

Research

Article submitted to journal
<https://conference.unpasurua.ac.id/index.php/ichst/index>

Subject Areas:

Technology in Education, Cultural
Adaptation, Adaptation in Education

Keywords:

quadrilateral pocket media, CTL,
geometry, contextual learning, junior
high school.

* Author for correspondence:

fifa.ani@gmail.com

CTL-Based Quadrilateral Pocket Media for Geometry Learning in Junior High School



Ani Afifah^{1*} , Intan Nadilah²

1. Universitas PGRI Wiranegara Pasuruan, Indonesia
2. Universitas PGRI Wiranegara Pasuruan, Indonesia

Junior high school students' understanding of geometry is often low due to abstract learning. This study developed a quadrilateral pocket media based on Contextual Teaching and Learning (CTL) to support more active and contextual geometry learning. This media includes a quadrilateral pocket with activity cards and concept maps to facilitate exploration of flat shape concepts such as squares and rectangles. Using the Research and Development (R&D) method with the ADDIE model, this study included needs analysis, media design, development, implementation in grade VII, and evaluation. The media was rated "Very Valid" with a score of 86.09%, and practicality assessments by teachers and students were 78% and 71.06%, respectively. Observations showed 80% teacher involvement and 84% student involvement, indicating an interactive learning atmosphere. This media is effective in improving geometry understanding and linking the material to real situations.

1. INTRODUCTION

Understanding geometry concepts at the junior high school level plays a strategic role in developing students' numeracy literacy and critical thinking skills, which are crucial for facing the global challenges of the 21st century. Internationally, assessments such as the Programme for International Student Assessment (PISA) emphasize the importance of mastering contextual mathematics, where students are able not only to calculate but also to solve real-life problems (Bart, 2024; Lin, 2020). However, PISA results show that Indonesian students' numeracy skills, particularly in solving contextual mathematical problems, are still below the global average. This indicates an urgent need to improve the approach to mathematics learning, particularly in geometry, which is the foundation for developing spatial thinking and problem-solving skills (Rohimah, 2023).

One of the main challenges in learning geometry in junior high schools is the tendency of teachers to present material abstractly, emphasizing memorization of formulas and procedures without connecting concepts to students' real-life experiences. As a result, many students struggle to understand the properties of plane figures, calculate perimeter and area, and apply geometric concepts to everyday life. This challenge is exacerbated by the limited use of concrete and manipulative learning media that can help students build understanding gradually through direct experience. Previous studies, such as those by Siswondo and Agustina (2020), highlighted that the Contextual Teaching and Learning (CTL) approach can increase student engagement, but its implementation is often not supported by effective concrete media. Meanwhile, Meryansumayeka et al. (2018) found that existing manipulative media are still limited in encouraging active student participation and do not connect mathematical concepts to real-world contexts. Previous studies have discussed various approaches to improving geometry understanding, ranging from the application of the CTL model (He, 2021), the development of simple manipulative media (Isnaniah, 2020), to the use of interactive digital media (Afifah & Putri, 2021). However, most of these studies still separate the contextual approach from the use of concrete media, or focus solely on one specific type of geometric figure. Furthermore, these studies were generally conducted on a limited scale and have not comprehensively tested the practicality and effectiveness of the media in real classrooms.

The novelty of this research lies in the development and implementation of CTL-based quadrilateral pocket media specifically designed for geometry learning in junior high schools. This media is not only a visual aid but also equipped with activity cards and concept maps that enable students to explore, engage in group discussions, and reflect on concepts of geometric figures such as squares, rectangles, and other geometric shapes relevant to everyday life. This innovation integrates CTL principles with concrete manipulative media, thus bridging the gap between abstract concepts and students' real-life experiences. Furthermore, this study systematically tests the validity, practicality, and effectiveness of the media through the ADDIE development model, and involves the active participation of teachers and students in the evaluation process.

The identified research gap is the limited number of studies combining the CTL approach with pocket quadrilaterals equipped with activity cards and concept maps for geometry learning in junior high schools. Previous research tends to focus on only one aspect, either CTL without concrete media or manipulative media without integrating real-life contexts. Furthermore, there are few studies that empirically test the practicality and effectiveness of media in the classroom, involving expert validation, observation of learning activities, and comprehensive teacher and student responses. This study also broadens the scope of geometry taught, not just to squares and rectangles, but also to other plane shapes frequently encountered by students in everyday life.

