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Does the Mathematics Assessment Website Support Mathematical Problem Solving Ability? A Systematic Literature Review

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ABSTRACT

Mathematical problem-solving ability is a core competency in mathematics education and a central focus of competency-based assessment. With the rapid advancement of digital technology, assessment websites have increasingly been utilized to measure and support students' problem-solving skills. However, systematic studies that synthesize their characteristics, approaches, and contributions remain limited. This study aims to systematically review the literature on the use of assessment websites in enhancing students' mathematical problem-solving abilities. A Systematic Literature Review (SLR) was conducted following PRISMA guidelines. Relevant articles were retrieved from Google Scholar and Scopus using keywords related to assessment websites and mathematical problem-solving. The inclusion criteria focused on websites that provide mathematical problems and allow students to access their results. The selected studies were analyzed thematically to identify assessment types, key website features, problem-solving frameworks, and their contributions. The findings indicate that assessment websites effectively support students' problem-solving abilities, particularly through the provision of non-routine problems and immediate feedback on students' work. The predominant framework identified is Polya's problem-solving stages. These findings highlight the importance of developing digital assessment platforms that foster authentic and sustainable problem-solving skills in mathematics education.

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1. INTRODUCTION

Problem-solving abilities represent an essential target in the mathematics classroom as they reflect on students' ability to think, apply concepts and take decisions when faced with non-routine problems (Ballon, Gomez, Castro, & Linares, 2024; Csapó, 2017; Santos-Trigo, 2024). The solving of problems demands that problem-solvers not only have procedural knowledge, but also deal with elements such as understanding the problem situation, setting suitable strategies and checking solutions. Thus,

assessment methods in mathematics learning should contemplate more students' thinking process and less the result of students' achievement.

Along with the paradigm towards competency-based assessment, attention to measuring higher-order thinking skills, including mathematical problem-solving abilities, is increasing. Advances in digital technology have also driven the emergence of various forms of technology-based assessment that offer flexibility and efficiency in implementation. One widely studied form is the assessment website, which allows for interactive presentation of problem-solving questions, direct feedback, and analytical data on learning outcomes (Csapó & Molnár, 2019; Marchisio, Barana, Fioravera, Rabellino, & Conte, 2018; Yang, Fu, Hwang, & Yang, 2016). With these properties, assessment websites can be typecasted as not only an evaluation instrument but rather also a part of the mathematics learning course.

Several empirical studies show that the use of web-based assessment tools can increase the involvement of students and allow them for acquiring mathematical problem solving skills (González-Videgaray, Ruiz, & del Rosario Hernández-Coló, 2015; González, Giuliano, & Pérez, 2022; Ukobizaba, Nizeyimana, & Mukuka, 2021; Yang et al., 2016). However the evidences are dispersed in research contexts with different purposes, assessment designs and problem solving approaches. Such diversity complicates an attempt to form a holistic view on the features of effective assessment websites and the ways in which these promote students' mathematical problem solving skills.

Furthermore, existing literature reviews generally examine learning technology or digital assessment in general, while systematic reviews specifically focusing on assessment websites and their relationship to mathematical problem-solving skills are still limited. The lack of a focused synthesis potentially makes it difficult for researchers, educators, and policymakers to design or adopt assessment websites that align with the demands of competency-based assessment.

The problem formulation in this article is whether mathematics assessment websites can support mathematical problem solving. According to these conditions, the goal of this paper is to run a SLR on the use of assessment websites in mathematics teaching and learning, with an emphasis on what they offer for promoting mathematical problem solving skills. It is hoped that the results of this study will serve as a theoretical and empirical basis to develop and provide sites for mathematics assessments, in relation to the Junior High School an Academic Competence Test (ACT), so as to support authentic, systematic, sustainable abilities when solving problems.

2. METHODS

In order to address the above question, this study conducted a Systematic Literature Review (SLR) to extensively investigate studies of mathematics assessment websites and their role in supporting students' problem solving. The rationale of this SLR approach is that it supports to perform an organized, transparent, and reproducible synthesis of research literature across studies which leads to a reliable and objective knowledge map. The SLR methodology in this paper follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach.

Literature was retrieved from various scientific data bases (Google Scholar), to guarantee a broad and applicable coverage of publications. The search was restricted to articles published from 2000 to 2025 in order to reflect the most current development of web assessment. The search terms were "assessment website" and "mathematical problem solving." In addition, the chosen studies were reviewed and grouped according to main themes and the conclusion regarding the effect of mathematics assessment websites on students' problem-solving skills.

The inclusion criteria were peer-reviewed journal articles; research on mathematics assessment websites and studies connecting assessment and mathematical problem-solving skills in English or Indonesian. The exclusion criterion was used to (1) conference proceedings, books and non-journal publication; (2) articles discussing platform use that did not express problem-solving ability; and (3) studies not linking the studied context of assessment in mathematics.

This study was conducted, in Figure 1, into three major steps of data collection, analyzing data and making conclusions (Kitchenham & Charters, 2007; Xiao & Watson, 2019). The data of the sources were collected from primary studies published in Sinta, international journal, and Scopus accredited journal articles. Google Scholar electronic database was searched to identify relevant literature. 'Method' process of SLR Method in the PRISMA guidelines which start from the screening step using a database to find articles up to the stage of full text evaluation. The process of article selection was opted in the eligibility phase, taking into account the predetermined criteria until reaching main article analysis.

