

Research on Mathematical Resilience: A Literature Review

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Abstract

This systematic review has the objective to define the concept and to analyze the empirical studies of mathematical resilience through the following procedures: 1) developing a research question; 2) defining selection criteria; 3) developing the search strategy; 4) study selection process; 5) appraising the quality of studies; and 6) synthesis result. 19 articles were selected and reviewed in total. This study shown the concept representation and also insight of empirical studies about mathematical resilience.

Keywords: *Systematic Review, Mathematical Resilience.*

Abstrak

Ulasan sistematis di penelitian ini bertujuan untuk mendefinisikan konsep dan menganalisis studi empiris dari resiliensi matematis melalui prosedur berikut: 1) Mengembangkan pertanyaan penelitian; 2) Menentukan kriteria seleksi; 3) Mengembangkan strategi penelusuran; 4) Proses seleksi studi; 5) Menilai kualitas studi; dan 6) Mensintesis hasil. Terdapat 19 artikel yang dipilih dan diulas. Penelitian ini menunjukkan konsep-konsep dan persepsi dari studi empiris mengenai resiliensi matematis.

Kata kunci: Ulasan Sistematis, Resiliensi Matematis

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INTRODUCTION

There are various difficulties in the process of learning mathematics, especially in an effort to improve the mathematical ability to be achieved. The difficulties in studying and mastering mathematics are reasonable because mathematics is a lesson that requires students to think logically, systematically and reflectively, diligently, thorough and earnest effort (Hutauruk & Priatna, 2017; National Research Council, 2001). Therefore, one aspect of learning that needs attention is the non-intellectual aspect according to Hutauruk in NCTM (2017; 2000), namely affective skills such as persistence, unyielding, inquisitive and confident, and understanding the role of mathematics in real life.

In the learning process, some students may have some unpleasant but inevitable experiences. Students have experienced failure and times of difficulties in the learning process. The experience is certainly irreversible, but its negative effects can be reduced or even eliminated by developing resilient learning abilities (Hutauruk & Priatna, 2017; Reivich & Shatté, 2002).

As a result of research on math anxiety in the fields of education and psychology, studies on the phenomenon of school and mathematical resilience have been increasingly common in the international arena (Johnston-Wilder & Lee, 2010; Johnston-Wilder & Moreton, 2018). The term

resilience in psychology has been used to describe a set of abilities that allow a person to avoid the consequences of a difficult situation or even achieve success and experience personal growth despite failures. In the social sciences, this phenomenon was first described in the 1970s (Luthar, 2003; Oszwa, 2022). With regard to mathematics education, the term used in the past was the student's emotional hardiness in mathematics (Ariyanto et al., 2017; Oszwa, 2022), understood as permanent features and adaptive abilities that allow an individual to develop positively despite struggles and stress.

Although resilience was well-researched and investigated, some properties of students' mathematical resilience was not focused on details. Hence, this current study is realized that there should be an identification of concept and reviews on empirical studies about mathematical resilience. Furthermore, this study may contribute to the body of literature, and serve as a guide for researchers in mathematics education to progress the educational system in Indonesia and beyond.

METHOD

This study was conducted in systematic literature review by representing transparency and rigorous research methods (Newman & Gough, 2020). The primary objective of this review is to critically evaluate the existing body of research on the topic under investigation. This study followed the research methods of Aisyah and Juandi (2022), consisting of six steps which outlined below.

Develop Research Question

This study proposed the following research questions as an act to the background of study: 1) What is defined as mathematical resilience?; and 2) How are the empirical studies about mathematical resilience?

Selection Criteria

The next step in the study procedures was to define selecting criteria. This process involved the application of multiple sets of inclusion and exclusion criteria to the article search process. The purpose of these criteria was to ensure that only articles meeting the predetermined standards were selected for inclusion in the study.

Table 1 displays the selection criteria employed in this study.

Criteria	
Inclusion	<ol style="list-style-type: none"> 1. Articles were the results of research published in a journal or proceeding. 2. Articles published from 2019 to 2023. 3. Articles were written either in English or Indonesia
Exclusion	<ol style="list-style-type: none"> 1. Chapter book, thesis, and brief report 2. Articles published outside of the stated timestamp 3. Articles were not written either in English or Indonesia

Table 1 Selection Criteria

Developing the Search Strategy

The present study performed an analysis of academic papers obtained from various electronic repositories, including Crossref. The articles were chosen with the aid of the software tool Publish or Perish, and subsequently underwent an intensive review process. The current investigation utilized the search term “mathematical resilience” and “resiliensi matematis” to extract academic papers from various databases.