The theoretical framework used in this research is constructivism theory, which emphasizes the importance of direct experience and social interaction in building conceptual understanding. This theory serves as the foundation for the application of the Contextual Teaching and Learning (CTL) model, where learning is designed to enable students to connect mathematical material to real-life

situations, collaborate in groups, and actively discover the meaning of concepts through exploration and discussion. Furthermore, the ADDIE development model was used as a systematic framework for designing, developing, implementing, and evaluating the resulting learning media.

The main concepts used in this research include the use of rectangular pocket media as concrete manipulatives, activity cards and concept maps as exploration and reflection tools, and CTL principles that emphasize the connection between subject matter and students' real-life experiences. Therefore, this research is expected to make a real contribution to improving the quality of geometry learning in junior high schools, strengthening students' numeracy literacy, and addressing global challenges in 21st-century mathematics education.

2. RESEARCH METHOD

This section systematically describes the research methods used in the development and implementation of the CTL-Based Quadrilateral Pocket Media for Geometry Learning in Junior High Schools.

2.1 Research Design

This research uses a Research and Development (R&D) approach with the ADDIE model. This model was chosen because it provides a systematic and iterative framework for developing valid, practical, and effective learning media (Qohar, 2021). Each ADDIE stage: Analysis, Design, Development, Implementation, and Evaluation was carried out sequentially to ensure the resulting media met student needs and learning objectives.

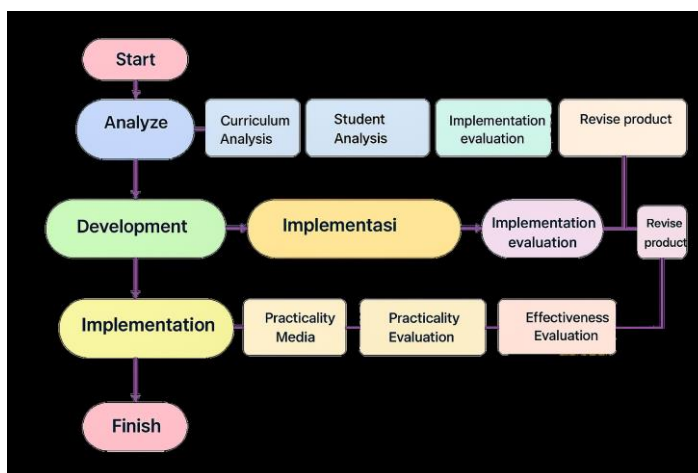


Figure 1: ADDIE Model Flowchart

2.2 Research Location and Subjects

The research was conducted at a public junior high school in East Java during the even semester of the 2024/2025 academic year. The research subjects were 30 seventh-grade students selected purposively, with a total of 30 participants. The subject selection was based on the need to test the effectiveness of media on

quadrilateral material relevant to students' daily lives (Nadilah et al., 2025).

2.3 Media Development Stages (ADDIE)

a. Needs Analysis

The analysis stage was conducted to identify student needs, material characteristics, and obstacles to learning geometry, which has previously been conducted in an abstract manner. The analysis results indicated the need for concrete media that could connect geometric concepts with students' real-life experiences (Nailurrohmah, 2022)

b. Media Design

In the design stage, an initial prototype of the quadrilateral pocket media was developed, consisting of a rectangular pocket, activity cards, and a concept map. Media design adheres to the CTL principle, which relates material to real-life contexts and encourages active student engagement (Hollebrands, 2020).

c. Prototype Development

The media prototype was developed and validated by two subject matter experts and one media expert. Validation was conducted to ensure the content, visual appearance, and integration aligned with the CTL principles. The validation results showed a validity score of 86.09% (category "Very Valid").

d. Classroom Implementation

The revised media was implemented in geometry lessons in seventh grade. Teachers and students used the media in activities exploring the concept of quadrilaterals, group discussions, and contextual problem-solving.

e. Evaluation

Evaluation was conducted both formatively and summarily to assess the validity, practicality, and effectiveness of the media. Practicality assessments were obtained from teacher (78%) and student (71.06%) questionnaires, while effectiveness was measured through observations of teacher (80%) and student (84%) activities (Rohimah, 2023).

2.4 Data Collection Techniques and Instruments

Data collection was conducted using several validated techniques and instruments: a validation sheet used by material and media experts to assess the validity of content, presentation, and suitability with CTL; a teacher and student response questionnaire using a Likert scale to assess the practicality and effectiveness of the media; and an observation sheet used to record teacher and student activities and engagement during the lesson.

