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THE IMPACT OF DIFFERENTIATED PEDAGOGY ON THE IMPROVEMENT OF HIGHER-ORDER THINKING SKILLS AMONG YEAR 5 STUDENTS IN THE SCIENCE SUBJECT AT SK. ST. AUGUSTINE (M), MERADONG

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Abstract:

Higher-order thinking skills (HOTS) are a vital aspect in the transformation of the education system in Malaysia. However, thinking skills are less effectively implemented in the Malaysian education system, leading to a lack of Higher-Order Thinking (HOT) skills among Malaysian pupils. One of the factors contributing to this problem is the teaching approach used by teachers during teaching and learning sessions in the classroom. The presence of students with a variety of learning styles, interests, and levels of ability in a classroom has been a challenge for teachers to undertake teaching and learning activities and subsequently the established teaching and learning objectives. According to the 2022 International Student Assessment Programme Report (PISA), Malaysia is ranked 53rd out of 81 participating countries, which is the lowest ranking when compared to other countries. This is the result of the student's inability to answer assessment questions that require high-level thinking skills. The same situation also occurred where Malaysia's performance in the Trend in International Mathematical and Scientific Studies (TIMSS) programme in 2019 showed that Malaysia was ranked 26th out of 39 participating countries. (TIMSS 2019). Differentiated Pedagogy (DP) is proposed as a solution, as it meets the learning needs and backgrounds of students who are different from the abilities aspect. The purpose of this study was to examine the impact of different pedagogy methods on the improvement of higher-order thinking skills within 5th-year primary school pupils in science subjects. The study was conducted using an experimental method by implementing differentiated pedagogical learning on a sample of 40 pupils selected purposefully from a school in the Meradong district. The sample of this study was divided by class, which was Year 5 of St. Thomas (n = 20) was used as a control group taught

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using conventional teaching methods, and Year 5 of St. Matthew (n = 20) was assigned to an experimental group taught using Differentiated Pedagogy method. The sample was given a high-level thinking skills test to determine the performance of pupils before and thereafter the implementation of differentiated pedagogy in learning the unit of 'Matter'. The results of this study indicated an improvement in higher-order thinking skills (HOTs) application in the treatment group that was taught utilizing differentiated pedagogy compared to that of the control group. This study suggests the use of this differentiated pedagogy in other schools as well as in other subjects.

Keywords:

Differentiated Pedagogy, Higher-Order Thinking Skills, Impact, Improvement

Introduction

The ability to solve problems is important in maintaining our education quality and beyond as it has a dominant impact on pupils' and students learning achievement and academic performance. Pupils and students with good thinking skills often perform well academically and succeed in various challenges. Higher-order thinking skills (HOTs) are used and practiced in critical thinking. Higher-order thinking skills extend beyond simple observation and memorizing. These are the crucial ideas that teachers should take into consideration to produce pupils and students that can be evaluative, creative, and innovative.

Advanced thinking abilities are necessary to fulfill the nation's promise of STEM education. To better equip the next generation of educators to meet the challenges of the twenty-first century, STEM education has been prioritized in the Malaysian Educational Development Plan 2013-2025 (PPPM 2013-2025). The acronym STEM stands for Science, Technology, Engineering (engineering), and Mathematics in the context of teaching and learning. STEM covers the knowledge, abilities, and values present in all topics during the teaching-learning process in the classroom. It is included in the Standard Basic School Curriculum (KSSR) and the Standard High School Curriculum (KSSM).

HOTs is a very interesting topic to discuss today, especially in the twenty-first century. Many countries are currently preparing their societies to face future challenges; there will be more competition, so we must be able to make decisions as a society and solve problems. Three thinking skills-creativity, analysis, and critical thinking are part of higher-order thinking skills (Lewis, A., & Smith, D., 1993) in Z. Misykah, A. A. Adiansha (2018). To address the issues with the Malaysian education system, the Ministry of Education proposed the Malaysian Education Blueprint 2013-2025. The important elements that were determined to require emphasis were efficiency, unity, equity, quality, and accessibility. The "Quality" aim is about making sure every child has the chance to receive a top-notch education that is both distinctively Malaysian and on par with the best international systems. This entails placing in the top three on the TIMSS and PISA lists.