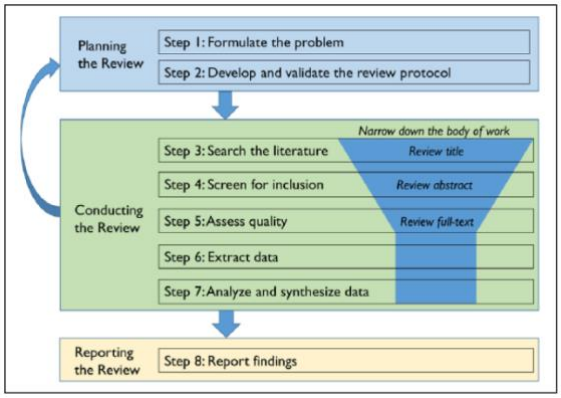

Figure 1. Process of systematic literature review

Twenty-two scientific articles relevant to the topic were reviewed. A meta-aggregation strategy was used for data analysis, synthesis, and interpretation. The goal was to provide answers to the research questions by summarizing various research findings. The research findings are presented in depth to answer the research questions.

To find potential documents relevant to the study of the keywords "mathematical assessment and problem-solving websites," a database was created. On January 6, 2026, at exactly 9:53 a.m. WIB (Western Indonesian Time), a search was conducted using the publish or peris software using the Google Scholar database. A total of 211 documents from 2000 to 2025, sourced from books, journals, conference proceedings, and book series, were found in the first search results. The material included articles, book chapters, conference papers, reviews, editorials, conference reviews, and books.

Several basic requirements are set for obtaining documents related to mathematics studies. First and foremost, the document content must include "websites and mathematical problem solving." Second, the documents must be sourced only from journal articles. Furthermore, the documents must be dated between 2000 and 2025. Documents that do not meet the requirements are the result of a selection process. According to some literature, there are four steps to methodically review documents: (1) identification, (2) screening, (3) eligibility, and (4) inclusion (Chen, Zhao, Sun, & Lu, 2021; de Dieuleveult, Siemonsma, van Erp, & Brouwer, 2017; Page et al., 2021).

3. FINDINGS AND DISCUSSION

Findings

Table 1. Metrics for publications and cititations

Description	Results
Publication years	2000-2025
Citation years	26 (2000-2026)
Total Publication (Papers)	211
Total Cititation	465133
Cites/year	17889.73
Cites/paper	2324.60
Authors/paper	2.63
h-Indeks	184
g-Indeks	200

Based on Table 1, there are 211 publications on website assessment and mathematical problem solving. These publications cover website assessment and mathematical problem solving between 2000 and 2025. These publications were cited 465,133 times in total, with an average of 17,889.73 citations per year. There are approximately 211 publications related to website assessment and mathematical problem solving literature. Furthermore, each collected document is cited with an average of 2,324.60 citations per paper. In addition, there are 184 documents that have at least 200 citations, as indicated by the document h-index of 184.

This examination of scientific papers and their associated citations is used to illustrate the evolution of the number of publications and citations related to mathematical representations during the period 2000 to 2025. The patterns in scientific publications and citation references are illustrated in Figures 2 and 3.

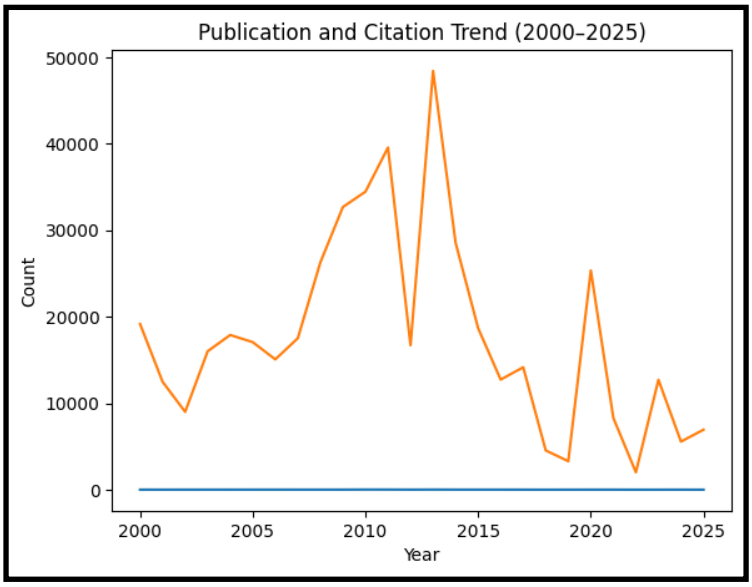

Figure 2. Analyzing the publication and citation dynamics of scholarly works over the 2000–2025 period

