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The Impact of Differentiated Instruction on High School Students' Math Learning Self-Efficacy

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Abstract:

This study primarily examines the effect of differentiated instruction on high school students' math learning self-efficacy. Differentiated instruction refers to designing teaching content based on students' varying knowledge foundations and learning abilities to enhance their learning confidence. Grounded in Bandura's self-efficacy theory, this research analyzes how differentiated instruction strengthens students' math learning self-efficacy by providing successful experiences, vicarious experiences, verbal persuasion, and optimizing emotional states. Research findings indicate that students in classes implementing differentiated instruction achieve higher mathematics scores and exhibit greater learning efficacy compared to those in classes without differentiated instruction. Research indicates this model significantly improves classroom engagement, academic performance, and test scores, enabling the learning efficacy of the vast majority of students to be enhanced to a certain degree. However, a low probability of adverse effects on a minimal number of students exists. This has resulted in a decline in learning efficacy rather than an improvement. The study concludes with recommendations for dynamic class adjustments and teacher care, offering research directions for optimizing differentiated instruction practices.

Keywords: High school students; Differentiated instruction; Learning self-efficacy.

1. Introduction

In China, high school mathematics presents a formidable challenge—not only due to the steep increase in knowledge complexity but also because it marks the transition from concrete operations to abstract thinking and logical reasoning. This transitional phase is precisely when students' interest and confidence in mathematics learning often experience a dramatic decline. To address this, some schools implement tiered instruction in mathematics, delivering knowledge more targeted to enhance students' sense

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of efficacy. Stratified instruction is a pedagogical strategy guided by the educational philosophy of "focusing on students' sustainable, positive development" [1]. Its core principle involves teachers designing tiered instructional content based on students' individual knowledge foundations, interests, and learning styles to help each student advance beyond their current level. In the context of mathematics learning, high school students' mathematical efficacy is defined as their subjective assessment of their ability to acquire knowledge and solve problems in mathematics [2].

This theory is grounded in Vygotsky's Zone of Proximal Development and Gardner's Theory of Multiple Intelligences, with Bandura's Social Cognitive Theory serving as its core logic. This theory emphasizes the triadic interaction among the individual, behavior, and environment ("triadic interactionism"). It posits that human learning arises not only from direct experience (e.g., trial and error) but also from observational learning of others' behaviors and their outcomes (also known as "vicarious learning"). Self-efficacy serves as the central concept within this framework [3]. Self-efficacy is significant because it reflects an individual's actions when confronting challenges. Individuals with high self-efficacy are more likely to persevere, while those with low self-efficacy tend to avoid challenges. Self-efficacy is the central concept of this theory [4]. Bandura proposed that an individual's self-efficacy primarily stems from four sources: First, successful experiences, such as high school students independently solving challenging math problems or making progress in their studies; Second, vicarious experiences, such as observing classmates (especially those of similar ability) mastering mathematics through effort and achieving good grades; Third, verbal persuasion, including encouragement from mathematics teachers, parental affirmation, or positive peer feedback; Fourth, physiological and emotional states, such as the calm confidence (or tension and anxiety) high school students experience when confronting challenging mathematical problems. These factors collectively influence their assessment of their own mathematical abilities.

Research gaps in this field may stem from insufficient studies bridging academic performance and psychological factors, or a lack of empirical research. Its significance lies in precisely addressing the diverse needs of students across different performance levels, aligning perfectly with the educational principle of "teaching according to individual aptitude" to enhance teaching efficiency. The research questions are: Can differentiated instruction improve students' math performance? Can differentiated teaching models enhance students' sense of learning efficacy? What are the differences between implementing and not implementing differentiated instruction? This study offers two key contributions: First, for instructors, it alleviates concerns about academic polarization among students within the same classroom. Second, for high school students, it ensures learners across different score brackets access age-appropriate content, reducing learning difficulty and frustration. This facilitates task completion and strengthens confidence in mastering mathematical challenges [5].

2. The Significance of Implementing Tiered Instruction

The rationale for implementing tiered instruction lies in the inadequacy of traditional one-size-fits-all teaching methods to address students' diverse learning needs. Within a 45-minute class period, educators cannot adequately cater to students of varying academic abilities, resulting in some students feeling "underchallenged" while others struggle to "keep up"[6]. Consequently, certain schools have adopted tiered instruction models to mitigate these issues. The significance of differentiated instruction lies in its provision of a practical pathway to implement the principle of "teaching according to individual aptitude." Its core value is respecting and accommodating students' individual differences. Each student no longer needs to adjust to others' paces, as within classes of similar ability levels, everyone progresses at comparable rates during each lesson. For students with weaker foundations, more fundamental concepts can reignite their enthusiasm for mathematics. For higher-achieving students, this approach offers greater exposure to challenging problems. Thus, by setting learning objectives and tasks of varying difficulty and replacing rote memorization with experiential learning, differentiated instruction precisely targets each student's Vygotskyian "zone of proximal development" [7]. Consequently, the paper believes this teaching model may enhance students' sense of efficacy, increase classroom engagement, and ultimately promote academic achievement. This is the significance of implementing differentiated instruction. Furthermore, differentiated instruction fosters a more inclusive and supportive learning environment. This personalized teaching approach not only enhances academic performance but also contributes to promoting students' mental well-being.