The pupils' HOTs proficiency hasn't yet attained a satisfactory degree. (Zainal Abidin, Kamisah Osman, and Mohammed Zaidir, 2017). This results from a failure to incorporate the teacher's critical thinking abilities into the teaching and learning process. The readiness of instructors is a major factor in the HOTs implementation in the twenty-first century. This is significant since

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the instructor is the one in charge of forming and instructing the pupils. One significant development in the use of HOTs in the twenty-first century is the role and responsibilities of instructors.

In all three of the literacy assessments, Malaysia's PISA 2022 results have decreased. Malaysia scored an average of 409 points in mathematics, 416 points in science, and 388 points in reading in the PISA 2022 assessment. In all three literacy domains, Malaysian students' average scores are lower than the OECD average. Malaysia scored 416 out of 438 points in PISA 2022, a 22-point decrease from PISA 2018's average scientific literacy score. The average score of Malaysia differs by 69 points from the OECD average. According to the OECD, 7% of Malaysian students meet Level 5 or 6 requirements for scientific literacy.

In the education sector, higher-order thinking abilities are crucial, especially in light of Malaysia's low standing relative to other nations in the 2022 Trends in International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA). With a scientific literacy score of 485 in the Program for International Student Assessment (PISA) 2022, Malaysia was ranked 53rd out of 81 participating countries (KPM, 2022). In the Trends in International Mathematics and Science Study (TIMSS) 2019 evaluation, Malaysia was ranked 26th out of 39 countries. Teachers' grasp of HOTs in the Malaysian educational curriculum is insufficient. Teachers' knowledge of HOTs is fairly similar ((Tahim Bael et al., 2021). Teachers must develop specialized learning strategies so that the learning process can be more methodical. There have been several sorts of learning strategies established for use in the learning process, including student-centric learning methods. (Sidek and Hashim, 2016). Student-centric learning strategies demand students to actively participate in learning sessions (Maria, Samsilah, and Tajulripin, 2014).

To ensure the desired performance, a skilled teacher incorporates such pupils' peculiarities into their educational preparation. To guarantee that differentiated teaching and learning activities are successful in their classrooms, teachers' roles are crucial. Understanding the teaching philosophy is essential for teachers and selecting the best exercises and strategies for each student in the class. Differentiated pedagogy extends educational theories that regard the learner as the focus of learning and teaching processes. Learners have the right to learn by their abilities and potential. Differentiated pedagogy is primarily based on structural theory and Vygotsky's social development theory, which contends pupils should be taught based on their aptitude and talents (Vygotsky, 1978 & 1987). Different pedagogy is a revolutionary teaching style that tailors instructor instruction to the needs of individual pupils. ((Mustaffa, Hussin, & Sulaiman, 2021). The Malaysian Ministry of Education is developing the Malaysia Education Plan (PPPM), Second wave (2016–2020). Different approaches strive to maximize each student's learning by varying the curriculum based on the student's skills (KPM, 2018).

Along with the implementation of the primary school administration (PPSR) of the Ministry of Education, the former chief educational director, Datuk Dr. Amin Senin, issued a circular that directs the isolation of the classroom based on the academic achievement of students, which ceased entirely in 2019. (KPM, 2019). Because students have varied learning styles, interests, and talents, teachers have faced significant difficulty in achieving their teaching-learning objectives. The influence of student diversity in the same classroom necessitates that the teacher be prepared by diversifying teaching approaches to provide the student with the right to grasp and master the lesson content rather than spending the entire course alone. (Basirah,

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Mohd Yakub, and Muhamad Alihanafiah, 2018). Similarly, because the children will be in a mixed class, the teachers will approach things completely differently. As a result, the teacher is responsible for modifying the curriculum, teaching materials, teaching activities, and teaching strategies to meet the learning session objectives. As stated by Zamri (2018), teachers must use teaching strategies that fit the demands of their pupils for them to learn optimally based on their ability and cognitive level.

