Analysis of Students' Error in Learning of Quadratic Equations : Systematic Literature Review

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Abstract: Quadratic equations are an important topic in mathematics at the secondary school level because this topic is widely used in solving problems in subsequent materials such as functions, logarithms, trigonometry, and several other materials. However, many students still make mistakes in solving quadratic equation problems. This study aims to get an overview of student errors in solving quadratic equation problems. The method used in this research is a systematic literature review. After going through the inclusion and quality test stages, the literature reviewed was 12 articles. The results of this study show that there are several student errors in quadratic equation material, namely concept errors, procedural errors, and operation errors and the factors that cause them are students not understanding the problem well, not understanding the sequence of steps used to solve the problem, and not being careful in calculating the final result, forgetting, answering originally and rushing in calculating.

Keywords: Students' error; Quadratic equation; Systematic literature review

Abstrak: Persamaan kuadrat merupakan topik penting dalam matematika di tingkat sekolah menengah karena topik persamaan kuadrat ini banyak digunakan dalam menyelesaikan masalah pada materi selanjutnya seperti fungsi, logaritma, trigonometri, persamaan dan pertidaksamaan nilai mutlak dan beberapa materi lainnya. Namun, pada beberapa penelitian masih banyak ditemui siswa yang melakukan kesalahan dalam menyelesaikan soal persamaan kuadrat. Penelitian ini bertujuan untuk mendapatkan gambaran kesalahan siswa dalam menyelesaikan masalah pada materi persamaan kuadrat. Metode yang digunakan dalam penelitian ini adalah sistematik literature review (SLR). Setelah melalui tahapan uji inklusi dan uji kualitas, literatur yang direview ada sebanyak 12 artikel. Hasil penelitian ini menunjukkan bahwa terdapat beberapa kesalahan siswa pada materi persamaan kuadrat yaitu kesalahan konsep, kesalahan prosedural, dan kesalahan operasi. Adapun faktor penyebab terjadinya kesalahan adalah siswa kurang memahami masalah dengan baik, tidak memahami urutan langkah-langkah yang digunakan untuk menyelesaikan masalah, dan tidak teliti dalam menghitung hasil akhir, lupa rumus, menjawab asal-asalan dan terburu-buru dalam menghitung.

Kata kunci: kesalahan siswa; persamaan kuadrat; Systematic literature review

Introduction

A quadratic equation is a mathematical equation where the variable has the highest power of two. A quadratic equation is generally defined as $ax^2 + bx + c = 0$, where a≠0, and a, b are coefficients, and c is a constant. This topic of quadratic equations is related to previous material such as algebraic operations and linear equations, which are prerequisites. This topic is also related to later algebraic material such as functions, logarithms, equations

and inequalities with absolute values, and trigonometry. Due to the organized structure of mathematics, students' prerequisite knowledge is an important aspect that should be considered in the process of learning mathematics (Suryadi, 2010). Therefore, the ability of students to solve quadratic equations is crucial in this regard.

The quadratic equation material has a greater chance of being understood by students because it has been studied since junior high school. However, students still make mistakes in solving quadratic equation problems. According to Munandar (2002), a mistake is defined as a deviation from what is correct and is systematic, consistent, or incidental in certain parts. Mistakes that are systematic and consistent are influenced by the student's current abilities, while those that are incidental are not necessarily a result of a low level of mastery of the subject matter.

The types of mistakes made by students vary depending on which aspect the mistake is being reviewed. According to Cooney, Davis, & Henderson (1975), mistakes made by students in solving math problems are reviewed from the mathematical object itself, which is in understanding the concept, mistakes in understanding and applying principles, as well as mistakes in carrying out algorithms. Sriati (1994) stated that student mistakes in working on math problems are translation errors, concept errors, strategy errors, systematic errors, and sign errors. White (2005) divides student mistakes in solving math word problems into five categories, which are reading errors (R), comprehension errors (C), transformation errors (T), process skills errors (P), and encoding errors (E).