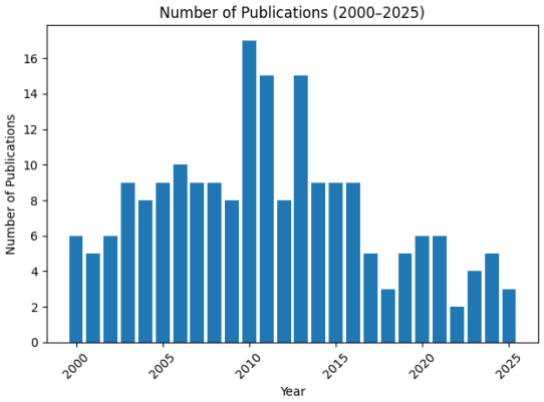

Figure 3. Analyzing the publication and citation dynamics of scholarly works over the 2000–2025 period

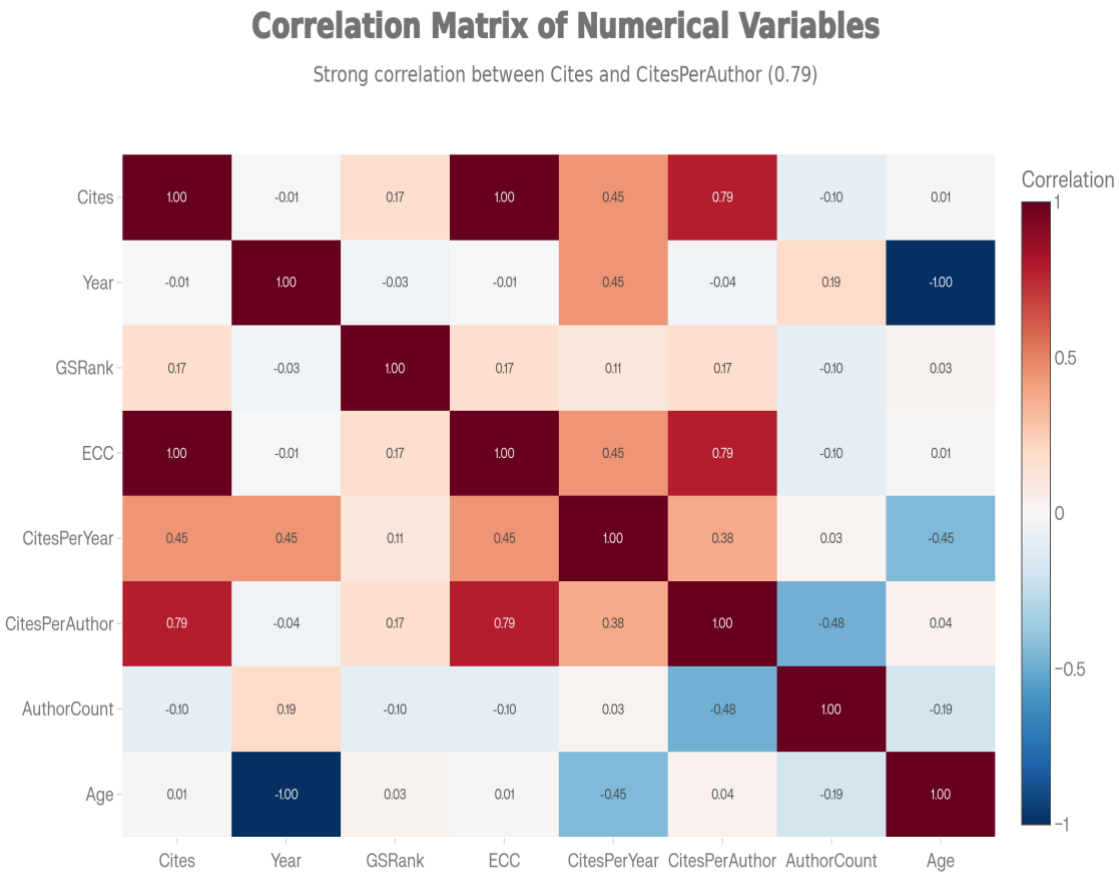

Figure 4. Headmap analysis

This heatmap depicts the Pearson correlation between eight numeric variables: Cites, Year, GSRank, ECC, CitesPerYear, CitesPerAuthor, AuthorCount, and Age. Red indicates a strong positive correlation, blue indicates a negative correlation, and colors closer to white indicate a weak or almost no correlation. Some variable pairs have such high correlations that they become the primary focus of interpretation. Cites has a very strong correlation with ECC (≈1.00) and CitesPerAuthor (≈0.79), indicating that articles with high total citations are also high in estimated citations and citations per author.

Year is perfectly negatively correlated with Age (≈−1.00), as Age is calculated as the difference between the analysis year and the publication year. This means that the more recent the publication year, the younger the article is, and this is visualized as a strong blue block in the Year–Age cell. Cites and CitesPerYear are moderately positively correlated (≈0.45), indicating that articles with high citation rates also tend to have high annual citation rates. CitesPerYear is also positively correlated with Year (≈0.44), indicating that newer articles tend to have higher annual citation rates, despite their shorter total age.

AuthorCount has a moderate negative correlation with CitesPerAuthor (≈−0.48), meaning that the more authors, the lower the average citations per author. The relationship between AuthorCount and total Cites is weak (around −0.10), so author team size does not significantly influence the number of total citations for an article. This information helps contextualize the relationship between key citation metrics, publication year, and structural elements, providing a comprehensive picture of how these factors interact in the context of scholarly publications (see Figure 5).

