A Meta-Synthesis of the Effectiveness of Differentiated Instruction Strategies on Students' Academic Performance in Mathematics

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ABSTRACT

This meta-synthesis examines the impact of Differentiated Instruction (DI) on student learning, with a focus on the mathematics subject. By reviewing various studies from reputable journals, the research highlights how tailoring content, teaching methods, assessments, and the learning environment to students' needs can improve academic performance, critical thinking, and engagement. Strategies such as tiered tasks and group work can help create more inclusive and responsive classrooms.

Although DI enhances academic performance outcomes, it has an ambiguous impact on students' attitudes and confidence, suggesting that motivational and emotional variables may require different focuses. This study also highlights several factors that can hinder teachers' ability to apply Differentiated Instruction effectively. Common issues include limited access to resources, large class sizes, and gaps in teacher training, particularly in planning and delivering differentiated lessons. Even so, there are encouraging signs that support from the school administration can make a difference. One example is the SME Project initiated by the Department of Education, which shows how institutional backing can help teachers overcome some of these challenges.

Overall, the study's results confirm that DI is a valuable approach to meeting diverse learner needs; however, success depends on strong teacher support, practical training, and flexible curriculum planning.

Keywords: differentiated instruction, mathematics achievement, learning style, inclusive teaching, instructional design

INTRODUCTION

Students with diverse backgrounds, skills, and learning styles enter a traditional classroom, necessitating the use of differentiated instruction to accommodate their varied needs. Learning and development will be hindered by a uniform approach that overlooks the needs of students. Teachers must pursue professional development, including training, workshops, and seminars on differentiation, to effectively implement this approach (Padmore & Ali, 2024). Sari et al. (2024) assert that effective differentiation necessitates a meticulous planning process that considers the diverse needs of students and employs technology to evaluate and address their varied learning requirements. Differentiated instruction (DI), according to Magableh and Abdullah (2020), is a teaching method that modifies resources, activities, tools, and learning environments to accommodate the various learning demands of students in a mixed-ability classroom. DI employed various instructional methodologies, tiered tasks, and variable grouping to achieve noticeably better general academic achievement compared to more conventional teaching approaches.

However, differentiated instruction is not frequently used in practice. Moreover, the purposes and goals behind differentiated instruction are often not explicitly stated. For instance, it may not always be clear that these strategies aim to enhance academic performance or develop social skills, and the applicability of differentiated instruction strategies for students of different abilities, including exceptionally high, middle, and low-achieving students, is not equal (Pozas et al., 2019). The appropriate differentiated instruction shall promote

active learning, cooperation, and reflection, taking into account teachers' feelings, knowledge, abilities, and adequate training (Langelaan et al., 2024). Such an approach to learning caters to different learning styles, genuinely excites students who are genuinely interested, and promotes cooperation in a congenial environment. The implementation of differentiated instruction strategies remains challenging, with teachers struggling to balance the need for personalization with strict adherence to curriculum standards. (Liou et al., 2023).

Professional development, collaboration, and teacher autonomy in the classroom are critical enablers for effectively implementing differentiated instruction. By contrast, limited resources, time relief, and inflexibility in all agents of change were considered disablers of effective DI implementation; hence, the need for systemic support and structured training (Van Geel et al., 2022). Guidance from school manuals and teacher training programs may support DI. However, this grounding must not result in variations in its implementation in practice, which would provide further justification for this study.

Barriers preventing effective differentiation in the classroom include limited classroom building space, teaching materials, and insufficient teacher preparation and training practices. Differentiated teaching is effectively implemented if individualized, responsive instruction is paired with support targeted to the appropriate level of pupils, using scaffolding in learning, supporting collaborative activities to promote self-efficacy, and developing a supportive environment of learning across the board to enhance students' performance in mathematics while providing sufficient insights to teachers and policymakers to support students who find mathematics difficult (Moses et al., 2023).

This meta-synthesis study aims to synthesize the effectiveness of Differentiated Instruction strategies on students' mathematics achievement. Specifically, this study will answer the following:

1. What is the overall effect of differentiated instruction strategies on students' mathematics performance across studies?
2. Are certain forms of DI (content, process, product, environment) more effective than others?