Mistakes in solving math problems can be used to detect students' difficulties in learning mathematics. Test questions are given to students to determine their abilities and understanding of the material that has been given by analyzing the mistakes made by students so that students can achieve better learning outcomes. Ramadhani, Yuwono, Muksar (2016) state that the mistakes made by each student can be used as a reference by teachers to design learning and benchmarks to help students realize their mistakes. In addition, Sudiono (2017) also states that educators can easily correct students' mistakes by knowing the mistakes that occur in each student. Thus, student mistakes need to be found as an evaluation for educators to conduct further learning.

Based on previous research (Sura et al, 2021; Angraini & Kartini, 2020; Resky et al 2022) that analyzed students' errors in quadratic equation material from various perspectives (conceptual, principles, procedures, and calculations) and categories (Newman) identified by researchers, it is necessary to have a systematic and comprehensive review to identify, examine, evaluate, and interpret all related studies on students' error analysis in quadratic equation material. Therefore, this study applies the *systematic literature review* method. This study is expected to provide information on student error analysis in quadratic equation material, as well as opportunities for further research on student error analysis in quadratic equation material.

Method

This study employed a Systematic Literature Review. The systematic literature review method is used to assess and synthesize research findings to inform practice, policy, further research, and minimize bias (Munn et al., 2018). The aim of the systematic literature review method is to identify, review, and evaluate all relevant research to answer a specific research question (Triandini, Jayanatha, Indrawan, Werla Putra & Iswara, 2019). This study consisted of several stages, including formulating the research question, setting inclusion and exclusion criteria, searching for literature, selecting literature, presenting data, processing data, and drawing conclusions. For studies that use tools and materials, the sophistication of the tool specifications and the types of materials used should be described. For qualitative research, the researcher's presence, subjects, informants, data collection

methods, and data quality/reliability should be described. The design of the Systematic Literature Review research procedure is as follows (Zawacki-Ritcher et al., 2020), it is shown in the following figure 1:
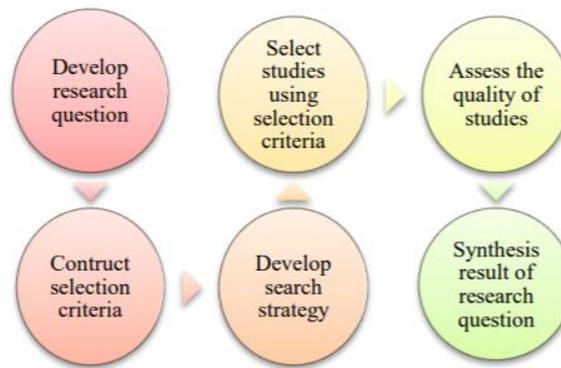

Figure 1. Diagram Procedures Systematic Literature Review (Zawacki-richter et al., 2020)

Develop Research Question

In this stage, the researcher formulates the problem that will be discussed in depth. This question is made based on the needs of the topic chosen by the researcher. The research question developed in this study is: What is the analysis of students' errors in quadratic equation material from various perspectives and categories?

Selection Criteria

This stage is carried out to decide whether the data found is suitable or not for use in the SLR research, and at this stage, inclusion and exclusion criteria are determined. The literature taken is literature that meets the inclusion criteria. For the selection criteria in this study, it is shown in the following table 1:

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Literature in the form of journal articles or conference proceedings that are appropriate to the research topic on the analysis of student errors in quadratic equations.	Literature in the form of journal articles or conference proceedings outside the research topic.
Student subject	Subjects are not students
Year of publication (2012-2022)	Year of publication prior to 2012

Developing The Search Strategy

The next stage is to search for relevant articles to answer the research question. The search process was conducted using search engines such as Google Scholar, IOP Publishing, Research Gate, and others. A search string is required for more specific searches and to avoid excessive filtering. The search string for this study is: ("Students' Error*" or "Students Error*" or "Kesalahan Siswa ") and ("Persamaan Kuadrat" or "Quadratic Equations*").

The Study Selection Process

In the study selection process, the titles and abstracts of articles are first checked to determine whether the research is relevant or not (Zawacki-Ritcher et al., 2020).

