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Fostering Academic Resilience in Mathematics on Flexible Learning

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Abstract: *Academic resilience, as the ability to handle academic challenges and setbacks, is crucial for success, especially in difficult subjects like mathematics. This systematic review employed a comprehensive search strategy to identify relevant studies on fostering academic resilience in mathematics through flexible learning. Results revealed five (5) emerging themes on fostering academic resilience in mathematics on flexible learning, namely; (1) Emphasizing a Growth Mindset; (2) Building Self-Efficacy; (3) Incorporating Problem-Based Learning; (4) Providing Social-Emotional Support; and (5) Continuous Feedback and Reflection. Fostering academic resilience in mathematics through flexible learning involves developing a growth mindset, building self-efficacy, incorporating problem-based learning, providing social-emotional support, and ensuring continuous feedback and reflection, all of which help students navigate mathematical challenges effectively. Educational institutions may integrate these themes into their mathematics curricula, train educators accordingly, and invest in technology and social-emotional support to create flexible learning environments that enhance student resilience and success in mathematics.*

Keywords— Academic resilience; Mathematics; Flexible learning; Systematic review

1. INTRODUCTION

Academic resilience, as the capacity of students to effectively deal with academic challenges and setbacks, is a crucial factor in educational success, particularly in subjects like mathematics that often present significant difficulties for many learners (Cheung, K. (2017). The ability to persevere through tough mathematical problems and concepts is not only essential for academic achievement but also for developing critical thinking and problem-solving skills (Sengupta-Irving & Agarwal, 2017). As the educational landscape evolves, fostering this resilience has become a focal point for educators and researchers alike, especially in the context of flexible learning environments that cater to diverse student needs (Turner, Scott-Young, & Holdsworth, 2017).

Flexible learning, characterized by the use of varied instructional methods, technology integration, and adaptable learning schedules, has gained prominence as an effective approach to address the unique challenges faced by modern learners (McGarry et al., 2015). This method allows for personalized learning experiences that can be tailored to individual student's strengths and weaknesses, providing opportunities for them to build resilience by engaging with content at their own pace (Cornu, 2009). In mathematics education, where students often experience anxiety and frustration, flexible learning environments can offer the support needed to develop a resilient mindset (Imms & Byers, 2017).

The integration of technology in flexible learning environments plays a significant role in enhancing academic resilience (Al-Abdullatif & Gameil, 2021). Digital tools and resources such as interactive simulations, adaptive learning platforms, and online collaborative projects provide students with immediate feedback and alternative ways to approach mathematical problems (Hoyles, 2018). These tools not only make learning more engaging but also help students to see mistakes as learning opportunities rather than failures, thereby fostering a growth mindset which is fundamental to resilience (Yeager & Dweck, 2012).

Research has indicated that flexible learning can significantly impact students' attitudes toward mathematics, transforming it from a subject of dread to one of interest and curiosity (Mavridis, Katmada, & Tsiatsos, 2017). By offering a range of instructional methods and supports, flexible learning can accommodate different learning styles and preferences, making mathematics more accessible and less intimidating (Luzano, 2023; Luzano & Ubalde, 2023). This adaptability is particularly important for students who may have previously struggled with traditional, rigid teaching methods that did not cater to their individual learning needs.

This systematic review aims to explore the existing research on fostering academic resilience in mathematics through flexible learning. By synthesizing findings from various studies, this review seeks to identify effective strategies and practices that have been successful in promoting resilience among mathematics learners. Understanding these strategies can provide valuable insights for educators and policymakers striving to create supportive and resilient learning environments. This review contributes to the broader discourse on how best to support students in overcoming academic challenges and achieving success in mathematics.