However, critical thinking is not properly carried out in Malaysia's education system, resulting in a lack of higher-order thinking skills (HOTs), especially among Malaysian pupils and students of all ages. Differentiated Pedagogy (DP) is suggested as a solution, as it caters to students' diverse backgrounds and learning needs. According to Chamberlin and Powers (2010), it is the process of adjusting curricula, teaching techniques, learning activities, and assessments to meet the learning needs of students, allowing them to learn, be motivated to learn, and learn effectively. Differentiated Pedagogy can be implemented through differentiation in terms of content, process, product, and learning environment. Implementing differentiation approaches in science classrooms takes into account the needs of students of differing backgrounds. Before beginning instruction, teachers should anticipate future demands for differentiated education and take into account the readiness levels, interests, and learning profiles of various pupils. Furthermore, differentiation has been shown to enhance student achievement, increase engagement, and foster diversity.

The meaning of differentiation is consistent across topics, yet there are techniques to make differentiation even more successful in science class. Differentiation is a teaching strategy that recognizes the talents, problems, or interests of individual students to ensure everyone can attain the same learning objective. Teachers can distinguish components unique to science instruction, such as experiments, hands-on science activities, types of resources employed, and much more. According to Eka Puteri, Ernawati, and Gita (2018), students have different learning styles, therefore teachers need to plan their daily lessons according to the diversity of students in the class to celebrate the diverse abilities of students. Martin and Pickett (2013) identified that when pupils were offered the option to select their tasks and activities, they were more inspired and involved, as well as less likely to behave inappropriately.

Gardner's theory of multiple intelligences highlighted that students may possess strengths in different areas, from logical-mathematical to bodily kinesthetics. Implementation of Differentiated Pedagogy in science caters to these varied intelligences. Basically, instructors have to examine the pupils they are teaching and, as a result, alter their instruction (Smit and Humpert, 2012). Differentiated pedagogy in science classrooms fosters scientific inquiry through inquiry-based learning. Students, in particular, conduct investigations through tasks and experiments. As a result, differentiated pedagogy offers pupils a variety of opportunities to experience the natural world. Regardless of the educational ideology utilized, differentiated pedagogy helps science learning because it eventually fosters student achievement (Ivory, 2023).

Objectives

The study's objectives were to;

I. To find out the impact of implementing differentiated pedagogy in the teaching of science subjects on improving higher-order thinking skills (HOTs) among Year 5 pupils.

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This observation aimed to reply to the subsequent question.

I. What impact does different pedagogy have on the improving of higher-order thinking skills among Year 5 students in science?

Literature Review

Primary education is so important to young people's development that access to it is considered a fundamental human right (United Nations, 1998). Children should be taught vital science during this early period of their education, and it should be a core component of the curriculum. Science and math are considered essential sciences, and in secondary school, this number is enlarged to four closely related areas of study: science, technology, engineering, and mathematics. Despite significant achievements in science education research, there is still more work to be done to persuade the general public and the education community of the importance of teaching future generations to be scientifically literate citizens (Linder et al., 2011). According to Garritz (2010), to create a favorable attitude toward science, education should assist in the transfer of scientific knowledge learned in school to the pupil's situation. Nonetheless, teaching science is difficult for instructors since they must meet curriculum standards engagingly and dynamically (Romine and Sadler, 2016).

Primary school students tend to be accepting of science at this age (Fernández Cézar and Solano Pinto, 2017), whereas secondary school students are less concerned with the subject, and this mindset only worsens as they get older (Vázquez and Manassero, 2015). There is a revived focus on improving knowledge of science, understanding, and skill sets in schools worldwide (Rosales Sánchez, Rodríguez Ortega, & Romero Ariza, 2020). GarcÃ-a-Carmona and Acevedo-DÃ-az's (2018) research suggests that teachers must prioritize innovative pedagogy and foster a positive learning environment to accommodate this unique learning style.