Appraising the Quality of Studies

To ensure that the articles obtained after the search meet the desired criteria, the next step is to assess the quality of the articles. The articles that will be discussed are those that have met the inclusion and exclusion criteria and will be discussed in depth and must meet the quality assessment criteria as follows:

1. Is the literature in the form of journal articles or conference proceedings?

2. Has the literature been indexed by SCOPUS, SINTA, or Google Scholar?

3. Does the literature address research problems relevant to this study?

4. Does the literature use qualitative research methods?

5. Are the research subjects in the literature Indonesian students?

Each journal literature will be given a score for each of the above questions with Y (Yes) or N (No)

Based on the analysis of the literature results from the articles that passed the quality assessment, the researcher then analyzes or breaks down, distinguishes something to be classified and grouped according to the quality assessment criteria and then makes research conclusions.

Results and Discussion

The result of the research data included in this literature review is an analysis and summary of literature articles related to the analysis of students' errors in quadratic equations from 2012 to 2022. There are 12 journal articles that fall into the researchers' classification. The following table shows the results of the research on the analysis of students' errors in quadratic equations.

Table 2. Description of Literature Characteristics

Characteristics	Variation	Amount
Publication Year	2022	6
	2021	1
	2020	1
	2019	3
	2018	1
	2017	0
	2016	0
	2015	0
	2014	0
	2013	0
	2012	0
Research subject	Junior high school	6
	High school	6
Indexed	Google Scholar	2
	Sinta	10
	Scopus	0
	Prosiding/Conference	0

Table 3. Literature data extraction of Student Errors in Quadratic Equation Material

Author and Year of Publication	Indicator	Journal	Research Result
Safitri et al (2018)	Viewed from the errors of concepts, skills, principles and facts.	Jurnal Pendidikan dan Pembelajaran Khatulistiwa	Based on the results of data analysis, interviews and discussion, it can be generally concluded as follows: (1) errors experienced by students in solving quadratic equations include fact errors, conceptual errors and principle errors. The reason students make conceptual errors is because students understand concepts correctly and students are not fluent in using operations, because students understand concepts correctly and students do not understand the meaning of symbols. This shows that students make skill errors. Students are not fluent in using arithmetic operations. This shows that students make principle mistakes. Students do not understand the concept correctly and students do not understand the meaning of symbols. This shows that students make factual errors.
Hidayati (2019)	Viewed from the material questions and steps in completion.	Math Didactic: Jurnal Pendidikan Matematika	In the study it was found that most students had not been able to apply the knowledge gained in completion steps 1 and 2 to step 3, students knew the formula used but did not know the processes and procedures for using it, resulting in mistakes even when operating algebra due to non-fluency in using operations and previous procedures affect the understanding of subsequent procedures resulting in the use of the wrong process and errors in calculations.
Fiqri et al (2019)	Viewed from conceptual errors, procedural errors, and computational errors (calculations).	Jurnal Kajian Pembelajaran Matematika	Conceptual errors that arise in solving quadratic equation problems are in the form of students not understanding the general form of quadratic equations and students not understanding what is meant by solving and not solving quadratic equations. Procedural errors that arise in solving quadratic equation material problems in the form of students making mistakes in simplifying step by step work on both the principles and rules in mathematics, students not understanding basic mathematical concepts such as the concept of arithmetic operations, the concept of integers, the concept of calculating fractions and the concept of exponents. The computations that appear in solving quadratic equation material problems are in the form of students making mistakes in calculating and writing arithmetic operations in addition, multiplication, subtraction and division.
Putri & Fuadiah (2019)	Viewed form Newman Method	Jurnal Silogisme Kajian Ilmu Matematika dan Pembelajarannya	At the stage of reading the problem as much as 98% of students experience errors in the form of wrong in determining the information that is known. At the stage of understanding the problem by 20% of students in the form of student errors in not writing known information. At the transformation stage, 20% of students experience errors in the form of student errors in writing quadratic formulas (ABC formulas) as a plan for solving problems in questions. At the stage of

learning process skills, 60% of students experience errors in using formulas and based on what is known according to the steps for solving problems that have been taught correctly and student errors in carrying out operations because they are wrong in determining the correct information. At the writing stage of the final answer, 98% of students experienced errors in solving the questions correctly and did not draw conclusions based on the results obtained.

