System Literature Review: IMPROVING PROBLEM SOLVING ABILITY AND STUDENTS' MATHEMATICAL DISPOSITION IN THE IMPLEMENTATION OF PBL LEARNING MODELS SUPPORTED MATH TRAILS

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Abstrak

Matematika merupakan bidang studi yang sangat berperan penting di era sekarang ini. Namun banyak dari siswa menganggap matematika merupakan pembelajaran yang sangat sulit. Ada banyak cara untuk menangani kasus tersebut, diantaranya dengan mengkombinasikan model pembelajaran *Problem Based Learning* (PBL) yang disertai dengan aktivitas luar kelas. Aktivitas luar kelas ini dapat dilaksanakan dengan berbantuan Math Trails pada Aplikasi Math City Map sebagai media pembelajaran matematika. Pembelajaran dengan berbantu Math Trails ini dapat melatih dan meningkatkan aspek kognitif pada siswa, yaitu kemampuan pemecahan masalah. Kemampuan pemecahan masalah menjadi hal yang utama dalam pembelajaran matematika yang perlu ditingkatkan. Guna untuk meningkatkan kemampuan pemecahan masalah siswa dapat dilakukan dengan aktivitas berbantuan Math Trails. Berbantuan Math Trails siswa dapat mengubah cara pandang siswa terhadap pembelajaran matematika. Suatu sikap individu terhadap cara pandang atas matematika, yang akan menampilkan perilaku rasa ingin tahu, tekun, percaya diri dan berminat terhadap matematika yang disebut dengan disposisi matematis siswa. Tujuan penulisan ini untuk mendeskripsikan pengaruh disposisi matematis terhadap kemampuan pemecahan masalah matematis siswa dalam implementasi model pembelajaran *Problem Based Learning* berbantuan Math Trails. Penelitian ini dilaksanakan dengan menggunakan metode System Literature Review (SLR) pada artikel ataupun jurnal terbitan tahun 2015-2023 tentang pengaruh disposisi matematis terhadap kemampuan pemecahan masalah matematis siswa dengan model pembelajaran *Problem Based Learning*. Hasil menunjukkan bahwa disposisi matematis siswa dalam implementasi model pembelajaran *Problem Based Learning* untuk meningkatkan kemampuan pemecahan masalah pada siswa dan memiliki kecenderungan untuk menguji pada kemampuan pemecahan masalah dengan menggunakan *Math Trails* efektif dilakukan dan relevan untuk dilakukan penelitian selanjutnya.

Kata kunci :
disposisi matematis, *Problem Based Learning*, kemampuan pemecahan masalah, math trails

Abstract
Mathematics is a field of study that plays an important role in today's era. However, many of the students consider mathematics to be a very difficult lesson. There are many ways to handle this case, including by combining the *Problem Based Learning (PBL)* learning model accompanied by activities outside the classroom. These outside-class activities can be carried out with the help of Math Trails on the Math City Map Application as a medium for learning mathematics. Learning with the help of Math Trails can train and improve students' cognitive aspects, namely problem solving skills. Problem solving ability is the main thing in learning mathematics that needs to be improved. In order to improve students' problem-solving abilities can be done with Math Trails assisted activities. With the help of Math Trails, students can change their perspective on learning mathematics. An individual attitude towards a perspective on mathematics, which will display behavior of curiosity, diligence, confidence and interest in mathematics is called a student's mathematical disposition. The purpose of this writing is to describe the influence of mathematical dispositions on students' mathematical problem solving abilities in the implementation of the *Problem Based Learning model* assisted by Math Trails. This research was carried out using the System Literature Review (SLR) method in articles or journals published in 2015-2023 concerning the effect of mathematical dispositions on students' mathematical problem solving abilities with the *Problem Based Learning learning model*. The results show that students' mathematical dispositions in implementing the *Problem Based Learning learning model* to improve problem solving abilities in students and have a tendency to test problem solving abilities using *Math Trails* are effectively carried out and relevant for further research.

Keywords :
mathematical disposition, *Problem Based Learning*, problem solving skills, math trails

1. Introduction

Knowledge and technology have developed very quickly in various aspects of life. This is certainly a challenge for the world of education, especially in the world of mathematics education. To face these challenges, of course, Human Resources (HR) are needed that are able to keep up with global demands. In addition, education must also be developed based on 21st century developments. There are several 21st century competencies, including critical thinking skills, communication and collaboration skills, creativity, literacy, and problem solving skills. Education as a means to achieve competence in the 21st century, one of the abilities that must be possessed is problem solving ability. In education to achieve this ability is through learning. In learning there is a learning model, one of which is the Problem Solving Learning Model or *Problem Based Learning* (PBL). Problem-based learning model which can be interpreted as a learning model in which there

is a series of learning whose process starts from a problem and then studied to gain knowledge and skills.