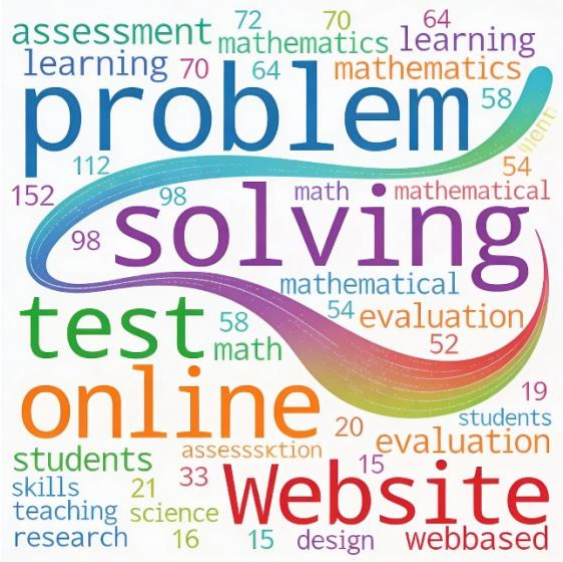

Figure 5. Wordcloud

Table 2. Findings from the study on assessment websites and mathematical problem-solving abilities

No.	Cites	Authors	Title	GS Rank	CitesPer Year
1	1	(Carreira, Jones, Amado, Jacinto, & Nobre, 2016)	"Mathematical Problem-Solving with Technology: An Overview of the Problem@ Web Project"	9	0.10
2	1	(Alkhatatneh, 2023)	"An Interactive Website Based on the "Systemic Approach" to Develop Mathematical Problem-solving Skills in Students of Sixth Grade in Primary School"	2	0,33
3	3	(Putri, Marmuah, &	"Web-Based Magasing Media to Improve Students' Mathematical Problem-Solving Skills at the Elementary School Level"	11	1.50

		Supianto, 2024)			
4	9	(Karyotaki & Drigas, 2016)	"Online and other ICT-based Assessment Tools for Problem-solving Skills"	12	0.90
5	99	(Nguyen & Kulm, 2005)	"Using web-based practice to enhance mathematics learning and achievement"	13	4.71
6	108	(Wang, 2011)	"Implementation of Web-based dynamic assessment in facilitating junior high school students to learn mathematics"	3	7.20
7	`177	(Nguyen, Hsieh, & Allen, 2006)	"The impact of web-based assessment and practice on students' mathematics learning attitudes"	8	8.85
8	1710	(Brusilovsky & Peylo, 2003)	"Adaptive and intelligent web-based educational systems"	188	74.35
9	1720	(Roschelle, Pea, Hoadley, Gordin, & Means, 2000)	"Changing how and what children learn in school with computer-based technologies"	35	66.155
10	1813	(Breslow et al., 2013)	"Studying learning in the worldwide classroom research into edX's first MOOC."	89	139.46
11	2304	(König, Jäger-Biela, & Glutsch, 2020)	"Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany"	62	384.00
12	37	(Ambarwati, 2021)	"The Effectiveness of Web Game-Based Learning Media to Improve Problem-Solving Skills in Elementary School Mathematics Learning"	1	5.29
13	15	(Fauziah, Kurnianti, & Hidayat, 2022)	"Development of Chatbot Website Learning Media Based on Problem Solving on Data Presentation Material for Grade IV Elementary School"	1	3.75
14	3	(Jakiah et al., 2022)	"Development of Website-Based Two-Variable Linear Equation System Teaching Materials to Teach Students' Mathematical Problem-Solving Skills"	1	0.75
15	5	(Widyastuti & Eliyen, 2022)	"Web-Based Exercise Development Using the Waterfall Method (Realistic Mathematics Question Type)"	1	1.25

16	1	(Falahuli, Lestari, Ellianawati, & Avrilianda, 2025)	"Literature Review: Quizizz as an Interactive Media to Improve Elementary School Students' Mathematical Problem-Solving"	1	1
17	8	(Disca Amellya & Khasanah, 2021)	"Development of mathematics learning media using Google Sites with a metacognitive approach for class XI"	1	1.60
18	25	(Lisnani, Putri, Zulkardi, & Somakim, 2023)	"Web-Based Realistic Mathematics Learning Environment for 21st-Century Skills in Primary School Students"	1	8.33
19	13	(Kawazoe & Yoshitomi, 2017)	"E-learning/e-assessment systems based on webMathematica for university mathematics education"	1	1.30
20	8	(Kamaruddin, 2020)	"The application of e-learning mathematics using moodle in improving students' problem solving ability"	1	1.33
21	0	(Alfat, Saluky, & Widodo Winarso, 2025)	"The Effectiveness of Using WordPress CMS as an Interactive Learning Media on Students' Mathematical Problem Solving Ability"	1	0
22	99	(Mistretta, 2015)	"Integrating technology into the mathematics classroom: the role of teacher preparation programs"	1	4.71

From an analysis of 22 articles, researchers identified several key findings related to the impact of websites on students' problem-solving abilities. Most studies indicate that using websites containing mathematics materials and problems can help support students' problem-solving abilities. For example, research by (Alkhatatneh, 2023; Carreira et al., 2016; Karyotaki & Drigas, 2016; Putri et al., 2024) stated that students who learned using websites demonstrated good mathematical problem-solving skills. Using websites encouraged students' active involvement in learning. Students found using the website to be more helpful in learning mathematics (Asfyra, Zulkardi, Putri, & Hartono, 2024; Kurniawan & Zulkardi, 2017; Zulkardi & Nieveen, 2001; Zulkardi & Putri, 2010).