Different learning styles can be addressed when preparing a teaching plan to assist pupils relate better to learning activities and enhance learning experiences that might enhance students' knowledge of science competencies (Palines & Cruz, 2021). To help students understand the subject they are studying, teachers can distinguish between three different learning aspects: the content that needs to be taught, the process or meaningful activity that students perform in the classroom, and the product creation that is required at the end to determine whether learning objectives have been met (Putra, 2021). Differentiating content can be achieved by educators through the use of a range of resources, learning contracts, short-term student workshops, several learning modalities, and a range of support systems, including buildings, rules, procedures, or programs. This method is inextricably linked to the teacher's assessment of students' sensory learning modalities, whether visual, aural, or kinesthetic (Marlina, 2019).

The findings of Goddard's research (2018) demonstrate a considerable advantageous association between different learning and teachers' capabilities. According to the findings of Saprudin and Nurwahidin's research (2021), the differentiation technique improves student interest and passion for working on reflections, making learning more enjoyable and having an impact on student character development. Suleiman et al. (2020) discovered that varied learning improves reading comprehension success in secondary school pupils. According to Alhafiz's research (2022), no learner relies solely on one learning technique. Student learning styles include the three learning types: visual, auditory, and kinesthetic.

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According to Irdhina (2021), there are three ways to create different lesson content in differentiated learning: adjusting what the teacher will teach or what students will learn based on the level of readiness, adjusting what the teacher will teach or what students will learn based on the interests of students, and adjusting how the content to be taught or learned will be conveyed by the teacher or obtained by students based on. This study validates the research findings of Faiz et al. (2022), who claimed that the teacher's capacity to select the models, techniques, and methodologies required in material design is critical. Student-read books and/or articles are tailored to the content being studied. García-Carmona (2021) suggests that improving scientific literacy can enhance the ability to explain scientific phenomena using scientific knowledge. To improve students' motivation and learning outcomes by fostering harmonious interpersonal relationships between students and teachers, so that students are more excited about learning. Of course, a creative teacher is required in differentiated learning to guide pupils to success and satisfaction in their studies.

In modern educational environments, differentiation is an important aspect of instructional practice that allows pupils to attain their objectives. The most important aspects of differentiating instructional methods are to distinguish the instructions and content, that is, what students should know; to differentiate the process, that is, what students should be able to do; to differentiate the products, that is, how students demonstrate their learning; and to differentiate the learning environment, that is, the physical and effective domain of the classroom (Pendergast et al., 2020). When students discover significance in their learning, they are more likely to be motivated and interested in the pursuit of knowledge (Confrey et al., 2018). Learning tasks that require students to connect knowledge, comprehension, and abilities are especially effective in their journey of learning.

Differentiation of students' learning is also founded on the assumption that cognitive variations exist in all classroom settings due to mixed talents and streams (Valiantes, 2015). To mediate and fulfill the requirements of pupils, differentiation in learning is a significant pedagogical method that may improve students' progress. According to the findings of Lailiyah's research (2016), pupils who receive diversified learning enhance their critical thinking skills more than those who receive regular learning. Higher-order thinking skills (HOTs) are becoming a key focus in Malaysian education. In primary schools, the Ministry of Education (MOE) emphasizes the aspect of reasoning as the most recent addition to the curriculum, following reading, writing, and counting (MOE, 2013). In this instance, the instructor must be open to students' inquiries and opinions. Celebrating student ideas enables teachers to discover how their pupils think and how this may be used to strengthen the teaching and learning process.