2. METHODS

This systematic review employed a comprehensive search strategy to identify relevant studies on fostering academic resilience in mathematics through flexible learning. The review focused on peer-reviewed journal articles, conference

papers, and educational reports published within the last ten years. Key databases, including JSTOR, Google Scholar, ERIC, and PubMed, were searched using specific keywords such as "academic resilience," "mathematics education," "flexible learning," "adaptive teaching," and "Generation Alpha." Inclusion criteria mandated that studies be empirical, involving primary data collection and analysis and that they specifically address the intersection of academic resilience and flexible learning in the context of mathematics education. Articles were excluded if they focused solely on theoretical frameworks or did not provide clear empirical evidence related to the research questions.

The selected studies underwent a rigorous screening process. Initially, titles and abstracts were reviewed to assess relevance, followed by a full-text evaluation of the remaining articles. A standardized data extraction form was used to gather key information from each study, including research design, sample characteristics, interventions or instructional strategies employed, and outcomes measured. The data synthesis involved identifying common themes and patterns related to the strategies used to foster academic resilience in mathematics and their effectiveness. This process facilitated a comprehensive understanding of the role of flexible learning in promoting resilience among mathematics students.

3. RESULTS AND DISCUSSION

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Theme 1: Emphasizing a Growth Mindset

A key theme in fostering academic resilience in mathematics is the emphasis on developing a growth mindset. This concept, popularized by psychologist Carol Dweck (2014), suggests that students who believe their abilities can be developed through dedication and hard work are more likely to overcome challenges and persevere through difficulties. In mathematics, where students often face complex problems and setbacks, a growth mindset can significantly enhance resilience by encouraging a positive attitude towards learning and improvement (Zeng, Hou, & Peng, 2016).

In flexible learning environments, where students may not have constant direct support from instructors, fostering a growth mindset becomes even more critical (Ni, 2019). Educators can incorporate growth mindset principles into their teaching by encouraging self-reflection, celebrating effort and progress, and providing constructive feedback that focuses on the learning process rather than just the outcomes (Fraser, 2018). This approach helps students view mistakes as opportunities for learning and growth, thereby building their resilience and ability to tackle mathematical challenges independently (Guo & Liao, 2022).

Theme 2: Building Self-Efficacy

Self-efficacy, or the belief in one's ability to succeed in specific tasks, is another central theme in fostering academic resilience in mathematics (Cassidy, 2015). High self-efficacy can empower students to face mathematical problems confidently and persistently, even when encountering difficulties (Skaalvik, Federici, & Klassen, 2015). Strategies to build self-efficacy include setting achievable goals, providing opportunities for early success, and offering positive reinforcement and feedback (Huang, Mayer, & Usher, 2020).

In flexible learning environments, building self-efficacy can be particularly challenging due to the reduced face-to-face interaction with instructors (Thai, Wever, & Valcke, 2020). However, online tools and resources can support this process. For instance, interactive modules that allow students to practice skills at their own pace and receive immediate feedback can help them gain confidence in their abilities (Adcock, Duggan, & Perry, 2010; Luzano, 2020). Additionally, online platforms that track progress and celebrate milestones can reinforce a sense of accomplishment, motivating students to continue striving despite challenges (Naranjo et al., 2019). By fostering self-efficacy, educators can help students develop the resilience needed to navigate the complexities of mathematics (Luzano, 2024).

Theme 3: Incorporating Problem-Based Learning

Problem-based learning (PBL) is an instructional method that uses complex, real-world problems as a context for students to develop problem-solving skills and acquire knowledge (Hmelo-Silver, 2004). This approach is particularly effective in fostering academic resilience in mathematics, as it engages students in meaningful tasks that require persistence, critical thinking, and collaboration (Cheung, 2017). PBL encourages students to take ownership of their learning, build perseverance, and develop strategies for overcoming obstacles (Wilder, 2015).