Problem solving ability is the ability to apply mathematical knowledge and skills in solving problems in everyday life. To be able to improve problem-solving skills through learning, this must be done by equipping students with solving problems in the real world (Judge. A. R et al., 2019). In addition, solving problems is not only a goal of learning mathematics, however, solving problems is also the main tool for carrying out the learning process (NCTM, 2000). The problem-solving ability of each individual is not only about the results that are assessed but also their attitude in the problem-solving process. The attitude here is a mathematical disposition.

Disposition is part of a person's affective (soft skills) which can be said to be very important to be able to survive facing a problem and find a solution to the problem. A mathematical disposition is a tendency or habit to view mathematics as reasonable, useful and valuable combined with a belief in one's persistence and success. The importance of developing mathematical dispositions is in studying mathematical competence, in this case students and students need to have high-level mathematical thinking skills, critical attitude, creative and careful, objective and open, appreciate the beauty of mathematics, as well as curiosity and pleasure in learning mathematics (Dewi. P. S et al., 2019).

Problem solving abilities and mathematical dispositions of each student will vary based on the level of ability of each individual. However, most of them indicated that the students' mathematical solving abilities and dispositions were still relatively low. The problem solving abilities and mathematical dispositions of class VII students from 3 MTs in Kuansing are still relatively low (Guswinda et al., 2019). In addition, low problem solving skills and mathematical dispositions were found in class VII-2 of SMPN 2 Cimahi (Hutajulu et al., 2019). Teachers try to improve students' problem-solving abilities and mathematical dispositions in implementing PBL learning models in various ways, including by selecting learning models, methods, and media to be used in the learning process according to the conditions of students. One of the learning media that can be used to improve students' problem-solving abilities and mathematical dispositions in the implementation of the PBL learning model is *Math Trails*. *Math Trails* is an increasingly popular part of outdoor math education.

Through learning in an outside room, learners find connections between mathematics And sciences other as well as its application in the real world (Hakim et al., 2019). The added value of *Math Trails* can be seen in the use of mobile devices in the mathematics learning process. *Math Trails* itself is closely related to *the Math City Map*. *Math City Map* is an application developed by the MATIS I Team from Goethe University Frankfurt, Germany. This project involves students in mathematics on *Math Trails* which is supported by the use of mobile phones that support GPS (Cahyono et al., 2015). All over the world there are specific locations where mathematical situations can be experienced in everyday life, but there are also many places where math problems are hidden in secret. *Math City Map* helps teachers and students solve math problems in interesting places. These interesting places can be found using GPS**.**

Based on this background, this study aims to describe the increase in problem solving abilities and students' mathematical dispositions in the implementation of the *Math Trails-assisted PBL learning model* which are detailed as follows (1) to describe the objectives, types, and research designs used; (2) to describe the selected learning model and media; (3) to describe research trends in 2015-2023 related to increasing students' problem-solving abilities and mathematical dispositions in the implementation of *Math Trails-assisted PBL learning models*.

2. Research methods

This research was conducted using the *Systematic Literature Review* (SLR) method. Research as a process whose purpose is to identify, review, evaluate and interpret some of the existing research. In this study, researchers carried out a series of review processes and identified several articles in a structured manner following the steps (Triandini et al., 2019), including the following. First, *Research Question* (RQ). RQ is made based on needs according to the chosen topic. The RQ in this study includes (RQ1) What are the objectives and types of research used in the article on improving students' problem-solving abilities and mathematical dispositions in the implementation of the Math *Trails -assisted PBL learning model* in 2015-2023?; (RQ2) What is the learning model chosen in the article regarding improving students' problem-solving abilities and mathematical dispositions in the implementation of the *Math Trails -assisted PBL learning model* in 2015-2023?; (RQ3) What are the research trends regarding improving students' problem-solving abilities and mathematical dispositions in the implementation of the *Math Trails* -assisted PBL learning model in 2015-2023. Second, *search process*. The purpose of this the search process is used to obtain relevant data to answer *research questions*. The search process was carried out through the Google Scholar and Scopus databases with the keywords *Problem Based Learning*, *Math Trails*, Problem Solving Ability, Mathematical Disposition. Third, *inclusion and exclusion criteria*. Inclusion and exclusion criteria were used to determine whether the data obtained could be used in SLR research or not. The inclusion and exclusion criteria can be seen in the table below.