Education in Malaysia focuses on polishing high-level thinking skills (Higher-Order Thinking Skills), which align with the curriculum's demands (Gradini, 2019). Students with advanced thinking abilities must analyze, connect, and interpret difficulties to find answers or new ideas (Saraswati & Agustika, 2020). Strengthening students' higher-order thinking skills is a learning process that is supposed to improve the quality of learning so that it is more effective, efficient, and relevant, hence increasing learning outcomes (Acesta, 2020). As a result, differentiated pedagogy is a strategy that allows teachers to create tactics to fulfill each student's requirements based on diversity of preparation, student learning profiles, and interests (Siburian et al., 2019).

Pupils of similar ages vary in their willingness to learn, interests, ways of learning, experiences, and lives (Hadi et al. 2022). As a result, this differentiation pedagogy can be a solution to

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increase high-level thinking abilities as well as improve students' scientific thinking skills based on scientific principles by satisfying their demands (Saraswati & Agustika, 2020). The development of high-level thinking skills in students must be stressed, particularly through the use of activities that promote these abilities, such as conversations, contextual problem-based learning, and comparisons, as well as practice answering HOTS-type questions. (Fanni et al., 2021). Based on learning, employing the problem-based learning (PBL) model in conjunction with a differentiated learning method can increase the skills to be tested when compared to standard learning models. Sarie's (2022) research supports this, demonstrating that varied learning can increase students' measurable abilities.

Differentiation instruction, while not a new topic in education, has recently garnered a lot of attention (Saleh, 2021). It is stated that differentiated education helps promote equity in the classroom by requiring each student to learn and be graded according to their portion (Ismajli & Imami-Morina, 2018; Marlina et al., 2019). Based on the many pedagogical methods and the current status of education in Malaysia, the most pressing and critical transformation to accomplish is a cultural revolution in the country's education system. This entails modifying teaching procedures to provide students with greater possibilities and freedom in their learning process, based on their learning needs. This equilibrium can be viewed as a transitional step toward the future use of differentiated pedagogy as a whole.

In a parallel study conducted in Abha, Saudi Arabia, Al-Shehri (2020) looked into the effectiveness of differentiated instruction and how sixth-grade students developed their critical thinking and academic performance. In this study, an educational program was applied to a sample of fifty children who were specifically chosen from a school in the city of Abha, using an experimental design. In this study, an experimental design was used to apply an educational program to a sample of fifty children who were specially selected from a school in the city of Abha. This study's findings were released in the International Journal of Learning, Teaching, and Educational Research. The sample was divided into two groups: the experimental group (n = 25) received teaching that was differentiated, while the control group (n = 25) received traditional instruction. The researchers created two assessments to assess students' critical thinking skills and academic success both before and after instruction. The public was given access to the test findings, which were given both before and after the program's execution. The results of the study showed that the experimental group's academic performance improved after receiving training using differentiated instruction modalities; differentiated instruction strengthened the students' critical thinking skills. As a result, the study concluded that to improve the quality of instruction in educational settings, teachers should take suitable courses and employ this teaching style across a wide range of subject areas.

Similarly to Mohd Hasrul, K. et al.'s (2022) study, their findings show that different teaching approaches have a significant favorable impact on the mathematical thinking process. The teacher is responsible for ensuring that the entire lesson plan, including activity design, is based on the six elements listed above: flexible collection, open and honest expression of ideas and thoughts, engaging activities, teachers' encouragement and support, and interactive, relevant evaluation. They also discovered that teachers must combine all of the previously described factors into the teaching and learning process to improve the mathematical thinking processes of gifted and talented children. The study also recommends more research to determine which activities should be undertaken to have a direct impact on the student's mathematical thinking process, as well as which should be avoided.

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Methodology

Research Design

A quasi-experimental approach was used since it was appropriate for the study's objectives. The chosen sample was categorized into two groups based on the unit 'Matter': a controlled group of students from Year 5 St. Thomas who were taught using traditional methods and an experimental group of students from Year 5 St. Matthew who were taught using Differentiated Pedagogy (DP). The independent variable in this study was the teaching approach, which comprises two levels: differentiated pedagogy (DP) and the conventional way. The individuals represented the dependent variable, with results from the Higher Order Thinking Skills (HOTs) evaluation.