Table 1. Research Instruments

Instrument	Assessment Instrument	Respondents	Assessment Scale
Validation Sheet	Media Validity	Subject Matter/Media	Scale 1-5
Teacher Questionnaire	Practicality and Effectiveness	Teacher	Likert Scale 1-5

Student Questionnaire	Practicality and Effectiveness	Student	Likert Scale 1-5
Observation Sheet	Learning Activities	Teachers, Students	Percentage of Activities

The data obtained were analyzed quantitatively by calculating the percentage of validity, practicality, and effectiveness, where the assessment criteria refer to the following categories from Nadilah et al., 2025: very valid if the percentage reaches 85% or more, practical if it is between 70% to 85%, and effective if the activity reaches 80% or more.

3. Result

3.1 CTL-Based Quadrilateral Pocket Media

This study developed and implemented a Contextual Teaching and Learning (CTL)-based quadrilateral pocket media to improve understanding of geometry concepts in junior high school students. This media consists of a quadrilateral pocket, activity cards, and concept maps designed to facilitate exploration of geometric concepts such as squares and rectangles, and relate them to everyday life. The study used the ADDIE (Analyze, Design, Develop, Implement, Evaluate) model and involved seventh-grade students at SMPN 2 Gondangwetan.

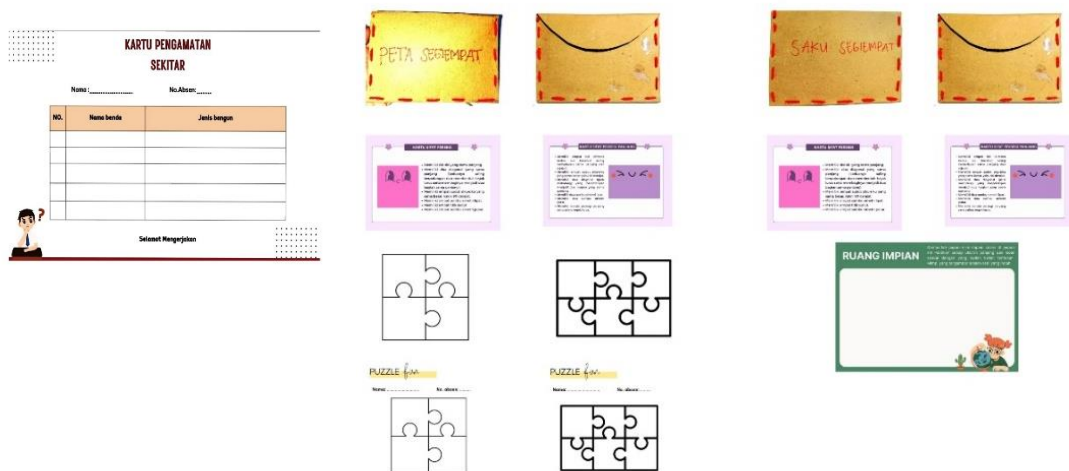


Figure 2. Early Prototype to Prototype 1

The CTL-based quadrilateral pocket media proved to be highly valid, practical, and effective in geometry learning. The active involvement of teachers and students demonstrated an interactive and contextual learning environment, and enabled the students to connect mathematical concepts to everyday life.

3.2 Data Analysis

Validation was conducted by two material experts and one media expert to assess the media based on content suitability, visual quality, and language. In addition, teachers and students completed a practicality questionnaire using a Likert scale to assess ease of use and acceptance of the media. Activity observations were also conducted to record teacher and student engagement during learning using the media.

Table 2. Interpretation of Results

Aspect	Score (%)	Category
Validity	86,09	Very Valid
Teacher Practicality	78	Practical
Student Practicality	71,06	Practical
Teacher Activity	80	Good
Student Activity	84	Good

The data shows that the media meets the criteria for validity, practicality, and effectiveness. Expert validation confirmed the appropriateness of the media's content and presentation, while teacher and student responses indicated that the media was easy to use and well-received. Activity observations confirmed an active and contextual learning environment.

This media implements the principles of CTL, namely linking material to real-world contexts, encouraging active and collaborative learning. This aligns with constructivist theory, which emphasizes the importance of direct experience in building conceptual understanding. Previous research often used only concrete media without interactivity or only implemented CTL without manipulative media. This study combines the two, making it more effective in increasing student understanding and engagement. These findings strengthen evidence that CTL-based manipulative media can overcome the challenges of abstract and less contextual geometry learning and improve Indonesian students' numeracy, which is still below the international average.