3. Enhancing High School Students' Math Learning Self-Efficacy Through Differentiated Instruction

Differentiated instruction elevates students' math learning

self-efficacy through multiple mechanisms. Bandura posits that individual self-efficacy primarily stems from four sources: direct experience, vicarious experience, verbal persuasion, and physiological and emotional states. First, differentiated instruction creates more "successful experiences" by precisely matching students' cognitive levels with instructional difficulty. Second, it provides high-quality "vicarious experiences." Average or struggling students no longer need to compare their performance with top performers, fostering the belief that success is achievable through effort and thereby strengthening self-efficacy [8]. Third, it enhances the effectiveness of teachers' "verbal persuasion." Educators gain deeper insights into each student's learning trajectory, enabling them to offer encouragement during slumps rather than undermining students' capabilities. Finally, differentiated instruction optimizes students' "emotional states" by eliminating feelings of being 'underchallenged' or "overwhelmed," thereby reducing anxiety and boredom. Research indicates positive emotional states significantly enhance students' learning confidence and engagement [9].

4. Impact of Implementing Tiered Instruction

On the positive side, this approach addresses traditional teaching methods' "one-size-fits-all" limitation. Within the same class, students no longer experience being 'underchallenged' or "struggling to keep up," and the disparity in academic performance gradually diminishes. This benefit extends beyond the classroom: homework assignments align more closely with the knowledge covered in class. Students no longer face the dilemma of skipping easy problems or struggling with difficult ones, reducing homework completion time, and enhancing their sense of learning efficacy. Similarly, from the teacher's perspective, this approach alleviates lesson preparation pressure. Educators no longer need to worry about asking questions of varying difficulty levels that could disrupt classroom efficiency due to students' differing math abilities.

However, differentiated instruction also carries certain drawbacks. When students are grouped into classes based on performance, those in lower-performing classes may perceive themselves as labeled "poor students" [10], developing resistance toward mathematics and experiencing further declines in performance. This not only fails to enhance students' learning efficacy but also yields diminishing returns. Therefore, at the start of each new semester, classes should be reorganized based on the previous semester's math grades. Given the significant increase in difficulty between semesters, timely adjustments to class composition are essential to ensure every student learns in a class suited to their current level. Additionally, teachers should provide encouragement and affirmation, emphasizing that the specific class placement matters less than the student's attitude toward learning, thereby helping to rebuild their sense of learning efficacy. However, China's education system suffers from inequities [11], with vast disparities in teaching quality between urban and rural areas, as well as significant differences in teacher availability. To address this, strategies include pairing high-performing students with teachers to co-tutor struggling peers or utilizing multimedia devices to stream online courses, thereby broadening students' access to knowledge. Another potential downside is that it may limit students' opportunities for advancement. This dynamic approach ensures students are always placed in an environment aligned with their current abilities and needs, preventing stagnation and fostering continuous growth.

5. Analysis of the Mechanism of Differentiated Instruction Among Different Student Groups

After implementing differentiated instruction for one semester, interviews were conducted with three distinct groups: students with weaker foundations, students with average performance, and top-performing students.

Students with Weaker Academic Performance: Research indicates that for students with weak mathematical foundations, the primary function of differentiated instruction is to adjust the learning slope, setting instructional goals within their "zone of proximal development". As the saying goes, "Without a solid foundation, one cannot climb high in learning" [12]. Consequently, they no longer doze off or engage in unrelated activities in math class. Instead, they perk up and listen attentively to the teacher. When tasks no longer exceed their capabilities, students gain the core source of "self-efficacy"—namely, "successful experiences"—by completing tasks independently. Gradually, their grades improve, and their sense of learning efficacy naturally rises. For these students, the customized approach of differentiated instruction helps bridge gaps in knowledge accumulated over years of unfamiliarity with certain concepts. Consequently, to improve their math performance, they gradually become more active participants in their learning journey, cultivate a more positive attitude, and develop a stronger belief in their ability to succeed.