Sampling

The participants of this study consisted of Year 5 pupils (40 pupils; 21 Male and 19 Female). All the participants were studying in the researcher's school at Sekolah Kebangsaan St. Augustine (M), Meradong, Sarawak. This school was chosen purposely due to the participants were taught by the researcher and this study did not interfere with other teachers' teaching and learning sessions. The participants were divided according to their class, namely Year 5 St Thomas as the control group and Year 5 St Matthew as the experimental group.

Table 1: Demographics of Participants

The study group	Total number of students	Percentage (%)
Experimental group (Year 5 St. Matthew)	20 (9 female, 11 male)	50
Controlled group (Year 5 St. Thomas)	20 (8 female, 12 male)	50

Instrumentation

This study is mostly based on one data instrument: data obtained from a test that assesses students' higher-order thinking skills (HOTs). The HOTs improvement exam was created to assess students' improvement in HOTs in science subjects before and after experimentation using Bloom's taxonomy cognitive domain.

Higher Order Thinking Skills (HOTS) Test

This test was created to assess the extent to which Year 5 students gain higher-order thinking skills (HOTs) in science before and after engaging with the three abilities of analysis, evaluation, and creation. These dimensions were used to disperse the test items: Analyze consists of five multiple-choice questions; evaluate consists of five multiple-choice questions; and create a set of five multiple-choice questions. Each item received one point for a valid response and zero points for an incorrect response. The maximum test score was 15, and students were allowed 30 minutes to complete the test.

To maintain the validity and suitability of these test items, this Higher Order Thinking Skills (HOTs) test was beforehand presented to four teachers who are highly experts in a science subject. These teachers are Master's degree holders in Science Education had been teaching for more than 20 years. Some modifications and amendments to the items were made based on their suggestions. The test had an overall reliability coefficient of 0.364.

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Data Analysis

To answer the study's questions, statistical analysis was performed by extracting the standard deviation and mean scores of participants' responses from the Higher Order Thinking Skills (HOT) exam. The researcher employed the T-test to answer the questions of this study to find the statistical differences between the two groups according to their scores in the post-Higher Order Thinking Skills (HOTs) exam.

Results

Finding Before Applying The Experiment

Before the trial began, both the control and experimental groups were given a higher-order thinking skills exam to confirm that they were equivalent. Table 2 displays the mean scores and standard deviations of replies for the development of HOTS in the scientific subject test.

Table 2: T-test Results for The Two Study Groups' pre-HOTS Test Responses.

Variable	Group	Number of pupils	Mean score	St. dev	t-value	Sig.
HOTs Pre-Test	Control	20	7.4500	1.27630	.806	.426 Not statistically significant
	Experimental	20	7.8500	1.81442		
	Total	40				

Table 2 demonstrates that there is no difference in the mean scores of the two groups between the control group (m = 7.4500, SD = 1.27630) and the experimental cluster (m = 7.8500, SD = 1.81442). The t-test value of.806 is not significant (at a = 0.05). There is no statistically significant difference in results between the two groups, indicating that they were both learning at the same level.

Finding After Experiment

The research topic was: What impact does differentiated pedagogy have on the improvement of higher-order thinking skills in year 5 pupils in science subjects? Table 3 shows the mean scores and standard deviations for each participant's test response after demonstrating advanced thinking abilities.

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Table 3: T-test Findings For The Two Research Groups' Post-HOTs Test Responses

Variable	Group	Number of pupils	Mean score	St. dev	t-value	Sig.
HOTs Post-Test	Control (Conventional method)	20	10.6500	2.70039	2.565	.014 statistically significant
	Experimental (differentiated pedagogy)	20	12.7000	2.34184		
	Total	40				

Table 3 displays a t-value of 2.565, signifying the presence of a statistically significant difference (at a = 0.05) in the mean score between the experimental and control groups. After learning to employ differentiated pedagogies, the experimental groups achieved higher scores. The experimental group performed exceptionally well on the post-test, while the control group, which trained via the traditional technique, had a mean score of 10.6500 with a standard deviation of 2.70039.