Table 2. 1 Inclusion and Exclusion Criteria

Inclusion	Exclusion
Math Trails-assisted PBL learning model as well as problem-solving abilities in terms of mathematical dispositions.	International or national articles that are irrelevant to the *Math Trails-assisted PBL learning model* and problem-solving abilities in terms of mathematical dispositions.
International or national articles in accordance with the title and research topic.	International or national articles which is not in accordance with the title and research topic.
Articles published in 2015-2023.	Articles published before 2015.
The language used is Indonesian or English.	The language used is other than Indonesian or English.

Fourth, *Quality Assessment* (QA). The data that has been obtained is evaluated based on the assessment criteria. The QA in this study includes (QA1) Was the article published in 2015-2023?; (QA2) Does the article state the purpose of the research or the type of research used?; (QA3) Does the article write down the learning model used? From the 3 QA, answers will be obtained in the

form of yes or no. Fifth, data collection. In this study, the data used for review were primary data, namely data collected through interviews, observation, or adjusting needs to support the research. Then, data analysis. The data that has been obtained and collected will be analyzed referring to *the Research Question* (RQ). Lastly, *deviation from protocol* . During the research there was a change, namely to refine the equivalent words for search keywords in the database.

3. Results and Discussion

Retrieved 16 articles that are relevant to the keywords that have been determined. Then, the researchers examined articles that were relevant to improving students' problem-solving abilities and mathematical dispositions in the implementation of the *Math Trails-assisted PBL learning model.*

Table 3. 1 Research Results INCREASING PROBLEM-SOLVING ABILITY AND STUDENTS' MATHEMATICAL DISPOSITION IN THE IMPLEMENTATION OF PROBLEM-BASED LEARNING ASSISTED WITH MATH TRAILS.

Source	Author, Year	Journal/Proceedings, Publication Category	Research result
Google Scholars	(Matthias Ludwig & Jen Jesberg, 2015)	Procedia-Social and Behavioral Sciences	*Math City Map* portal to upload self-developed or student-developed assignments and they can also create private math pathways for their students.
Google Scholar	(Nabila Dafina Putri, Zalsabila Yanuarriska Putri, & Deby Mardikaningsih, 2023)	ProSANDIKA UNIKAL (Proceedings of the National Seminar on Mathematics Education, University of Pekalongan)	Problem-based learning models with contextual activities Math Trails assisted by the Mobile MathCityMap application can provide active learning activities, improve problem solving skills, increase positive attitudes towards mathematics, and improve students' mathematical thinking skills
Scopus	(Martínez-Jiménez, Álvaro Noll, & Elvira Fernández, 2022)	MDPI article	There is a certain bias in the assignments present on *Math Trails* with the content covered (an abundance of tasks with a geometric component and a dearth of tasks involving algebra or the concept of probability). Most of the assignments are presented in a real context.

Google Scholars	(ČERETKOVÁ Soňa & BULKOVÁ Kristína , 2020)	Application Proceedings	The composition of trails assignments with MCM is publicly available. The types of assignments created in Slovakia by students in early teacher education are introduced in this contribution and compared to assignments created also in Slovakia but by educators, members of the project's partner team.
Google Scholars	(Ana Barbosa & I sabel Vale , 2021)	Tech-Edu Journal	The use of *the Math City Map* (MCM), a project of the MATISI working group (IDMI, Goethe-Universität Frankfurt) in collaboration with the Stiftung Rechnen, was reported to have a positive impact in supporting teachers and students in the process.
Google Scholar	(Mutia et al., 2023)	AIP Conference Proceedings	The results of the study show that students with high, medium, and low disposition levels have the same analogical thinking process. There is no difference in troubleshooting.
Google Scholars	(Edi & Nayazik, 2019)	Journal of Medicine	The results of the research show that there is an increase in the learning outcomes of the material using the perimeter and area of a quadrilateral formula in solving problems through the application of the "Golden Route"
Scopus	(Iwan Gurjanow & Matthias Ludwig, 2020)	International Perspectives on the Teaching and Learning	Outdoor learning is considered “more effective for developing cognitive skills than classroom-based learning.
Scopus	(Adi Nur Cahyono et al., 2020)	Journal on Mathematics Education	The Augmented Reality Mobile *Math Trails program* contributes positively to students' abilities in mathematical modeling.
Scopus	(Adi Nur Cahyono, Matthias Ludwig, &	ICMI-East Asia Regional Conference on Mathematics Education	MCM-Tasks must be authentic tasks, connected to real-life objects, and verifiable.