Students with average grades: Research indicates that students at the middle level face a dilemma of being neither as outstanding as top performers nor willing to settle for mediocrity, often caught between "aiming too high and

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falling short, or aiming too low and failing to reach" [13]. Therefore, their goal should be steady progress rather than rushing for quick results or following the crowd. Their learning challenges are often more subtle, and traditional one-size-fits-all teaching models make it difficult for them to receive targeted guidance. After implementing differentiated instruction, students addressed their weaknesses by aligning them with the knowledge points taught by the teacher. They tackled problems from the ground up, gaining a clearer understanding of why they had previously failed—it was due to inadequate methods, not insufficient ability [14].

Top Students: Top students are a rare minority. Research indicates that their learning efficacy often improves through solving a particularly difficult problem. When grouped with most average-performing students, they perceive the material as overly simplistic, disengage from classroom interactions, and lose interest in mathematics. After implementing tiered instruction, dedicated teachers address challenging problems with them, unifying their problem-solving approaches and significantly boosting their motivation [15], thereby further enhancing their academic self-efficacy. In addition, for high-achieving students, grouping with peers of comparable ability fosters healthy competition and collaboration, further enhancing their learning experience and sense of self-efficacy.

6. Recommended Measures

Implement timely dynamic class adjustments: High school mathematics features highly challenging content each semester, with strong conceptual independence. A student's underperformance in one semester does not necessarily predict continued poor performance in the next. Therefore, classes should be reorganized at the start of each new semester to ensure students consistently learn in environments matching their current ability levels, thereby sustaining high learning efficacy [16]. This approach effectively implements differentiated instruction, allowing each student to learn content aligned with their individual capabilities.

Regularly monitor students' mental health: A small proportion of students with fragile self-esteem placed in lower-performing classes may develop psychological issues, ranging from mild anxiety and worry to severe depression risks. Therefore, schools should enhance teachers' (or, where feasible, dedicated counselors') attention to students' mental health. Regular communication should be maintained with students experiencing prolonged anxiety, offering stress-relief strategies such as listening to light music to briefly clear the mind [17]; breathing fresh air on the playground and performing stretches to ease nervous tension. Through these simple psychological interventions, students will gradually emerge from anxiety, regain confidence in their mathematical abilities, and see their learning efficacy restored.

Implementing Student Collaborative Learning in Small Groups: Some students hesitate to ask questions out of fear of being reprimanded by teachers with remarks like "I've explained this so many times, why don't you get it?" This reluctance leads to weak mastery of certain concepts, creating a bottleneck effect [18]. However, this fear does not exist among peers. Therefore, forming study groups with three students who struggle with math fundamentals and one with average math skills allows group members to actively ask questions, learn from each other, progress together, and work collectively. Approaching problems from a peer perspective facilitates mutual understanding, optimizes time utilization, and resolves students' reluctance to seek teacher assistance. Only by thoroughly explaining and mastering challenging problems—thus strengthening the weakest link—can mathematical performance improve, naturally enhancing students' sense of learning efficacy.

Strengthening Teacher Professional Development and Support: Implement specialized training in differentiated instruction, such as establishing teacher learning communities. Encourage mathematics teachers within the same grade level to form lesson planning teams, holding weekly collective lesson preparation and discussion sessions at fixed times. Share challenges encountered and successful practices in differentiated teaching, collaboratively develop tiered learning materials and assessment tools. This approach enables peer learning and knowledge exchange among teachers, thereby indirectly enhancing students' sense of efficacy in mathematics learning.

7. Conclusion

This study found that implementing differentiated instruction can enhance the mathematical self-efficacy of the vast majority of high school students. Thus, it is evident that the differentiated instruction model plays a significant role. Most students demonstrate enthusiasm in class, engage willingly with teachers, and consequently achieve academic improvement, leading to heightened learning efficacy. However, a small number of students remain trapped in underperforming classes, labeled as "poor students," and suffer from internal conflicts. Despite teachers' encouragement and guidance, their learning efficacy has actually diminished. To better leverage the benefits of differentiated instruction for enhancing high school students' mathematical self-efficacy, two measures are recommended: First, promptly adjust class placements af-

ter each semester‘s final exams, moving high-performing students to advanced classes while reassigning those experiencing academic decline to intermediate or lower-level courses. Second, teachers should strengthen their attention to students, promptly intervening when signs of self-sabotage emerge.

This study fills a gap in understanding the specific mechanisms and variations of differentiated instruction‘s impact, holding significant research value. It confirms that differentiated teaching models can benefit students and teachers in the classroom, fostering greater student enthusiasm for learning while alleviating teachers‘ lesson preparation burdens. Furthermore, this research offers a new perspective for subsequent studies and suggests extending differentiated teaching models to other subjects to explore their effects on learning efficacy further.

This study has several limitations. The sample was relatively homogeneous and restricted to mathematics, potentially limiting its generalizability. Future research should therefore involve students from diverse regions and varying academic backgrounds, employing long-term, comprehensive studies to minimize random factors.

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