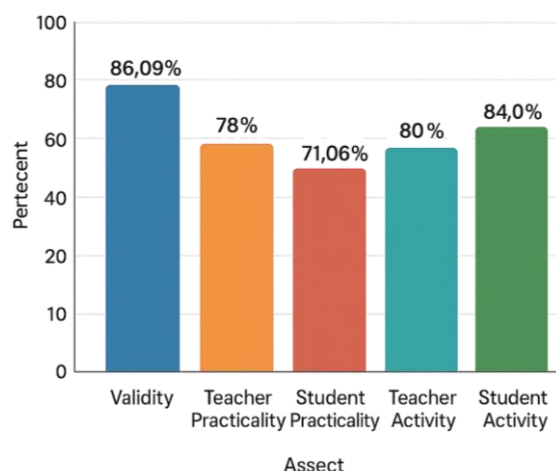
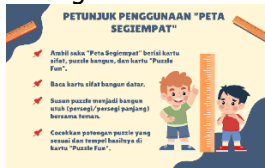


Figure 3. Bar Chart of Media Validity, Practicality, and Effectiveness

The diagram above shows that all aspects of the media assessment were above 70%, with the highest validity (86.09%) and the lowest student practicality (71.06%), but still in the "Practical" category.

The CTL-based quadrilateral pocket media is highly valid, practical, and effective for geometry learning in junior high schools because it improves conceptual understanding, encourages active student engagement, and connects mathematical material to real-world situations. The use of the ADDIE model ensures that the media development process is systematic and tested.

Table 3. Comments and Revision Decisions

No	Comments/Suggestions	Revision of Decision
1	Problem 1 There are no clue cards on the rectangular map.	Problem 1 Adding clue cards to a rectangular map 
2.	Problem 2 The Map and Pocket Rectangle with the same design have a less attractive appearance. 	Problem 2 The Quadrilateral Map and Pockets have been enhanced with visual elements such as color, supporting images, and labels on each pocket. These changes aim to make the media more aesthetically appealing and easier for students to use. 

Further development can be carried out by expanding the material coverage, such as trapezoids and parallelograms, and developing the media in a digital or interactive app-based format. It is also recommended to test this media in various schools and grade levels to verify the generalizability of the results. Furthermore, teachers need to be trained in designing and implementing CTL-based media to make learning more meaningful. This research was conducted in only one class (VII-D) and focused on squares and rectangles. The media's long-term effectiveness or other geometry materials were not tested. In addition, the media developed is still physical-based and not yet in digital form.

4. Discussion

4.1 Validity of the CTL-Based Quadrilateral Pocket Media

Media validity is a fundamental aspect in developing learning tools, as it ensures that the developed media truly aligns with the learning objectives, material, and student characteristics. The results of the study showed that the CTL-based quadrilateral pocket media achieved a validity score of 86.09%, categorized as "Very Valid" based on expert assessment. This high score indicates that the media meets the criteria of material substance, curriculum alignment, language clarity, and visual and instructional appropriateness. This finding aligns with research by Suherman et al. (2021), which emphasized that expert validation is crucial to ensure that learning media is not only visually appealing but also conceptually accurate and relevant to

student needs. Furthermore, high validity is also a prerequisite for the media to be widely implemented and contribute to improving the quality of mathematics learning in junior high schools.

4.2 Practicality of Media in Learning Implementation

The practicality of the CTL-based pocket quadrilateral media was measured through teacher and student responses, which scored 78% and 71.06%, respectively, both categorized as "Practical." This indicates that the media is easy to use, the instructions are clear, and it does not require excessive time or resources to implement. Teachers found this media helpful because it facilitated more structured and interactive learning, while students found it easier to understand geometric concepts because they could directly manipulate concrete objects. These findings are supported by research by Rahmadona et al. (Rohayati & Hardini, 2017), which stated that CTL-based manipulative media can increase the efficiency of the learning process and minimize misconceptions in material geometry. However, it should be noted that the practicality of the media is also greatly influenced by teacher readiness to integrate the media into learning and the availability of supporting facilities at the school.

4.3 Media Effectiveness in Increasing Student Engagement and Understanding

The effectiveness of the CTL-based pocket quadrilateral media is reflected in the high level of teacher (80%) and student (84%) engagement during the learning process, which is categorized as "Good." This active engagement indicates that the media is capable of creating an interactive, collaborative, and contextual learning environment. Students are not merely recipients of information but also actively explore, discuss, and solve problems relevant to everyday life. Research by Intan Nadilah et al. (2020) confirms that the use of CTL-based manipulative media significantly improves understanding of geometric concepts, as students can connect abstract material with real-life experiences. This aligns with findings from recent studies, such as those reported by Putri et al. (Lein, 2020), which shows that context-based and manipulative learning can improve retention and transfer of mathematical knowledge to new situations. Thus, this media is not only effective in the short term but also has the potential to have a long-term impact on students' mathematical literacy.