The Study Selection Process

In the course of this study, a search strategy was formulated and implemented. The articles and abstracts obtained through this strategy were subjected to an initial screening process to assess their relevance and adherence to predetermined selection criteria. Following the initial screening process, a comprehensive evaluation of the article was conducted. Articles that did not satisfy the predetermined selection criteria and were deemed irrelevant were excluded from further analysis.

Appraising the Quality of Studies

Following the process of study selection, the articles are subjected to an evaluation of quality based on a set of predetermined criteria in order to determine their relevance to this study. The following are the quality assessment criteria: 1) Does the article discuss mathematical resilience in the educational domain?; and 2) Does the article have a research problem that is relevant to this study?.

Synthesis Result

The present study aimed to provide a comprehensive analysis of the mathematical resilience. To achieve this objective, the synthesis procedure was executed in accordance with the research objectives. This study undertook a thorough examination of the contents of each article, followed by the identification of defined concept and empirical studies of mathematical resilience. These findings were afterwards used to address the research questions that were formulated.

RESULT AND DISCUSSION

A total of 19 from 1214 articles have been determined to have met the selection and quality criteria through the selection process.

Table 2 shown a bit details of the papers included.

Study	Method	Level	Country
(Fembriani et al., 2023)	Qualitative	Elementary School	Indonesia

(Arbain & Sirad, 2023)	Quantitative	Elementary School	Indonesia
(Arjun & Muntazhimah, 2023)	Quantitative	High School	Indonesia
(Oszwa, 2022)	Literature Review	-	Poland
(Khumalo et al., 2022)	Qualitative	High School	South Africa
(Yohanes & Darmawan, 2022)	Qualitative	University	Indonesia
(Casinillo et al., 2022)	Quantitative	High School	Philippines
(Faradillah & Humaira, 2021)	Qualitative	High School	Indonesia
(Murni et al., 2021)	Quantitative	University	Indonesia
(Faradillah & Fadhilah, 2021)	Qualitative	Secondary, Vocational, and High School	Indonesia
(Haerani et al., 2021)	Qualitative	Elementary School	Indonesia
(Tambunan, 2021)	Quantitative	School	Indonesia
(Ishak et al., 2020)	Literature Review	-	Malaysia
(Attami et al., 2020)	Quantitative	Secondary School	Indonesia
(S. Rohmah et al., 2020)	Qualitative	Secondary School	Indonesia
(Athiyah et al., 2020)	Mixed	Islamic High School	Indonesia
(Syahrur Rohmah et al., 2020)	Quantitative	Secondary School	Indonesia
(Rokhmah et al., 2019)	Quantitative	Vocational School	Indonesia
(L. S. Zanthly et al., 2019)	Quantitative	High School	Indonesia

Table 2 Studies included in the review

The Concept of Mathematical Resilience

In the field of education, Clare Lee and Sue Johnston-Wilder (2017; 2022) suggested that mathematical resilience should become the term used to describe a student maintaining positive emotions toward mathematics despite difficulties that they may experience and associate with the subject. Such an approach, which assigns a specific attribute of resilience, associating it with a given field (for example, mathematical resilience or sports resilience) is consistent with the partial approach to wellbeing. On the one hand, wellbeing can be discussed as a general assessment of one's own life, but on the other hand, it could be perceived as physical, spiritual, or creative well-being. Thus, mathematical resilience is a special type of resilience, an emotional and mental phenomenon related to the ability to return to a state of equilibrium despite periodic difficulties in learning mathematics.

Focusing on the positive aspects of mathematics education can prove to be beneficial, not only in the context of preventing math anxiety, but also in making mathematics a field of knowledge

accessible to many, and not reserved only for the mathematically gifted students. This is especially important in view of the research on gender stereotypes in mathematics (Bieg et al., 2015) and the threat that this stereotype poses among girls (Finnigan & Corker, 2016).