Angraini & Kartini (2020)	Viewed from errors in concepts, procedures, and operations.	AXIOM Jurnal Pendidikan dan Matematika	:	The most common mistake students made in question number one was a conceptual error of 80%. In question number two, the error that most students made was an operating error of 10%. In question number three, the most frequent errors made by students were operational errors of 60%. In question number four, the most errors made by students were conceptual errors of 50%. In question number five, the most frequent errors made by students were operational errors of 80%.
Sura etal (2021)	Viewed from errors in concepts, principle errors, and calculation errors.	*Issues in Mathematics Education*		Concept errors experienced by students in solving quadratic equation problems, namely errors in determining the formula to answer the problem. The principle error that students experience in solving quadratic equation problems is skipping or ignoring an important step in the completion process and mistakes in solving problems that are not in accordance with the question instructions. Calculation errors experienced by students in solving quadratic equation problems, namely errors in performing addition operations on fractional numbers and errors in using arithmetic operations.
Defiana et al (2022)	Viewed from errors in concepts, principle errors, and calculation errors.	LAPLACE Jurnal Pendidikan Matematika	:	Subjects with high ability, do not make conceptual mistakes when solving caudratic equation problems. Meanwhile, subjects with moderate abilities also did not make conceptual mistakes when solving quadratic equation problems. However, low-ability subjects make mistakes in solving concepts when solving caudratic equation problems. Subjects with high abilities do not make principle mistakes when solving caudratic equation problems. Meanwhile, moderate-ability subjects and low-ability subjects made principle mistakes in solving caudratic equation problems. Subjects with high ability in solving caudratic equation problems made one calculation error. Then the capable subject made two calculation errors in solving the caudratic equation problem. Meanwhile, low-ability subjects made three calculation errors in solving quadratic equation problems.
Mutmainah et al (2022)	Viewed fron Ashlcok Method	Prosiding Seminar Nasional Pendidikan Matematika, Universitas Mulawarman		Respondents made an addition operation error that should have used a subtraction operation, so the researcher classified this as an operating error. Respondents made a mistake when looking for the value $x + 1 = 1$ which the respondent should have written $x + 1 = 1$. So the researchers classified this as a counting error. The respondent made a mistake in the

processing step, the respondent did not answer as intended in the problem, namely working using the step of completing perfect squares. This is because students forget how to solve it. Respondents wrote down answers that had nothing to do with solving the problem. Therefore the researcher classifies this error as an arbitrary answer error.

Resky et al (2022)	Viewed from Newman Method	Jurnal Equation Teori dan Penelitian Pendidikan Matematika	The most errors experienced by students in process skills, caused by students not being careful in the process and not practicing questions. The second most common type of error occurs in writing the final answer. The lack of focus and inaccuracy of students resulted in students neglecting to complete the desired completion of the problem. The third most common type of error is transformation error, the main cause of students who experience this error is mostly due to a lack of understanding of the concept of quadratic equations. The fourth most common type of error occurs in misunderstanding the problem.
Mustika & Roesdiana (2022)	Viewed from Watson Method	Jurnal Didactical Mathematics	It is found that each error based on the Watson category has a percentage that is different from one another. For the type of inappropriate data error (inappropriate data/id) that is equal to 24.44%, the type of inappropriate procedure error (ip) is 7.78%, the type of lost data error (omitted data/od) is 0% or with In other words, there were no missing data errors in this study, the type of omitted conclusion error (oc) was 17.78%, the type of error response level conflict (RLC) was 2.22%, the type of indirect manipulation error (undirected manipulation/um) of 5.56%, types of errors in skill hierarchy problems (skill hierarchy problems/shp) of 27.78%, and types of errors other than the 7 categories above (above other/ao) of 14.44 %.
Fauziah & Astutik (2022)	Viewed from Polya Method	Jurnal Cendekia: Jurnal Pendidikan Matematika	Based on the results of the tests and interviews conducted on each research subject, the types of errors that were often experienced by the subjects were errors in planning, where the subjects could not carry out proper calculations and the impact of errors that occurred in the previous stage. Meanwhile, the smallest error made by the subject was an error in planning.
Hakim & Hendriana (2022)	Viewed from Kastolan Method	JPMI Jurnal Pembelajaran Matematika Inovatif	At least the students made mistakes in the concept, namely question number 2 where only one out of five students, 20%, made mistakes. Then in questions number 1 - 3, only 2 out of 5 students made procedural errors, namely 40%, made procedural errors. All students made 100% technical errors in questions number 1 and 4. Then in number 3 there were 4 out of 5 students 80% made technical errors and at least number 2 only 40% made technical errors, namely 2 out of 5 students.