Relevant Theories

Multiple Intelligences Theory. Differentiated instruction aligns with Gardner’s theory by allowing educators to design lessons that cater to different types of intelligence. For example, linguistic learners may benefit from reading and writing tasks, while bodily-kinesthetic learners may grasp concepts better through hands-on activities. When utilizing multiple teaching strategies (i.e., problem-solving activities, visual aids, experiential learning, and group interaction), teachers can accommodate a range of learning styles and types of intelligence, enabling all students to participate and comprehend mathematically actively (Howard Gardner, 1983). Differentiation, when employed by teachers, allows students to engage in the content in a way that is tailored to their strengths, thus achieving greater comprehension and promotion. The new curriculum, for example, has QR codes that connect to various types of resources, gadgets, and also integrative videos. The evidence from previous studies has emphasized the role of a practical course in enhancing critical thinking and problem-solving skills (Sari et al., 2024). Language, logical-mathematical, spatial, bodily-kinesthetic, musical, intrapersonal, interpersonal, and later naturalistic intelligence are among the different forms of intelligence that people are said to possess. Teachers can create learning activities that better suit each student's unique intelligence by applying MI theory. It is confirmed that this would ensure more focused and efficient learning experiences, and in turn, such experiences would lead to better academic grades (Pope, n.d.). According to Onyishi and Sefotho (2021), using such a framework enables teachers to plan a wide variety of learning activities, which means that students can be involved in the same study area from different intelligences and with their interests and strengths. This is consistent with the study's emphasis on differentiated instruction (DI), which aims to equip students with the tools they need to solve problems and think creatively while studying the material. (Melesse & Belay, 2022) According to Magableh and Abdullah (2020), teachers were urged to let pupils use their preferred intelligences when completing assignments. By working in ways that play to their strengths, this approach encourages scaffolding, which provides children with more opportunities

to succeed. There is a need for alternative teaching strategies to accommodate students' varying learning styles, as they all learn in different ways.

Zone of Proximal Development. Lev Vygotsky (1930). Differentiated instruction is rooted in Vygotsky's ZPD, as it emphasizes adjusting tasks to meet students at their current skill levels and providing scaffolding to help them advance. Teachers may use peer collaboration, guided instruction, or teacher-led interventions to help students bridge the gap between their current understanding and their potential learning with support. By structuring lessons that gradually shift responsibility from the teacher to the student, differentiated instruction helps learners move from their current skill level to a more complex mathematical understanding. Pope (n.d.) stated that tasks that are too simple or too difficult hinder efficient learning. According to various studies, the best learning occurs in this "zone" where students can advance beyond their existing capabilities with the aid of scaffolding. This method embodies the scaffolding principle of ZPD, which teachers offer direction that diminishes as pupils gain proficiency. Flexible grouping and ongoing evaluation are essential components of effective differentiation, which guarantee that students are constantly challenged without becoming overburdened. DI promotes individualized growth by matching instructional tactics to each student's ZPD, making learning relevant and accessible for all students, regardless of their current stage in the learning process. The premise that learning flourishes when students are directed through obstacles at an appropriate level of difficulty is reinforced by this customized approach, which supports varied learners by encouraging engagement, skill development, and higher accomplishment. Each learner works within their ZPD thanks to DI tactics, including customizing processes, products, and materials to match students' learning styles, interests, and readiness. While struggling students receive organized support, high achievers take on increasingly challenging assignments (Onyishi & Sefotho, 2021). According to Melesse and Belay (2022), the study focuses on the "zone of proximal development" (ZPD). ZPD is the point at which a student can finish work with assistance, not totally on their own, but also not without help. ZPD-based individualized education enhances outcomes for all students by tailoring the content to be suitably challenging for each student. This ensures that both above- and below-average students are exposed to materials suitable for their level, thereby avoiding boredom from overly easy or frustrating material. (Magableh & Abdullah, 2020)