	Samuel Marée, 2015)		
Google Scholar	(Y Yustiana et al., 2021)	Journal of Physics: Conference Series	The results showed that students with a high category of mathematical disposition were able to carry out all stages of Polya problem solving. Students in the moderate mathematical disposition category can carry out the stages of understanding the problem, developing a problem solving plan and carrying out the plan. In addition, students in the low mathematical disposition category can carry out the problem understanding stage.
Google Scholar	(Masta Hutajulu, Tommy Tanu Wijaya, & Wahyu Hidayat, 2019)	Journal of Mathematics Education	The results of the data analysis show that mathematical disposition and learning motivation are significantly influenced by the problem-solving abilities of junior high school students.
Google Scholar	(Guswinda, Putri Yuanita, & Nahor Murani, 2019)	Journal of Educational Sciences	The results showed that there was an increase in KPMM and DM students who received the TTW Strategy in Cooperative Learning higher than students who received learning with a scientific approach.
Google Scholar	(Kurniawan & Kadarisma, 2020)	Journal of Innovative Mathematics Learning	The results of the research show that mathematical disposition has a positive contribution to problem solving abilities.
Google Scholar	(Hakim et al., 2019)	Postgraduate National Seminar	*Math Trails* activity with the help of *the Math City Map* is able to improve students' mathematical problem solving skills.
Google Scholar	(Angelo Ariosto et al., 2021)	AAPP Mathemaatiche e Naturali	*The Math City Map Project* is effective for supporting outdoor student learning activities.

(RQ1) What are the objectives and types of research used in the article on improving students' problem-solving abilities and mathematical dispositions in the implementation of the *Math Trails -assisted PBL learning model* in 2015-2023?

Figure 3. 1 below shows research in 2015-2023 regarding improving students' problem-solving abilities and mathematical dispositions in the implementation of the *Math Trails-assisted PBL learning model* there are differences in research focus. There are 3 research focuses found from 15 articles. The focus of research to describe the increase in problem-solving abilities and students' mathematical dispositions in the implementation of the *Math Trails*-assisted PBL learning model shows a percentage of 41%. It can be concluded that research in 2015-2023 concerning problem-solving abilities and students' mathematical dispositions in the implementation of the *Math Trails-assisted PBL learning model* tends to focus on increasing problem-solving abilities with *Problem Based Learning* (PBL) using *Math Trails* .

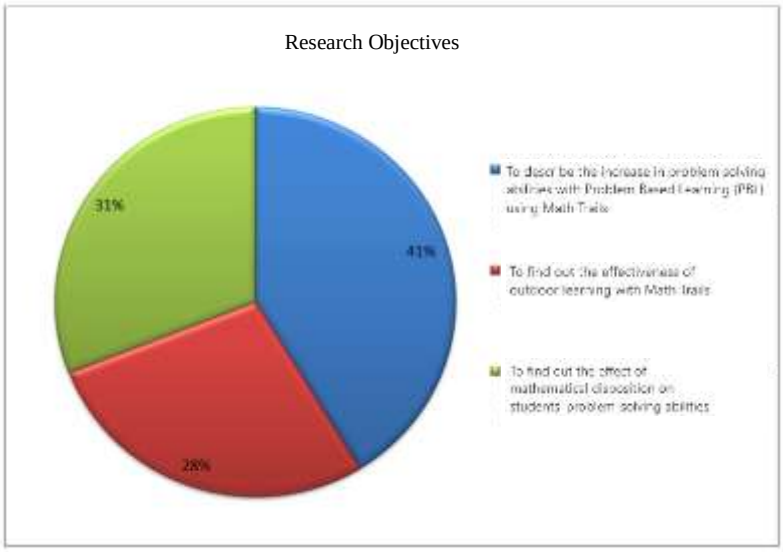

Figure 3. 1 Research purposes

While the research focus on the effectiveness of outdoor learning with *Math Trails* shows a percentage of 28%, including the third research focus tends to be used after the research focus on improving problem solving abilities with *Problem Based Learning* (PBL) using *Math Trails.* The trend of research focusing on improving problem solving abilities with *Problem Based Learning* (PBL) using *Math Trails* can still be developed further. Besides that, the focus of research on the influence of mathematical dispositions on problem-solving abilities has the opportunity to be further investigated and become a necessity in facing the 21-century era.