4.4 Critical Analysis and Reflection on Media Development

The development of CTL-based quadrilateral pocket media using the ADDIE model provides a systematic and flexible framework, from needs analysis to effectiveness evaluation. However, this process also faces challenges, such as the need for sufficient time for revisions based on expert input, as well as the need for teacher training to optimize the media's use. Furthermore, the limitations of the study, which only covered squares and rectangles and were implemented in a single classroom, are important considerations for further development. Other studies, such as those by Sari & Pratama (Udhma & Sari, 2017), highlight the importance of expanding the media's scope to other geometric shapes and integrating digital technology to increase the media's accessibility and appeal. Reflections on the results of this study indicate that the media's success is greatly influenced by collaboration between developers, teachers, and students, as well as school policy support in providing innovative learning tools (Afifah, Ainiyah, & Dehham, 2024).

4.5 Impact and Implications of Research Findings on Geometry Learning

The primary impact of implementing CTL-based quadrilateral pocket media is the creation of geometry learning that is more meaningful and contextual, and empowers students as active participants in the learning process. This media is able to bridge the gap between abstract concepts and everyday reality, so that students not only understand formulas and definitions, but are also able to apply them in real life. The practical implication of this finding is the need for wider adoption of similar media in schools, as well as the continued development of other mathematics materials. Recent studies also confirm that CTL-based learning and manipulative media can be an effective solution to improve mathematical literacy and 21st-century skills, such as problem-solving, collaboration, and critical thinking. Thus, the results of this study make a significant contribution to innovation in mathematics learning at the junior high school level and can serve as a reference for the development of learning media in the future.

5. Conclusions and Suggestions

5.1 Conclusions

Based on the research and implementation of the Contextual Teaching and Learning (CTL)-based rectangular pocket media in geometry instruction in junior high schools, it can be concluded that this media is highly valid, practical, and effective for use in the learning process. Validation by experts demonstrated a high level of validity (86.09%), indicating that the media met the standards for content, design, and conformity to CTL principles. Practicality assessments by teachers (78%) and students (71.06%) indicated that this media was easy to use, engaging, and well-received by classroom users. Observations of learning activities also demonstrated the active involvement of teachers (80%) and students (84%), reflecting the creation of an interactive, contextual learning environment that encouraged optimal student participation.

The rectangular pocket media, equipped with activity cards and concept maps, has been proven to facilitate the exploration of geometric concepts, such as squares, rectangles, and other geometric shapes relevant to everyday life. By integrating CTL principles, this media successfully bridges the gap between abstract mathematical concepts and students' real-life experiences, thereby increasing students' understanding, engagement, and interest in geometry. This finding confirms that the use of CTL-based quadrilateral pocket media can be an innovative solution to overcome the low understanding of geometric concepts at the junior high school level.

5.2 Sugestions

Based on the research findings, it is recommended that junior high school mathematics teachers utilize CTL-based pocket quadrilaterals as an alternative learning medium for geometry, particularly plane geometry. This medium can help students understand concepts more concretely and contextually, and increase their engagement in the learning process.

For further development, it is recommended that the scope of the pocket quadrilaterals be expanded, both in terms of material (e.g., solid geometry or other

geometry topics) and format (e.g., developing a digital or interactive version). Further research can also be conducted involving more schools and classes to test the effectiveness of the medium on a broader scale and identify factors influencing its successful implementation across various learning contexts. Furthermore, training for teachers on the use and integration of CTL-based pocket quadrilaterals in mathematics instruction is highly recommended to ensure optimal and sustainable use. Thus, it is hoped that this medium can contribute significantly to improving the quality of geometry learning and student numeracy literacy in Indonesia.