In table 2, the characteristics of inclusive literature that will be analyzed and synthesized are presented. The literature obtained includes publications from 2012 to 2022. The subjects include junior high school and high school students. The research method used is qualitative. The literature used consists of journal articles or conference proceedings indexed in Google Scholar, Sinta, or Scopus. Based on the data extraction of literature on students' errors in quadratic equation material in table 3, the following are students' errors reviewed in terms of conceptual errors, procedural errors, and operational or computational errors.

Misconceptions on Quadratic Equation Material

Concept error refers to students' mistakes in classifying or categorizing a group of objects (Soedjadi, 2000). Based on previous research, some examples of students' conceptual mistakes include misinterpreting and misusing mathematical concepts, such as errors in finding the roots of quadratic equations using factoring (Safitri, Halini, & Nursangaji, 2018; Angraini & Kartini, 2020), misunderstanding the symbol ± (Safitri, Halini, & Nursangaji, 2018), and making errors in determining or writing formulas to answer math problems (Sura et al, 2021; Hakim & Hendriana, 2022; Fauziah & Astutik, 2022; Safitri, Halini, & Nursangaji, 2018). In addition, some students cannot convert quadratic equations from standard to vertex form. These mistakes are caused by students' lack of understanding of the origin of a principle, not grasping concepts correctly, and not capturing the meaning of symbols (Safitri, Halini, & Nursangaji, 2018). Figure 2 is an example of a conceptual mistake made by students (Sura et al, 2021), where students did not write the abc formula and did not use the abc formula to determine the roots of a quadratic equation.

Figure 2. Example of Concept Error

Another conceptual error that students make is when they attempt to convert the information provided in the problem statement into mathematical models. This is often due to students not providing complete information about what is known, as well as a lack of understanding of the concepts of addition and multiplication used to create mathematical models (Fauziah & Astutik, 2022; Putri & Fuadiah, 2019). Additionally, students often lack an understanding of the general form of quadratic equations, and may not understand the difference between the solution and the root of a quadratic equation (Fiqri et al, 2019; Resky et al, 2022).

Procedural Errors in Quadratic Equation Material

Procedural errors in solving quadratic equation problems occur when students make mistakes in simplifying the step-by-step process and following mathematical principles and rules (Fiqri et al, 2019). Students make mistakes when translating the question into a mathematical model, which results in incorrect substituted values, and they also make mistakes in calculations and fail to write conclusions (Mustika & Roesdiana, 2022). They use the wrong formula and do not write down the steps of the solution. These errors occur due to mistakes in the previous step, lack of focus and accuracy, (Resky et al, 2022) and a lack of diligence in solving problems that prevent students from doing the calculations correctly

(Fauziah & Astutik, 2022). Figure 3 is an example of a procedural error made by students (Mustika & Roesdiana, 2022), where students do not write down the steps based on the form of the quadratic equation and instead write down the formula for a rectangle without a more detailed calculation process in accordance with the instructions in the problem.