Several studies have found that students taught using websites show significant improvements in their problem-solving skills compared to using conventional tools (Ambarwati, 2021; Hwang, Chen, & Hsu, 2006; Khikmiyah, 2021; Ratih Noverlika, Mujahidawati, & Ilham Falani, 2024; Setiawan, Handican, & Rurisman, 2023).

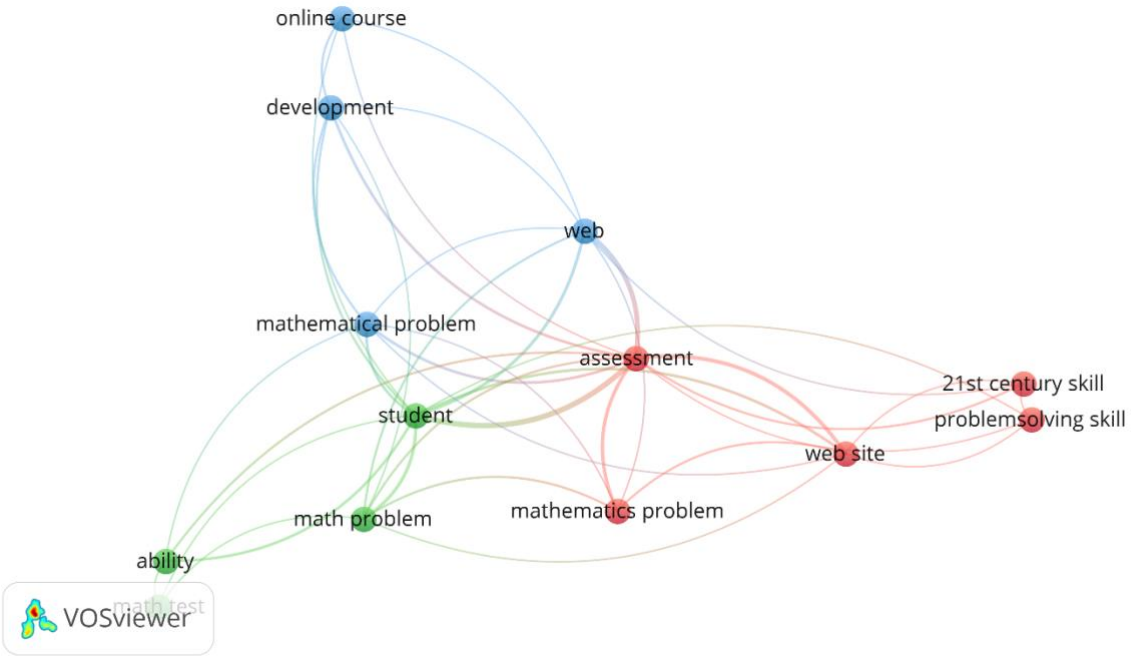

Figure 6. Network visualisation of co-word analysis

Figure 6 presents a visualization of the co-word analysis network, which illustrates the relationships between key terms related to assessment websites and mathematical problem solving. Co-word analysis groups terms into clusters based on their co-occurrence in the literature, highlighting how frequently these terms are used together in research studies.

This visualization shows several main clusters, each represented by a different color, and connects frequently occurring terms together, forming a network. The size of the nodes represents the frequency of occurrence of the terms, and the proximity between nodes indicates the strength of the relationship between the terms. Larger nodes represent more central concepts in the network, while smaller nodes are peripheral yet quintessential to the entirety of the structure.

The network visualization of the keyword analysis shows clusters of keywords that correspond to the major thematic areas in mathematical problem-solving and assessment website research. the highly recurring terms, website, web assessment, problem-solving skill, mathematics problem mathematical problem math problem 21st-century skill student ability online course and development are the core of the network that highlights some key features in this research. Terms "website," "problem-solving skill," "21st-century skill," "assessment" and the stem term mathematics problem comprise the red cluster that reflects some rudimentary outline of websites and their utility for assessment. This highlights the necessity of assessment including also websites as a way to help improve students' competence in mathematical problem solving. On the other hand, the green cluster has "ability," "math problem" and "student", suggesting a focus on some particular case studies of applying math problems to students ability. On the other hand, words such as "web", "mathematical problem", "development" and "online course" are focal in the blue cluster, indicating that more emphasis is given to development of web sites for diagnosis of math test questions and online courses.

The network visualization analysis highlighted the significance of web sites as online environments enabling forward and backward transfer in solving math problems by students. The connections between terms illustrate how assessment websites support students to work on problems, promoting their problem solving abilities. Additionally, the clustering of terms hints at areas that warrant further study, i.e., a junior high school mathematics Academic Competency Test (ACT) web for students importance of mathematical problem solving.