Constructivist Learning Theory. Jean Piaget (1936). The researchers emphasize the constructivist learning methodology, in which students actively participate in experiments, uncover scientific concepts, and apply what they have learned to actual circumstances. To maximize student learning outcomes and significantly increase students' comprehension and engagement. It promotes adaptable teaching methods and ongoing evaluation to guarantee that every student succeeds. Well-trained teachers, sufficient funding, and a move away from strict, traditional curricula are all necessary for effective differentiation (Sari et al., 2024). According to Pope (n.d), Constructivist learning theory serves as the basis for differentiated instruction (DI). Learning occurs when students construct their knowledge through firsthand experiences rather than merely receiving it. The theory supports the notion that to help students generate meaningful learning experiences and succeed academically, instruction should build on their prior knowledge. To provide students with an opportunity to build understanding based on their unique experiences, the study also links this idea to teachers' perspectives and experiences with differentiated instruction. The current study, which examines the effectiveness of differentiated instruction (DI) in meeting the diverse needs of learners, is closely aligned with the constructivist learning theory. It highlights how students actively create knowledge from their unique interpretations of the world and past experiences. This implies that in a differentiated classroom, training should begin where the student is, taking into account their prior knowledge, cultural background, and preferred learning method. This is in line with the fundamental ideas of DI, which state that educators should modify materials, procedures, and outcomes to fit the readiness, interests, and learning styles of each student. Processes and products differentiation also reflects constructivism, which holds that students learn best when they can interact with the content in ways that suit their chosen learning styles, whether that be through solo study, group projects, or hands-on activities.

These three theoretical stances work together to create a strong basis for differentiated education. Piaget's constructivism reveals the circumstances that make learning meaningful and lasting. Vygotsky's ZPD

describes how support can be modified based on the learner's preparedness. Gardner's MI theory explains why instruction should be customized. When these concepts are combined, DI becomes a multifaceted strategy that values student diversity, encourages academic achievement, and creates inclusive math classrooms.

METHODS

This research employs qualitative methods, specifically utilizing a meta-synthesis approach. It involves a rigorous secondary analysis of existing qualitative and mixed-method studies on differentiated instruction (DI) in mathematics education. The primary goal is to provide a deeper understanding of the phenomenon under this study and to evaluate how the original research approaches influenced the findings, using keywords like "differentiated instruction," "mathematics education," "inclusive teaching," "content/process/product/environment differentiation," and "academic achievement," a systematic literature search was carried out across academic databases, including ERIC, Scopus, ScienceDirect, JSTOR, and Google Scholar. The search was restricted to peer-reviewed articles published between 2015 and 2024, with a focus on studies that examined the implementation of DI in primary and secondary mathematics classrooms. Studies that involve areas other than mathematics, as well as those that only address theoretical arguments without empirical data, are excluded. Through a systematic coding process, researchers identified recurring themes that directly address the core issues of this study. Cross-case analysis was employed to integrate findings and examine consistencies and discrepancies across studies. This method led to the creation of a complete framework that shows how DI strategies change the results of math education for students.

RESULTS AND DISCUSSION

Effect of Differentiated Instruction Strategies on Students

Differentiated instruction has emerged as a transformative methodology in education, owing to its ability to address the diverse needs, competencies, and learning preferences of students (Bal, 2023). Research indicates that differentiated instruction enhances academic performance, especially in mathematics, where students frequently find it challenging to grasp abstract concepts and procedural skills. When teachers used DI strategies like adaptive teaching methods and tiered training, students' math skills got a lot better.

More general research supports that DI customizes material, procedures, and results to fit individual learner profiles, thereby creating inclusive and efficient learning environments. This pedagogical method emphasizes the need for scaffolding learning within students' capacities and aligns with socio-constructivist ideas, particularly Vygotsky's concept of the zone of proximal development. Although DI helps increase performance and accommodate different students, issues such as resource limitations, teacher readiness, and implementation complexity persist. Therefore, leveraging the possibilities of DI to improve academic success and student involvement in various classroom environments depends on professional development and methodical curriculum changes.

Differentiated Instruction is sometimes viewed as a technique for helping groups based on individual learning styles or specific needs of students. This lack of understanding, however, limits DI's ability to design inclusive classrooms where all students, regardless of ability, can benefit from a variety of learning opportunities. It highlights the value of inclusive education, which depends on contact and collaboration among peers (Gaitas et al., 2022).

The 2020 study by Ginja and Chen emphasizes that teacher educators see DI as crucial for closing achievement disparities and raising student enthusiasm. Still, difficulties include misunderstandings, big classes, and poor professional development. Studies suggest that programs for teacher preparation should emphasize effective DI techniques and address common misconceptions to foster more inclusive classrooms. To accommodate the various learning needs of students in contemporary classrooms, differentiated instruction, or DI, is essential. To equip teachers with the skills necessary for effective DI implementation in real-world settings,

adequate professional development and training are crucial. It highlights how reflection, active learning, and group projects can be combined successfully in ventures (Langelaan et al., 2024).