References

- Afifah, A., Ainiyah, D., & Dehham, S. H. (2024). Interactive Digital Media PanPinRu as an Effort to Increase Interest in Learning Students in Linear Equations of One Variable, *2*(December), 185–188.
- Afifah, A., & Putri, A. D. (2021). Development of e-komatik media (mathematical e-comic) with a contextual approach to the material of rectangles and triangles. *Jurnal Scientia*, *10*(1), 99–108. Retrieved from <http://infor.seaninstitute.org/index.php/pendidikan>
- Bart, D. (2024). Research discourse in the programme for international student assessment: A critical perspective. *European Educational Research Journal*, *23*(1), 145–162. <http://doi.org/10.1177/14749041221127758>
- He, L. (2021). Petri Net Based CTL Model Checking: Using a New Method to Construct OBDD Variable Order. *Proceedings 2021 International Symposium on Theoretical Aspects of Software Engineering Tase 2021*, 159–166. <http://doi.org/10.1109/TASE52547.2021.00033>
- Hollebrands, K. F. (2020). Effective design of massive open online courses for mathematics teachers to support their professional learning. *Zdm Mathematics Education*, *52*(5), 859–875. <http://doi.org/10.1007/s11858-020-01142-0>
- Hyun, C. C. (2020). Implementation of contextual teaching and learning (CTL) to improve the concept and practice of love for faith-learning integration. *International Journal of Control and Automation*, *13*(1), 365–383. Retrieved from <https://www.scopus.com/inward/record.uri?partnerID=HzOxMe3b&scp=85081642204&origin=inward>
- Isnaniah. (2020). Students' Understanding of Mathematical Concepts Using Manipulative Learning Media in Elementary Schools. *Journal of Physics Conference Series*, *1471*(1). <http://doi.org/10.1088/1742-6596/1471/1/012050>
- Khulafa, F. N., & Santosa, P. (2018). The developmet of pocket book as learning media to make batik jumput in multicultural arts and scarf subject. *Asia Pacific Journal of* Retrieved from https://apiarpublications.com/wp-content/uploads/2017/08/6_ICTP_2017_BRR709_Edu-42-48.pdf
- Lein, A. E. (2020). Effectiveness of mathematical word problem solving interventions for students with learning disabilities and/or mathematics difficulties: A meta-analysis. *Journal of Educational Psychology*, *112*(7), 1388–1408. <http://doi.org/10.1037/edu0000453>
- Lin, S. W. (2020). Taiwan: Performance in the programme for international student assessment. *Improving A Country S Education Pisa 2018 Results in 10 Countries*, 203–226. http://doi.org/10.1007/978-3-030-59031-4_10

- Nailurrohman, A. (2022). Developing realistic mathematics education learning set in polyhedron subject to improve mathematical concepts understanding skills. *Aip Conference Proceedings*, 2575. <http://doi.org/10.1063/5.0107950>
- Pudjiastuti, S. R., Sutisna, M., & Ati, H. M. (2020). The Development of Pocket Book Learning Media Based on Mind Mapping, Dynamic Material Application of Indonesian Democracy in Senior High School. *2nd Annual Civic Education* Retrieved from <https://www.atlantispress.com/proceedings/acec-19/125937423>
- Qohar, A. (2021). Development of Android-Based Mathematics Learning Game on the Topic of Congruence and Similarity. *International Journal of Interactive Mobile Technologies*, 15(9), 52–69. <http://doi.org/10.3991/ijim.v15i09.20723>
- Rohayati, S., & Hardini, H. T. (2017). *Development of Pocket Book Accounting Based E-Learning Media with Student Center Approach*. scitepress.org. Retrieved from <https://www.scitepress.org/Papers/2017/69880/69880.pdf>
- Rohimah, S. M. (2023). Developing mathematical proficiency in junior high school: A case study on linear equations in one variable. *Aip Conference Proceedings*, 2734(1). <http://doi.org/10.1063/5.0162111>
- Suherman. (2021). SQ3R method assisted by ethnomathematics-oriented student worksheet: The impact of mathematical concepts understanding. *Iop Conference Series Earth and Environmental Science*, 1796(1). <http://doi.org/10.1088/1742-6596/1796/1/012059>
- Udhma, U. S., & Sari, R. C. (2017). The Development Of Learning Media By Using Pocket Book Of Financial Literacy To Improve Knowledge Of Vocational Student's Personal Finance *Kajian Pendidikan Akuntansi Indonesia*. Retrieved from https://www.researchgate.net/profile/Umi-Udhma/publication/379082405_THE_DEVELOPMENT_OF_LEARNING_MEDIA_BY_USING_POCKET_BOOK_OF_FINANCIAL_LITERACY_TO_IMPROVE_KNOWLEDGE_OF_VOCATIONAL_STUDENT'S_PERSONAL_FINANCE_MANAGEMENT/links/65fa61ffa4857c796260eaa3/THE-D