Analyses of students who manifest resilience in life situations consistently reveal the presence of three factors: a) individual immune resources, b) emotional support from parents, and c) a supportive psychosocial environment that encourages interaction, a creative approach to tasks, cooperation, and the development of problem-solving skills (Johnston-Wilder & Lee, 2010). Researchers have pointed out that students' mathematical resilience can be developed by emphasizing the value of effort in the education process and encouraging the student to make further attempts despite failures (Pieronkiewicz & Szczygieł, 2019). It is important for the teacher to have a flexible approach to the student, focusing on their development and encouraging them to take up challenges with attention on effort being the driving force of success (Dweck, 2017).

Since 2008 (2020), there have been many papers produce to discuss the use of mathematical resilience. It is an approach that assembles all the support needed to encounter mathematics problems. For many people, mathematics is something that they need to face until the end of school, but many choose to avoid it as soon as school is over (Ishak et al., 2020; Lee & Johnston-Wilder, 2017). There are four aspects of mathematical resilience which are:

- Growth mindset
- The personal value of mathematics
- Knowing that mathematics requires struggle
- And knowing how to find support when pursuing mathematics learning.

Mathematical resilience can be concluded as a positive stance when learner find mathematics is challenging, and they will find new strategies to overcome it. There are three effective domain to be a resilient mathematical learner which are Value (consider experience learning mathematics is valuable), Struggle (recognize that everyone face hardship with mathematics) and Growth (a belief that all people can develop mathematics skills) (Lee & Johnston-Wilder, 2017).

An Overview of Empirical Studies of Mathematical Resilience

In Elementary School level, study of Arbain (2023) implied that contextual and construct approach helped in promoting students mathematical resilience and numeration and also literacy. Mathematical resilience being highlighted here as an important role in mathematics learning since it contributed in improving students academic achievement (Luvy Sylviana Zanthi, 2018). Haerani (2021), concerning about students work in solving word problems found that low resilient level students having comprehension errors, moderate resilient level students making transformation errors, dominantly, while high resilient level students answering more questions correctly, having only a bit processing skill errors. A conducted research from Fembriani (2023) found that students with high mathematical resilience have mathematical literacy skills, which are aspects of formulate, employ and interpret.

Students with medium resilience have mathematical literacy skills, which are aspect of formulating problems, while students with low mathematical resilience do not have the three abilities of mathematical literacy.

An overview in Secondary School level, Attami (2020) implied that there was a positive contribution of mathematical resilience to problem solving ability. Rohmah (2020) concluded that students with high resilient level to be having better problem solving ability than the lower resilient level students. On the other hand, Rohmah (2020) also found that this condition was also met in connection ability. Faradillah (2021), while simultaneously conducting the study at secondary, vocational, and high school, concerning mathematical problem solving on slow learners shown that there was a directly proportional correlation with mathematical resilience.

Studies in Vocational and High School level, such as by Arjun (2023) confirmed that there was a positive contribution of mathematical resilience to problem solving. Khumalo (2022), doing it in qualitative way, got an insight that weathering the storm strategy could promote mathematical resilience. Athiyah (2020), through a correlation study, come up with the results that shown there was a slight positive connection between mathematical resilience and mathematical problem solving. Zanthly (2019) come with a result that most of students that was going through purposive sampling were having medium resilient level. However, several studies come up with different results. Arjun (2023) found that there was no slight connection between mathematical resilience and mathematical anxiety. Rokhmah (2019), with the same approach also found there were no slight connection between mathematical resilience and mathematics achievement. In qualitative way, Faradillah (2021) said that high resilient level students were having a low level of critical thinking ability, while low and moderate resilient level students were having moderate level of critical thinking ability.

As of University level studies, Yohanes (2022) confirmed that mathematical resilience could be promoted through Project Based Learning (PBL). Through correlation study, Murni (2021) found that mathematical resilience, simultaneously with students perception, were having a slight positive connection with mathematical power.

CONCLUSION

Based on the findings and discussion that were discussed, it can be confirmed that Mathematical resilience can be concluded as a positive stance when learner find mathematics is challenging, and they will find new strategies to overcome it. The empirical studies, mostly, found that mathematical resilience was contributed in mathematics learning. However, there has to be further investigation for which there may be another factors beside of mathematical resilience.

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