As for the metadata analysis of the Cites starting field in the Sankey diagram, one crucial step determining a publicatation's visibility and importance is expressed by its number of citations (Cites). The heavy flow from "Cites" to "GSRank" suggests that there is a high positive relation between number of citations and Google Scholar ranking, i.e., highly cited articles will be ranked better. "Cites" affects "CitesPerAuthor," and the more citations, ergo the average number of citation by author is higher. The relationship between "Year" (year of publication) and the other metadata features suggests that older publications are citing a larger number of times compared to new ones, which makes sense because they have been cited for longer time. There is also a slight correlation between "Year" and "CitationsPerYear," suggesting that it is still possible for new articles to garner large numbers of citations per year, maintaining their relevance to the growth of science.

The relationship between the numbers of authors ("Number of Authors") and citations show that papers with more authors receive more citations. Research collaboration enhances academic networking, increases the likelihood of being noticed and cited in publications. The connection between Number of Authors and Citations Per Year also explains that the more authors, the larger the citable rate per year shall be, stressing the role of cooperation for a whole.

The results of this literature review indicate that assessment websites have strong potential to support students' problem-solving abilities. Using websites not only helps students better understand mathematical concepts but also increases their interest (Hamdunah, Yunita, Zulkardi, & Muhafzan, 2016; Kurniawan & Zulkardi, 2017; Octaria, Zulkardi, & Somakin, 2013). It should also be noted that the site is going to owe much of its success to word-of-mouth among educators and the use of a good curriculum. Place them on the newly developed website, for what is necessary to make it work: for the website of the Junior high school mathematics academic competence test (ACT).

Discussion

A number of research showed that working on websites significantly supported problem-solving abilities. Web construction enhances students' practical familiarity with mathematical concepts. The increasing interest towards how websites can enhance students' math problem-solving skills has been evidenced by the studies that utilized Web-Based Magazine to get an N-Gain score of 56.03 in which the classification is "moderately effective"(Putri et al., 2024).

It is through the use of website technology in the learning of mathematics that it can stimulate mathematical thinking and appreciation knowledge on possible applications in students' mathematical problem-solving activities (Carreira et al., 2016). The findings confirm that an interactive website in conjunction with a comprehensive pedagogical approach has a significant effect on the mathematical problem-solving ability of sixth graders (Alkhatatneh, 2023; Suciati & Putra, 2025).

The results of this literature review indicate that assessment websites have strong potential to support students' problem-solving skills. Using websites not only helps students better understand mathematical concepts but also increases their motivation. However, it is important to note that the success of a website is highly dependent on support from educators and an appropriate curriculum. To ensure successful website implementation, it is necessary to develop a website for the assessment needed today: a website for the Junior High School Mathematics Academic Competency Test (ACT) questions.

4. CONCLUSION

Overall, this review indicates that assessment websites can support students' mathematical problem-solving skills. Website use can also create a more positive learning experience for students. It is recommended that educators develop assessment websites, such as the Junior High School Mathematics TKA question website, for use in mathematics assessments at school, as this can support students' mathematical problem-solving skills. To support this integration, it is important to hold training sessions and workshops for educators on assessment websites, which can increase teachers' understanding of developing assessment websites for use in schools. Theoretically, this study

contributes by establishing a clear conceptual link between web assessment and problem-solving heuristics, extending the literature on web-based mathematics pedagogy.

REFERENCES

Alfat, C., Saluky, & Widodo Winarso. (2025). The Effectiveness of Using WordPress CMS as an Interactive Learning Media on Students' Mathematical Problem Solving Ability. *Universal Education Journal of Teaching and Learning*, *2*(2). https://doi.org/10.63081/uejtl.v2i2.50

Alkhatatneh, S. (2023). An Interactive Website Based on the "Systemic Approach" to Develop Mathematical Problem-solving Skills in Students of Sixth Grade in Primary School in Jordan. *Information Sciences Letters*, *12*(5). https://doi.org/10.18576/isl/120537

Ambarwati. (2021). Efektivitas Media Pembelajaran Berbasis Web GameUntuk Meningkatkan Kemampuan Pemecahan Masalah Pada Pembelajaran Matematika SD. *Mimbar PGSD Undiksha*, *6*(2). Retrieved from https://doi.org/10.23887/jjpgsd.v7i2.17472

Asfyra, I. B., Zulkardi, Putri, R. I. I., & Hartono, Y. (2024). Learning the Area of Trigonometric using Website-assisted with Fashion Context for Vocational High School Students. *AIP Conference Proceedings*, *3052*(1). https://doi.org/10.1063/5.0201039

Ballon, E. M. M., Gomez, F. L. R., Castro, A. E. L. F., & Linares, M. R. F. C. (2024). Evaluating problem-solving and procedural skills of first-year students in a Peruvian higher education institution. *Eurasia Journal of Mathematics Science and Technology Education*, *20*(2). https://doi.org/10.29333/ejmste/14154

Breslow, L., Pritchard, D. E., DeBoer, J., Stump, G. S., Ho, A. D., & Seaton, D. T. (2013). Studying learning in the worldwide classroom research into edX's first MOOC. *Research & Practice in Assessment*, *8*, 13–25. Retrieved from https://www.learntechlib.org/p/157941/