In **Figure 3. 2** below, it shows that out of 16 articles there are 4 types of research used on *Math Trails* and problem solving abilities and or mathematical dispositions towards problem solving abilities published in 2015-2023. Quantitative research with a percentage of 54%, illustrates that this type of research tends to be used more in research on *Math Trails* and problem solving abilities and or mathematical dispositions towards problem solving abilities. In addition to the research focus on improving students' problem-solving abilities and mathematical dispositions in implementing the *Math Trails-assisted PBL learning model*, research in 2015-2023 tends to be carried out with quantitative research.

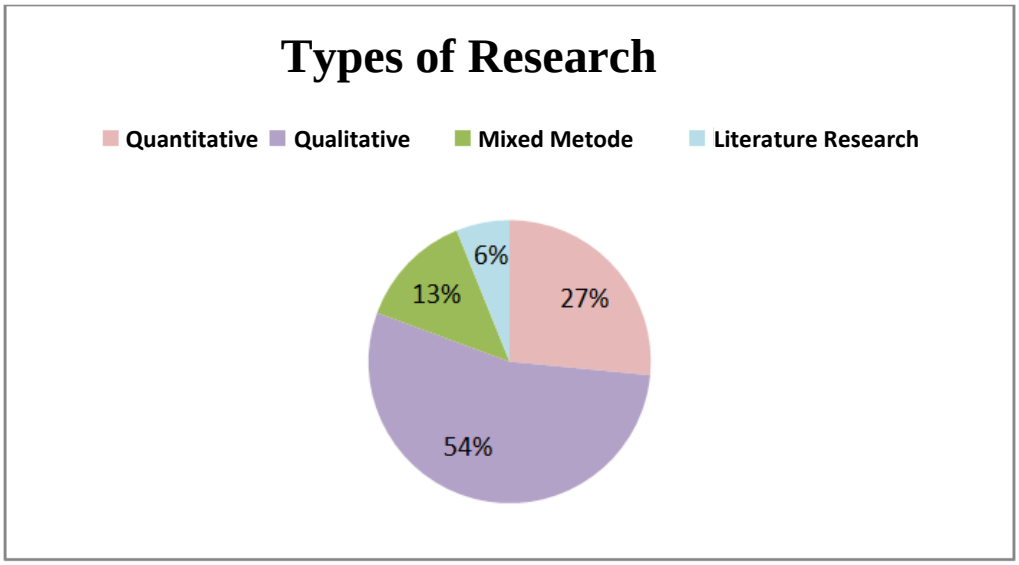

Figure 3. 2 Types of Research

(RQ2) What is the learning model chosen in the article regarding improving students' problem-solving abilities and mathematical dispositions in the implementation of the *Math Trails -assisted PBL learning model* in 2015-2023?

Figure 3. 3 depicts the learning model used in research on improving students' problem-solving abilities and mathematical dispositions in the implementation of *Math Trails-assisted PBL learning models*. The figure shows that the *Problem Based Learning* (PBL) learning model tends to be used in published research in 2015-2023.

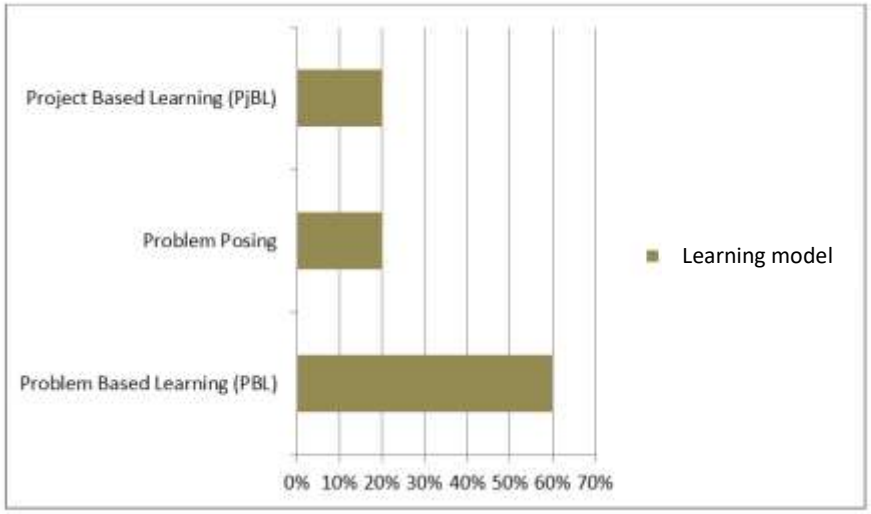

Figure 3. 3 Learning model

(RQ3) What are the research trends regarding improving students' problem-solving abilities and mathematical dispositions in the implementation of the *Math Trails*-assisted PBL learning model in 2015-2023?

