techniques and addressed some inefficiencies in traditional approaches. However, challenges remain in improving its user-friendliness and personalization capabilities. With continued refinement and broader testing, the ITEA model holds promise for enhancing mathematics education through predictive analytics.
Project Developer: Ong Shu Rou
Project Supervisor: Dr. Shakiroh binti Khamis
3
PROPOSED METHOD/ APPROACH
01 Problem Identification
To identify the problem areas in teaching mathematics.
02 Data Investigation
To gather relevant surveys that are related to teaching methods and student performance.
03 Pre-processing of Data
To clean and prepare data for analysis to ensure accuracy and efficiency.
04 Exploratory Data Analysis (EDA)
To analyse data to uncover patterns and relationships.
05 Data Modeling
Build predictive models for analyse teaching method effects on academic performance.
06 Model Evaluation/ Monitoring
Evaluate and monitor models' performance.

PLAGIARISM CHECK RESULT



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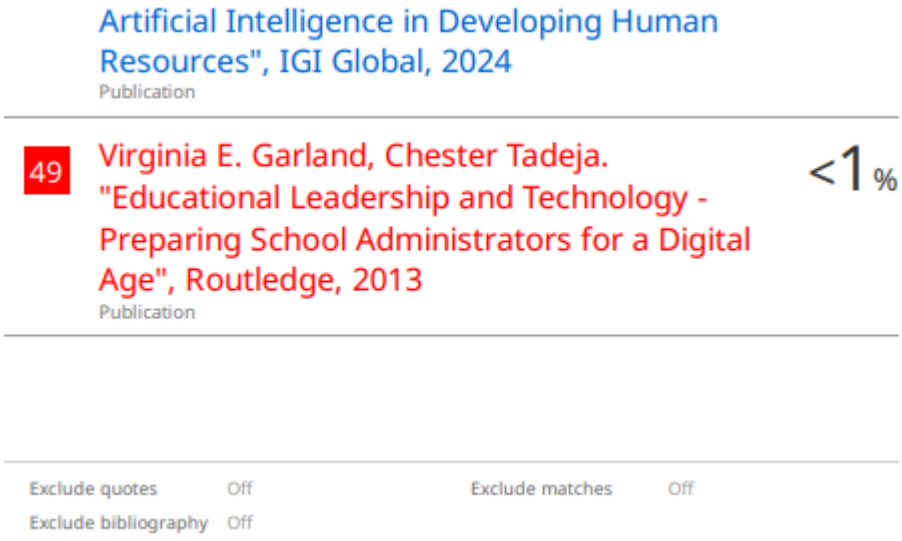
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Full Name(s) of Candidate(s)	ONG SHU ROU
ID Number(s)	22ACB00520
Programme / Course	IB
Title of Final Year Project	The Impact of Teaching Methodology for Academic Achievement in Mathematics Subject by Using Predictive Analytics

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Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

Signature of Supervisor

Signature of Co-Supervisor

PLAGIARISM CHECK RESULT

Name: SHAKIROH BINTI KHAMIS Name: _____

Date: 11/09/2024 Date: _____

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UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY
(KAMPAR CAMPUS)

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Student Id	22ACB00520
Student Name	Ong Shu Rou
Supervisor Name	Dr Shakiroh Binti Khamis

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