This circumstance could be the result of the best fit of several pedagogical teaching approaches (convergence of ideas, cooperative learning, and thinking, paired and shared) as well as the relationship between high-order thinking skills and the science subjects of the subject matter. This lets participants use a range of mental skills while learning, including conducting various debates and providing viewpoints, structuring ideas, and allowing kids to think. It also allows students to connect ideas to the things they're studying, which fosters higher-order thinking skills. Because this method is based on respecting each student's ideas and potential and encouraging them to voice their opinions, listen to those of their peers, and engage in group discussions, it will enable every student to learn more about the subject being studied. This will also help the students develop higher-order thinking skills.

Discussions

The findings regarding the study question are connected to the employment of alternative pedagogies to improve the higher-order thinking skills of students in the experimental group in science disciplines. The application of differentiated pedagogical strategies in scientific learning resulted in superior accomplishments for the control group pupils (table 3). The experimental group achieved a minimum score of 12.7000, while the control group only achieved a minimum score of 10.6500. The post-HOTs test has a p-value of 0.002 less than (at a = 0.05). This shows that there is a substantial difference between the experimental and control groups in the post-test. It also clearly points out that making use of different pedagogies in science education can enhance students' higher-order thinking skills. This is because through this method students are encouraged to communicate with each other, learn inquisitively, collaboratively, and solve problems according to different levels of ability and abilities and intelligence. Because the experimental group's students engaged in a variety of activities designed to help them utilize their maximum potential during the science session, it is challenging to draw broad conclusions about why the experimental group's pupils outperformed the control group.

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This finding is strengthened by the findings of a study conducted by Palines and Cruz (2021), which say that learning differently is a useful factor to consider when building lesson plans to help students relate learning activities to maximize learning experiences that can improve students' scientific literacy. This study also parallels the results of a study conducted by Saprudin & Nurwahidin (2021) showing that differential learning can increase students' enthusiasm for fun learning activities and impact shaping student attitudes.

The outcomes of this study are also corroborated by Suleiman et al. (2020), who found that differential learning successfully increases reading comprehension proficiency among secondary school pupils. Similarly, the results of the Alhafiz study (2022) reveal that no student relies solely on one learning technique. Students' learning styles are a blend of three: visual, aural, and kinesthetic. García-Carmona and Acevedo-Díaz's (2018) research suggests that teachers must prioritize innovative pedagogy and foster a positive learning environment to accommodate this unique learning style.

This study's results are consistent with those of Lailiyah's (2016) investigation, which found that students taught using alternative means of instruction generally improved their critical thinking abilities more than those taught using traditional techniques. In Malaysia, higher-order thinking skills, or HOTs, are becoming a major focus of education. According to Acesta (2020), teaching students to think more critically is a learning process that should be able to raise the standard of instruction and make it more effective, efficient, and relevant to raising learning objectives.

According to Saraswati and Agustika (2020), they argue that by focusing on individual requirements, differentiated pedagogy can assist students in developing their capacity for higher-order thinking as well as scientific thinking based on scientific principles. This study is also supported by the findings of the Sarie study (2022) which states that differential learning can improve students' measurable abilities.

These findings are supported by the findings of Ismajli & Imami-Morina (2018) and Marlina et al. (2019), which state that differential teaching may promote equity in the classroom by making sure every student receives instruction and an evaluation based on their aptitudes. According to Salleh (2021), while differential pedagogy is not a novel idea in education, it has recently drawn a lot of interest from a variety of parties in education, especially in Malaysia.