Figure 3. An example of a procedural error

Another mistake that students make is not double-checking their calculations and the solutions obtained. This mistake is due to the fact that students are not accustomed to reviewing their results, and they believe that reviewing calculations would waste their time (Fauziah & Astutik, 2022). This is consistent with the investigation conducted by Fauziyah et al. (2020) which revealed that a recurring error among students is not reviewing their answers because they are not accustomed to doing so and believe that it would be a waste of time.

In addition, students are confused in continuing the factoring step due to the numbers. Students are already wrong from the beginning in grouping the quadratic equation so that when they want to factor the number, it becomes confusing and they do not continue the problem-solving steps. This indicates that students do not pay close attention to the problem and rush in the solution process. (Hakim & Hendriana, 2022).

When solving quadratic equation problems, students often skip or ignore an important step in the problem-solving process, and their mistakes in solving the problem do not match the instructions given in the problem (Sura et al, 2021). The research found that most students were unable to apply the knowledge they had gained, as they knew the formula to use but did not know the process and procedures to apply it. As a result, errors occurred, even in algebraic operations, due to their lack of proficiency in using operations and the previous procedures that affected their understanding of subsequent procedures, leading to the use of incorrect processes and calculation errors.

Computational Errors in Quadratic Equation Material

Computing error means errors in mathematical calculations or operations (Muliana Sayekti, 2015:24). Imswatama and Muhassanah (2016:11) state that these calculation errors are caused by students' lack of precision in working on problems, even though they have mastered the given concepts. Students who are good at arithmetic are able to perform calculations correctly and accurately.

The computation errors found by the researcher in the quadratic equation material are that students make mistakes in calculating and writing arithmetic operations in addition, multiplication, subtraction (Safitri, Halini, & Nursangaji, 2018), and division, as well as writing final answers (Fiqri et al, 2019; Sura et al, 2021; Mutmainah et al, 2022; Defiana et al, 2022; Mustika & Roesdiana, 2022; Hakim & Hendriana, 2022). The reason why students

make these mistakes is that they are not proficient in using the operations (Safitri, Halini, & Nursangaji, 2018). Figure 4 shows an example of a computation error made by a student (Angraini & Kartini, 2020), where the student made a mistake in adding 9-(-1), whereas the correct result should be 10.

Figure 4. Example of a Computing Error

Students make a lot of operational errors in the problem of identifying the sum and product of the roots of a quadratic equation based on the coefficients, compiling a quadratic equation if the roots are known, and stating everyday problems in the form of quadratic equations (Angraini & Kartini, 2020). As well as students who answered incorrectly in solving questions with discriminant material less than zero (D < 0), when solving and determining the roots of quadratic equations whose roots are imaginary/imaginary (Hidayati, 2019).

Conclusion

Based on the results of the systematic literature review conducted on student errors in quadratic equation material, it can be concluded that many student errors are still found in solving quadratic equation problems from various categories, including Newman's error, Polya's error, Kastolan's error, Watson's error, as well as conceptual, procedural, and computational errors. Conceptual errors that arise in solving quadratic equation problems are that students do not understand the general form of quadratic equations and do not understand the meaning of "solution" and "non-solution" in quadratic equations. Procedural errors that arise in solving quadratic equation problems are that students make mistakes in simplifying step-by-step procedures, principles, and rules in mathematics, lack a basic understanding of mathematical concepts such as the concept of arithmetic operations, integers, fractions, and exponents. Computational errors that arise in solving quadratic equation problems are that students make mistakes in calculating and writing arithmetic operations in addition, multiplication, subtraction, and division. The causes of student errors include difficulties in understanding sentence meanings in problems, lack of mastery of prerequisite material, lack of mastery of quadratic equation material, lack of understanding of number operations, lack of attention to detail, and teachers not always providing feedback during learning.

References

Anggraini, Y. P, & Kartini. (2020). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Persamaan Kuadrat pada Siswa Kelas IX SMPN 2 Bangkinang Kota. *AXIOM: Jurnal Pendidikan dan Matematika, 9*(2), 210-233.