Furthermore, in **Figure 3. 4**, it provides an overview of the mathematics learning materials selected in research on improving students' problem-solving abilities and mathematical dispositions in the implementation of *Math Trails-assisted PBL learning models* in publications in 2015-2023. It can be seen that **geometric** mathematics material is often chosen in research related to GeoGebra-assisted STEAM on the ability to think creatively mathematically.

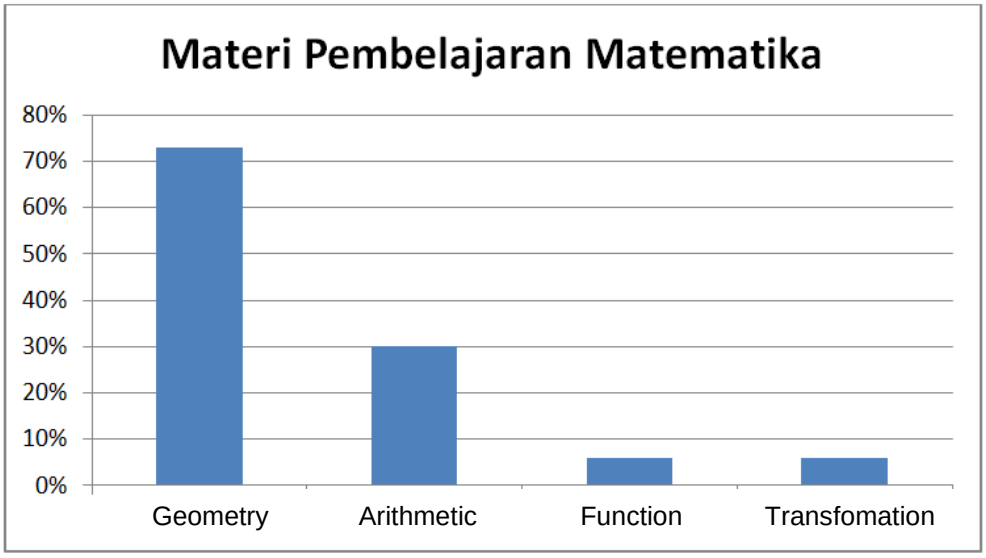

Figure 3. 4 Mathematics Learning Material

The Math Trails-assisted PBL learning model can be developed in a learning model. *Math Trails* as a learning medium is proven to be effective on problem solving skills (Jiménez, Álvaro Noll, & Elvira Fernández, 2022; Ana Barbosa & I sabel Vale , 2021; Edi & Nayazik, 2019; Adi Nur Cahyono et al., 2020). Then mathematical disposition influences problem-solving abilities (Mutia et al, 2023; Y Yustiana et al., 2021; Masta Hutajulu, Tommy Tanu Wijaya, & Wahyu Hidayat, 2019; Kurniawan & Kadarisma, 2020).

4. Conclusion

Based on the results and discussion of the literature review of 16 articles published in 2015-2023, that it can be concluded. First, research on improving students' problem-solving abilities and mathematical dispositions in the implementation of the *Math Trails-assisted PBL learning model* was found to have a tendency to test problem-solving abilities using *Math Trails* , while the effectiveness of outdoor learning with *Math Trails* in third place can be an alternative research

focus that can be redeveloped. The next trend is the use of quantitative research types. Second, in research on improving students' problem-solving abilities and mathematical dispositions in implementing the *Math Trails*-assisted PBL learning model published in 2015-2023 it was found that they tend to use *the Problem Based Learning* (PBL) learning model and choose geometric mathematical material. From this, it can be concluded that the improvement of students' problem-solving skills and mathematical dispositions in the implementation of the *Math Trails-assisted PBL learning model* was found to have a tendency to test problem-solving abilities using *Math Trails* effectively and is relevant for further research.

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