The findings of this investigation also align with those of a study by Mohd Hasrul Kamarulzaman et al. (2022), which examined the effects of differentiated instruction on gifted and talented students' mathematical thinking processes. The study revealed that the use of differentiated instruction in the classroom had a noteworthy effect on the development of mathematical thinking skills.

Conclusion

Differential pedagogy is a method that allows educators to create plans that cater to each student's unique needs by taking into account each learner's learning style, preferences, and willingness (Siburian et al., 2019). As compared to students who were taught using traditional teaching methods, the study's findings showed that students who were taught using different pedagogies achieved more in terms of higher-order thinking skills. This is in line with the findings of the Fairuz et al. (2017) study which suggested that differentiated pedagogies should

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be included in teacher teaching because it can enhance and provide positive impact and motivation to students in science learning. In line with the findings of this study, it is necessary to use differentiated pedagogies in learning in science classrooms as students also have different learning styles, abilities, willingness, and also different interests so that students are treated equally and gain knowledge from their learning.

From the perspective of the learner, the "one-size-fits-all" approach is no longer suitable for implementation in classroom teaching sessions as in one class there is a diversity of students after the class isolation system was abolished in 2019 (KPM, 2018). Based on the researcher's own experience, a classroom where there is a diversity of students, will also create issues with teacher pedagogy to accommodate varied student demands in terms of interests, abilities, preferences for learning, and readiness. Concerning this issue as well, the findings of the study by Tengku Kasim & Abdurajak, (2018), found that teachers have problems in managing diverse students in the classroom and it is difficult to diversify teaching activities to diverse students.

This study, which includes an endeavor to improve HOTs by utilizing several pedagogical teaching styles in scientific education, has yielded significant findings. This is particularly true of the application of differentiated pedagogy in science instruction in the classroom, which has the potential to increase students' HOTs and hence their academic performance in science subjects. This exposure highlights the critical requirement to deal with kids with varied interests, learning styles, and levels of aptitude in a single class so that all students have equity and rights in accomplishing learning goals. This study also found that differentiated pedagogy can help students enhance their science skills. With this finding, the stated study objectives have been met, and teachers might think about implementing different pedagogical teaching approaches to ensure that students receive an equal opportunity during the teaching and learning process in the classroom.

This can be seen in the pre- and post-experimental test achievements of the 5th grade of St. Matthew, which is a group of experiments and learning using different Pedagogical approaches, and the 5-th grade St. Thomas is used as a control group of learning using traditional approaches. As a result, the results in the HOTs test were better for the experimental group with a min score of 12.7000 compared to the control group that scored 10.6500. This suggests that different pedagogical approaches are perfectly suited to class conditions where students have a variety of learning styles, interests and abilities.

To address this issue, teachers must be positive, proactive, and innovative when developing and implementing their lessons. Teachers must concentrate on (i) developing varied objectives, (ii) providing materials for various learning activities, (iii) distinct learning materials, and (iv)learning resources that may engage all pupils. Thus, future researchers should concentrate on:

1. Methodologies for adopting alternative instructional approaches in the classroom utilizing experimental methodologies.
2. Investigate the efficacy of various teaching methods in topics other than science.
3. Create instructional modules utilizing various pedagogical approaches.

Adding and enriching the understanding and knowledge of different pedagogical approaches to teaching HOTs in science subjects is essential in the endeavour to realize the aspirations of the Malaysian educational development plan 2013–2025.

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Finally, the use of differentiated pedagogy teaching methods will help teachers provide effective teaching as well as improve student achievement in science subjects and foster higher-order thinking skills among students, according to the Malaysian Education Development Plan's aspirations for 2013–2025.

Recommendations

Based on the study's findings, here are some recommendations that academics, especially those actively involved in education, should consider; Incorporate Differentiated Pedagogies in the curriculum of science teaching-learning. Second, develop and improve textbooks, textbooks by taking into account better and more modern teaching strategies by the transformation in education. Third, giving educators specialized training on the application of differentiated pedagogies in the classroom teaching and learning process.

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