Cooney, T. J., Davis, J. E., & Henderson, B. K. (1975). Dynamics of Teaching Secondary School Mathematics. Boston, MA: Houghton Mifflin Company.

Defiana, A., Anggoro, B. S., & Putri, R. W. (2022). Studi Analisis: Kesalahan Siswa Dalam Menyelesaikan Soal Matematika Pada Materi Persamaan Kuadrat . *LAPLACE : Jurnal Pendidikan Matematika* , 5(2), 410-425.

Didis, M. G., & Erbas, A. K. (2015). Performance and Difficulties of Students in Formulating and Solving Quadratic Equations With One Unknown. *Kuram ve Uygulamada Egitim Bilimleri*, 15(4), 1137–1150.

Fauziah, F. A., & Astutik, E. P. (2022). Analisis Kesalahan Siswa dalam Pemecahan Masalah Soal Cerita Matematika Berdasarkan Langkah Polya. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 6(1), 996-1007.

Fiqri, C. I., Muhsetyo, G., & Qohar, A. (2019). Analisis Kesalahan Siswa Dan Scaffolding Dalam Menyelesaikan Soal Pada Materi Persamaan Kuadrat. *Jurnal Kajian Pembelajaran Matematika*, 3(2), 1-8.

Fuchs, L. S., Schumacher, R. F., Sterba, S. K., Long, J., Namkung, J., Malone, A., Hamlett, C. L., Jordan, N. C., Gersten, R., Siegler, R. S., & Changas, P. (2014). Does Working Memory Moderate The Effects of Fraction Intervention? An Aptitude-Treatment Interaction. *Journal of Educational Psychology*, 106(2), 499–514.

Hakim, M. A., & Hendriana, B. (2022). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Matematika Pada Pembelajaran Daring. *JPMI Jurnal Pembelajaran Matematika Inovatif*, 5(4), 1041-1048.

Hidayati, R. (2019). Analisis Kesalahan Dalam Menyelesaikan Soal Persamaan Kuadrat Siswa Smk Kesehatan. *Math Didactic: Jurnal Pendidikan Matematika*, 5(1), 93-100.

Huijsmans, M. D. E., Kleemans, T., & Kroesbergen, E. H. (2021). The Cognitive Profiles for Different Samples of Mathematical Learning Difficulties and their Similarity to Typical Development: Evidence from a Longitudinal Study. *Journal of Experimental Child Psychology*, 214, 1–17.

Karagiannakis, G., Baccaglini-Frank, A., & Papadatos, Y. (2014). Mathematical Learning Difficulties Subtypes Classification. Frontiers in Human Neuroscience, 8(57).

Kutluca, T., & Baki, A. (2013). Evaluation of Student Views About Worksheets Developed in Quadratic Functions. *Haccetepe University Journal of Education*, 28(3), 319–331.

Mazzocco, M. M. M. (2013). Contributions of Longitudinal Studies to Evolving Definitions and Knowledge of Developmental Dyscalculia. *Trends in Neuroscience and Education*, 2(2), 65–73.

Memnun, D. S., Aydın, B., Dinç, E., Çoban, M., & Sevindik, F. (2015). Failures and Inabilities of High School Students about Quadratic Equations and Functions. *Journal of Education and Training Studies*, 3(6), 50–60.

Mutmainah, B. H. (2022). Analisis Kesalahan Menyelesaikan Soal Persamaan Dan Fungsi Kuadrat Siswa Kelas XI SMK Negeri 18 Samarinda Tahun Ajaran 2021/2022. *Prosiding Seminar Nasional Pendidikan Matematika, Universitas Mulawarman* , 52-58.

Näykki, P., Isohätälä, J., & Järvelä, S. (2021). "You Really Brought All Your Feelings Out" – Scaffolding Students to Identify the Socio-Emotional and Socio-Cognitive Challenges in Collaborative Learning. *Learning, Culture and Social Interaction*, 30, 1–14.