Brusilovsky, P., & Peylo, C. (2003). Adaptive and Intelligent Web-based Educational Systems ADAPTIVE AND INTELLIGENT TECHNOLOGIES FOR WEB-BASED EDUCATIONAL SYSTEMS. *International Journal of Artificial Intelligence in Education*, *13*. Retrieved from https://telearn.hal.science/hal-00197315v1

Carreira, S., Jones, K., Amado, N., Jacinto, H., & Nobre, S. (2016). *Mathematical Problem-Solving with Technology: An Overview of the Problem@Web Project*. https://doi.org/10.1007/978-3-319-24910-0_1

Chen, Q., Zhao, D., Sun, J., & Lu, C. (2021). Aldosterone Blockade in Acute Myocardial Infarction: A Systematic Review and Meta-Analysis. *Cardiovascular Therapeutics*, Vol. 2021. https://doi.org/10.1155/2021/1710731

Csapó, B. (2017). The Nature of Problem Solving. In *Educational research and innovation*. Organization for Economic Cooperation and Development. https://doi.org/10.1787/9789264273955-en

Csapó, B., & Molnár, G. (2019). Online Diagnostic Assessment in Support of Personalized Teaching and Learning: The eDia System. *Frontiers in Psychology*, Vol. 10. Frontiers Media. https://doi.org/10.3389/fpsyg.2019.01522

de Dieuleveult, A. L., Siemonsma, P. C., van Erp, J. B. F., & Brouwer, A. M. (2017). Effects of aging in multisensory integration: A systematic review. *Frontiers in Aging Neuroscience*, Vol. 9. https://doi.org/10.3389/fnagi.2017.00080

Disca Amellya, & Khasanah, U. (2021). Pengembangan Media Pembelajaran Matematika menggunakan Google Site dengan Pendekatan Metakognisi untuk Kelas XI. *Quadratic: Journal of Innovation and Technology in Mathematics and Mathematics Education*, *1*(2). https://doi.org/10.14421/quadratic.2021.012-04

Falahuli, A. D., Lestari, W., Ellianawati, E., & Avrilianda, D. (2025). Literature Review: Quizizz sebagai Media Interaktif Meningkatkan Pemecahan Masalah Matematika Siswa SD. *Ilmu Pendidikan: Jurnal Kajian Teori Dan Praktik Kependidikan*, *10*(2). Retrieved from https://doi.org/10.17977/um027v10i22025p121-128

Fauziah, A., Kurnianti, E. M., & Hidayat, O. S. (2022). Pengembangan Media Pembelajaran Website Chatbot Berbasis Pemecahan Masalah Pada Materi Penyajian Data Untuk Kelas Iv Sekolah Dasar.

Efektor, *9*(1), 23–34. Retrieved from https://doi.org/10.29407/e.v9i1.16348

González-Videgaray, M. C., Ruiz, R. R., & del Rosario Hernández-Coló, M. (2015). Open access web technology for mathematics learning in higher education. *Educación y Humanismo*, *17*(29), 134–155. https://doi.org/10.17081/eduhum.17.29.1258

González, J. A., Giuliano, M., & Pérez, S. N. (2022). Measuring the effectiveness of online problem solving for improving academic performance in a probability course. *Education and Information Technologies*, *27*(5), 6437–6457. https://doi.org/10.1007/s10639-021-10876-7

Hamdunah, Yunita, A., Zulkardi, & Muhafzan. (2016). Development a constructivist module and web on circle and sphere material with wingeom software. *Journal on Mathematics Education*, *7*(2). https://doi.org/10.22342/jme.7.2.3536.109-116

Hwang, W. Y., Chen, N. S., & Hsu, R. L. (2006). Development and evaluation of multimedia whiteboard system for improving mathematical problem solving. *Computers and Education*, *46*(2). https://doi.org/10.1016/j.compedu.2004.05.005

Jakiah, N., Ahmad, M., Ardiana, N., Fakultas,), Matematika, P., Ilmu, D., … Masalah, K. P. (2022). PENGEMBANGAN BAHAN AJARSISTEM PERSAMAAN LINEAR DUA VARIABEL BERBASIS WEBSITEUNTUK MEMBELAJARKAN KEMAMPUAN PEMECAHAN. *Journal.Ipts.Ac.Id*, *5*(3).

Kamaruddin, E. (2020). THE APPLICATION OF E-LEARNING MATHEMATICS USING MOODLE IN IMPROVING STUDENTS' PROBLEM SOLVING ABILITY. *JISAE: Journal of Indonesian Student Assessment and Evaluation*, *6*(1). https://doi.org/10.21009/jisae.v6i1.14432

Karyotaki, M., & Drigas, A. (2016). Online and other ICT-based Assessment Tools for Problem-solving Skills. *International Journal of Emerging Technologies in Learning*, *11*(4). https://doi.org/10.3991/ijet.v11i04.5339

Kawazoe, M., & Yoshitomi, K. (2017). E-learning/e-assessment systems based on webMathematica for university mathematics education. *MSOR Connections*, *15*(2). https://doi.org/10.21100/msor.v15i2.416