Differentiated instruction (DI) is a pedagogical strategy used by Pozas et al. (2021) to cater to the learning needs of pupils through targeted instructional approaches. Students' opinions on their teachers' use of DI showed a favorable correlation with their school's well-being, social inclusion, and academic self-concept. There is a need for professional development programs that stress the application of DI to create inclusive and encouraging learning environments, as well as teacher preparation. It demonstrates how well-customized teaching plans can enhance student involvement and learning outcomes. Based on early research, which emphasizes the importance of customizing education to fit various learner needs, current school methods are being exposed. When used appropriately through streaming, individualized education supports diverse learning styles and fosters an inclusive classroom atmosphere that accommodates varying abilities (Magableh & Abdullah, 2020).

Rijal et al. (2024) emphasized that Differentiated Instruction in mathematics education has become increasingly important as a means of meeting the diverse needs of students in classrooms. This study examined the effectiveness of this strategy in improving math performance for first graders. There is an importance of tailoring materials, procedures, and products to students' varying degrees of preparedness, interests, and educational backgrounds. With an increase in post-test scores, it was observed that notable improvements in learning outcomes were achieved by incorporating multiple instructional tactics, including group discussions, varying task complexity, and individualized student feedback. Differentiated approaches also improve engagement, critical thinking, and independent learning, therefore complementing the objectives of the twenty-first-century classroom.

One useful pedagogical tool that helps address the challenges presented by various classroom environments is differentiated instruction. Changing material delivery, learning strategies, and evaluation tools ensures that students achieve the best learning results, thereby promoting fairness and inclusiveness. Personalized teaching tactics help demonstrate this by raising academic achievement and fostering a closer involvement and passion for learning. This combined data emphasizes the requirement of teachers to use multiple approaches to establish mathematics and responsive, inclusive, and prosperous learning environments.

To enable students to learn at their own pace and gain confidence in their skills, Insorio (2024) emphasizes the importance of tailoring instructional strategies, resources, and assessments to meet their individual needs. Notwithstanding its achievements, the study also highlighted areas that require improvement, such as enhancing self-efficacy and promoting more inclusive educational environments. This highlights the importance of curriculum changes in effectively implementing DI concepts and underscores the need for teachers to pursue their professional development continually.

Differentiated Instruction has been clearly shown to help lower math anxiety; other studies also support its role in creating inclusive and encouraging classroom environments. DI reduces anxiety and enhances mathematical performance by customizing information, procedures, and results to particular student profiles. Differentiating instruction is a practical strategy for meeting a range of educational demands, according to the studies reviewed. However, more needs to be done to improve its utilization, particularly in fostering inclusivity and boosting self-efficacy.

Types of Differentiation

Content differentiation is modified according to students' interests and prior knowledge. While lower-proficiency pupils work on well-known subjects, advanced students tackle more difficult ones. Process differentiation involves adjusting preparation time to correspond with student readiness. While struggling students receive more preparation time and larger teams for help, stronger students complete a challenge in pairs or small groups. Moreover, product differentiation modifies the standards for student performance (Ortega et al., 2018).

According to Melesse and Belay (2022), prioritizing the differentiation of the learning environment and content over the differentiation of process and product alone is essential. Teaching strategies (process differentiation) and the classroom setting (learning environment differentiation) must be modified before students may successfully demonstrate learning (product differentiation). Substantial empirical evidence for diversified instruction underscores the need for adaptable teaching strategies to accommodate the diverse learning styles of students. It examines the connection between differentiated instruction (differentiation in content, process, product, and learning environment) and student qualities (background knowledge, interest, preparedness, and learning profile). Confirming that student traits had a direct and indirect impact on differentiated instruction. Show that student characteristics directly influence learning environment and content differentiation more so than process and product differentiation. Product differentiation is most directly impacted by process differentiation, which is heavily influenced by content differentiation. Furthermore, the influence of student qualities on product differentiation is mediated by process and learning environment differentiation, highlighting the critical role that classroom environment and instructional strategies play in shaping student learning outcomes.

According to Ipah (2023), the importance of product differentiation in problem-based learning for real-world problem-solving in education is emphasized. Students become more engaged with the material and develop their critical thinking and creative skills when they are allowed to assume various roles. The results highlight the value of differentiated instruction in classrooms by indicating that creative teams with a diverse membership foster creativity. The best results were obtained by groups with a variety of learning styles (visual, auditory, and kinesthetic), especially those who successfully integrated practical problem-solving with thorough implementation strategies. Promoting critical thinking, teamwork, and solution-oriented learning, problem-based learning stimulates creativity. As a result, problem-based learning with product differentiation enhances creativity by allowing students to engage in real-world problem-solving through diverse outputs.