Öner, G., Yıldırım, İ., & Bars, M. (2014). The Effect of Blended Learning on Students' Achievement fort He Topic of Quadratic Equation in Mathematics Education. Journal of Computer and Education Research, 2(4), 152–165.

Putri, S. M., & Fuadiah, N. F. (2019). Identifikasi Kesalahan Siswa Berdasarkan Newman Dalam Menyelesaikan Soal Pada Materi Persamaan Kuadrat Tingkat Sekolah Menengah Pertama. *Jurnal Silogisme Kajian Ilmu Matematika dan Pembelajarannya, 4(1),* 21-29.

Ramadhani, A.N., Yuwono, I., Muksar, M. 2016. Analisis Kesalahan Siswa Kelas VIII SMP Pada Materi Aljabar serta Proses Scaffolding-nya. *Jurnal: Silogisme,* 1(1), 11-22.

Resky, M., Wahab. A, A., & Buhaerah. (2022). Analisis Kesalahan dalam Menyelesaikan Soal Persamaan Kuadrat Pada Siswa Kelas IX UPTD SMP Negeri 4 Parepare. *Jurnal Equation Teori dan Penelitian Pendidikan Matematika*, 5(2), 45-56.

Rina Mustika, L. R. (2022). Analisis Kesalahan Berdasarkan Kategori Watson dalam Menyelesaikan Permasalahan Persamaan Kuadrat pada Siswa SMP . *Jurnal Didactical Mathematics* , 4(1), 170-180.

Safitri, D., Halini, & Nursangaji, A. (2018). Analisis Kesalahan Siswa dalam Menyelesaikan Persamaan Kuadrat di Kelas XI SMAN 5 Pontianak. *Jurnal Pendidikan dan Pembelajaran Khatulistiwa, 7(8),* 1

Simalango, M. M., Darmawijoyo, & Aisyah, N. (2018). Analisis Kesulitan Siswa Dalam Menyelesaikan Soal-Soal PISA Tahun 2012 Level 4, 5, dan 6 di SMP N 1 Indralaya. Jurnal Pendidikan Matematika, 12(1), 43–58.

Sriati, A. (1994). Kesulitan Belajar Matematika pada Siswa SMA (Pengkajian Diagnosa). Jurnal Kependidikan nomor 2 Tahun XXIV

Sudiono, E. 2017. Analisis Kesalahan dalam Menyelesaikan Soal Matematika Materi Persamaan Garis Lurus Berdasarkan Analisis Newman. Jurnal: UNION , 5(3), 295-301.

Sura', G. L., Tahmir, S., & Dassa, A. (2021). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal pada Materi Persamaan Kuadrat. *Issues in Mathematics Education*, 5(1), 73 – 81.

Suryadi, D. (2010). Menciptakan Proses Belajar Aktif: Kajian dari Sudut Pandang Teori Belajar dan Teori Didaktik. In Seminar Nasional Pendidikan Matematika di UNP, 1-16.

Triandini, E., Jayanatha, S., Indrawan, A., Putra, G. W., & Iswara, B. (2019). Metode SystematicLiterature Review untuk Identifikasi Platform dan Metode Pengembangan Sistem Informasi diIndonesia.IJIS: Indonesian Journal of Information Systems,1(2), 63–77.

Utami, D. R., Nusantara, T., & Qohar, A. (2021). Analisis Kesulitan Siswa Pada Aspek Kognitif Dalam Menyelesaikan Soal Persamaan Kuadrat Berdasarkan Kesalahan Newman. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan* , 6(12), 1853−1860.

VanLuit, J. E. H. (2019). Diagnostics of dyscalculia. In International Handbook of Mathematical Learning Difficulties, 653– 668.

White, A. L. (2005). Active Mathematics In Classrooms: Finding Out Why Children Make Mistakes – And Then Doing Something To Help Them. Journal of The Primary Association for Mathematics, University of Western Sydney, Square One, 15(4). 15-19

Zawacki-Ritcher, O., Kerres, M., Bedenlier, S., Bond, M., & Buntins, K. (2020). Systematic Reviews in Educational Research. Spring Nature.