In flexible learning environments, PBL can be adapted to online and hybrid formats, allowing students to work on projects individually or in virtual teams (Yeh, 2010). This approach not only enhances mathematical understanding but also builds resilience by requiring students to tackle challenging problems, seek out resources, and iteratively refine their solutions (Harsela, Asih, & Dasari, 2021; Nallada et al., 2024). The iterative nature of PBL, where students are expected to try, fail, and try again, aligns well with the development of resilience (Vitale, 2017). It helps students become comfortable with the iterative process of learning and equips them with the skills and mindset needed to persist through difficulties (Andrade et al., 2020).

Theme 4: Providing Social-Emotional Support

Social-emotional support is a vital theme in fostering academic resilience, particularly in the context of flexible learning where students might feel isolated (Beri & Kumar, 2018). Building a supportive learning community can help students manage stress, cope with setbacks, and maintain motivation (Stefanou & Salisbury-Glennon, 2002). Social-emotional learning (SEL) initiatives, such as teaching emotional regulation, goal-setting, and interpersonal skills, can

enhance students' ability to handle academic challenges (Low et al., 2019).

In flexible learning environments, providing social-emotional support requires intentional strategies to foster connection and community (Kirk & MacCallum, 2017). Online discussion forums, virtual office hours, and peer mentoring programs can help students feel connected and supported (Luzano, 2024). Educators can also integrate SEL activities into the curriculum, such as reflective journaling, mindfulness exercises, and group discussions about coping strategies (Olive, Gaudreault, & Lucero, 2021). By addressing the social-emotional aspects of learning, educators can help students build the resilience needed to face mathematical challenges with confidence and persistence (Beri & Kumar, 2018).

Theme 5: Continuous Feedback and Reflection

Continuous feedback and reflection are essential components in fostering academic resilience in mathematics (Granville & Dison, 2009). Regular feedback helps students understand their progress, identify areas for improvement, and stay motivated (Luzano, 2023). Reflection encourages students to think critically about their learning processes, recognize their achievements, and develop strategies for overcoming challenges (Aranzo et al., 2023; Pang-an et al., 2023). Together, these practices help students build resilience by promoting a growth-oriented approach to learning.

In flexible learning environments, continuous feedback and reflection can be facilitated through various digital tools and platforms (Leinonen et al., 2016; Casanova et al., 2023; Romorosa et al., 2023). For instance, learning management systems can provide timely feedback on assignments and assessments, while reflective journals and e-portfolios can encourage students to document their learning journey and set goals (Buzzetto-More, 2010; Luzano et a., 2024). Educators can also create opportunities for self-assessment and peer feedback, fostering a culture of continuous improvement and resilience (Tortola, 2021; Concina, 2022). By embedding feedback and reflection into the learning process, students are better equipped to navigate the challenges of mathematics and develop the resilience needed for academic success (Rakoczy et al., 2013).

4. CONCLUSION AND RECOMMENDATION

Fostering academic resilience in mathematics through flexible learning environments involves a multifaceted approach that incorporates the development of a growth mindset, building self-efficacy, incorporating problem-based learning, providing social-emotional support, and ensuring continuous feedback and reflection. Each of these elements plays a critical role in helping students navigate the complexities of mathematical concepts and challenges. By emphasizing a growth mindset, educators can encourage students to view difficulties as opportunities for growth. Building self-efficacy empowers students to believe in their capabilities, while problem-based learning engages them in meaningful, real-world tasks that build perseverance. Social-emotional support fosters a sense of community and belonging, crucial for maintaining motivation and managing stress. Continuous feedback and reflection help students track their progress and develop strategies for improvement. Collectively, these strategies create a supportive and adaptive learning environment that enhances academic resilience in mathematics.

Educational institutions may prioritize integrating these themes into their mathematics curricula and teaching practices. Professional development for educators may include training on fostering a growth mindset, building self-efficacy, and implementing problem-based learning effectively. Additionally, schools may invest in technological tools that facilitate continuous feedback and reflection, as well as platforms that provide robust social-emotional support networks for students. By adopting these recommendations, educators can create flexible learning environments that not only improve mathematical understanding but also equip students with the resilience necessary to overcome academic challenges and achieve long-term success.

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