Sriyanti et al. (2024) say that differentiated learning tries to meet the needs of students with different learning styles, interests, and talents. Still, it can't be fully used because of practical and technical problems. Teachers frequently find it challenging to modify their differentiation strategies to accommodate the varied learning preferences and readiness levels of their students. Although it can improve student comprehension and engagement, properly implementing diversified learning is still difficult. Effectively meeting the varied needs of children necessitates flexible lesson planning, institutional support, and teacher preparation. Finding a balance between structure and flexibility is key to making differentiation an effective and sustainable teaching strategy. By improving understanding and participation, differentiated learning increases educational efficacy and inclusivity. Teachers should employ a variety of teaching methods. (Susanti, 2024)

According to Borja et al. (2015), the study examines how differentiation in content, method, product, and learning environment can enhance student learning in the classrooms. Adapting lessons and resources to each student's aptitude and interests is known as content differentiation. Process differentiation places a strong emphasis on a range of instructional techniques, such as role-playing, dialogue, and peer collaboration. Due to product differentiation, students can demonstrate their knowledge in various ways, including oral presentations, debates, and storytelling.

Collaboration, respect, and tailored learning support are all enhanced by differentiating the learning environment. To meet the diverse needs of their students, teachers must adapt their lesson plans and employ flexible teaching methods that foster participation and comprehension. Differentiated instruction makes learning more efficient and individualized while improving academic performance, motivation, and language acquisition. Contrary to Smale-Jacobse et al. (2019), differentiated instruction (DI) is essential for addressing student diversity.

To improve the teaching and learning process in secondary schools, the Department of Education (DepEd) Order No. 52, s. 2010 specifies the execution of the Science and Mathematics Equipment (SME) Project. Emphasizing hands-on and inquiry-based learning strategies, this program fits the 2010 Secondary Education Curriculum (SEC).

The SME Project gives public high schools the lab equipment and teaching materials they need to help students get better at math and science. The goal of the directive is to close the gap between academic learning and real-world use in a variety of fields, since it values learning by doing. The SME Project is a key support system for improving the quality of teaching and helping students succeed by promoting a stronger foundation in scientific inquiry and mathematical reasoning. The initiative helps to achieve the general aim of quality secondary education in line with world standards by providing schools with contemporary learning resources (DepEd Order No. 52, s. 2010).

CONCLUSIONS

This meta-synthesis shows that Differentiated Instruction (DI) is a useful and effective way to teach that helps students learn better, especially in math. DI lets teachers meet students where they are by taking into account their different levels of readiness, learning styles, and interests. Research indicates that effective implementation of differentiated instruction (DI) occurs through strategies such as tiered tasks, flexible grouping, and diverse assessments. It leads to a better understanding of concepts, stronger problem-solving skills, increased engagement, and greater student independence.

DI appears to have little effect on students' attitudes, such as their feelings about math or their confidence in their ability to learn, despite promoting academic progress. This shows that we need more ways to get students interested in their education and keep them motivated. Another important factor in the success of DI is how ready and supported teachers are. Without ongoing training, support from the institution, and flexible curriculum plans, it can be hard to put DI into practice well. The research also underlines the importance of balancing the different forms of differentiation, which are content, process, product, and learning environment. Adapting what students learn and the environment in which they learn seems most closely tied to their needs. Meanwhile, how students learn and demonstrate what they have learned depends heavily on thoughtful lesson design and delivery. Real-world approaches, such as problem-based learning, can add even more value, encouraging creativity, teamwork, and critical thinking skills that are essential in today's classrooms.

Despite the many benefits, teachers still face real challenges, including large class sizes, limited time, a lack of resources, and insufficient training, which can all hinder their effectiveness. Overcoming these barriers requires schools and education systems to commit to providing meaningful support, clear policies, and flexible teaching frameworks that support student learning.

Efforts like the Philippines Department of Education's SME Project demonstrate how national-level support, such as providing tools for hands-on learning, can reinforce the goals of differentiated instruction, particularly in subjects like math and science.

While DI is not a perfect solution, it remains one of the most effective ways to ensure every student gets a chance to succeed. With the proper support, training, and resources, teachers can use DI to create more inclusive, responsive, and engaging classrooms where all learners thrive.

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