Khikmiyah, F. (2021). Implementasi web live worksheet berbasis problem based learning dalam pembelajaran matematika [Implementation of web live worksheet based on problem based learning in mathematics learning]. *Pedagogy: Jurnal Pendidikan Matematika*, *6*(1). Retrieved from https://doi.org/10.30605/pedagogy.v6i1.1193

Kitchenham, B., & Charters, S. (2007). B. Kitchenham and S. Charters, "Guidelines for performing Systematic Literature reviews in Software Engineering Version 2.3." *Engineering*, *45*(4ve). Retrieved from https://www.researchgate.net/publication/302924724_Guidelines_for_performing_Systematic_Literature_Reviews_in_Software_Engineering

König, J., Jäger-Biela, D. J., & Glutsch, N. (2020). Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany. *European Journal of Teacher Education*, *43*(4), 608–622. Retrieved from https://doi.org/10.1080/02619768.2020.1809650

Kurniawan, H., & Zulkardi, Z. (2017). PENGEMBANGAN WEB SUPPORT UNTUK SISWA SEKOLAH MENENGAH ATAS JURUSAN IPA POKOK BAHASAN TRIGONOMETRI. *Jurnal Pendidikan Matematika*, *11*(1). https://doi.org/10.22342/jpm.11.1.3594.79-93

Lisnani, Putri, R. I. I., Zulkardi, & Somakim. (2023). Web-based realistic mathematics learning environment for 21st-century skills in primary school students. *Journal on Mathematics Education*, *14*(2). https://doi.org/10.22342/jme.v14i2.pp253-274

Marchisio, M., Barana, A., Fioravera, M., Rabellino, S., & Conte, A. (2018). *A Model of Formative Automatic Assessment and Interactive Feedback for STEM*. 1016–1025. https://doi.org/10.1109/compsac.2018.00178

Mistretta, R. M. (2015). Integrating Technology Into the Mathematics Classroom: The role of Teacher Preparation Programs. *THE MATHEMATICS EDUCATOR*, *15*(1). https://doi.org/10.63301/tme.v15i1.1883

Nguyen, D. M., Hsieh, Y.-C., & Allen, G. D. (2006). The Impact of Web-Based Assessment and Practice on Students' Mathematics Learning Attitudes. *Journal of Computers in Mathematics and Science Teaching*, *25*(3). Retrieved from https://psycnet.apa.org/record/2007-08586-003

Nguyen, D. M., & Kulm, G. (2005). Using Web-based practice to enhance mathematics learning and achievement. *Journal of Interactive Online Learning*, *3*(3). Retrieved from https://www.ncolr.org/jiol/issues/pdf/3.3.1.pdf

Octaria, D., Zulkardi, & Somakin. (2013). Pengembangan Website Bahan Ajar Turunan untuk Meningkatkan Minat Belajar Peserta Didik. *Jurnal Kependidikan*, *43*(2). Retrieved from https://jurnal.uny.ac.id/index.php/jk/article/view/1965

Page, M. J., Moher, D., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., … Mckenzie, J. E. (2021). PRISMA 2020 explanation and elaboration: Updated guidance and exemplars for reporting systematic reviews. *The BMJ*, Vol. 372. https://doi.org/10.1136/bmj.n160

Putri, F. R., Marmuah, S., & Supianto. (2024). Web-Based Magasing Media to Improve Students' Mathematical Problem-Solving Skills at the Elementary School Level. *International Journal of Elementary Education*, *8*(2). https://doi.org/10.23887/ijee.v8i2.75077

Ratih Noverlika, Mujahidawati, M., & Ilham Falani. (2024). Pengembangan Media Pembelajaran Wegos (Web Google Sites) Berbasis Problem Based Learning untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa. *JURNAL PENDIDIKAN MIPA*, *14*(2). https://doi.org/10.37630/jpm.v14i2.1524

Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing how and what children learn in school with computer-based technologies. *Future of Children*, *10*(2). https://doi.org/10.2307/1602690

Santos-Trigo, M. (2024). Problem solving in mathematics education: tracing its foundations and current research-practice trends. *ZDM*, *56*(2), 211–222. https://doi.org/10.1007/s11858-024-01578-8

Setiawan, H., Handican, R., & Rurisman, R. (2023). Revolutionizing Math Education: Unleashing the Potential of Web-based Learning Media for Enhanced Mathematical Problem Solving Skills. *JDIME : Journal of Development and Innovation in Mathematics Education*, *1*(2). https://doi.org/10.32939/jdime.v1i2.2978

Suciati, R., & Putra, H. D. (2025). The Development of Problem Solving Web-Based Teaching Materials to Improve Mathematical Comprehension Skills and Independent Learning. *(JIML) JOURNAL OF INNOVATIVE MATHEMATICS LEARNING*, *8*(1). https://doi.org/10.22460/jiml.v8i1.30255

Ukobizaba, F., Nizeyimana, G., & Mukuka, A. (2021). Assessment Strategies for Enhancing Students' Mathematical Problem-solving Skills: A Review of Literature. *Eurasia Journal of Mathematics Science and Technology Education*, Vol. 17. Modestum Limited. https://doi.org/10.29333/ejmste/9728

Wang, T. H. (2011). Implementation of Web-based dynamic assessment in facilitating junior high school students to learn mathematics. *Computers and Education*, *56*(4). https://doi.org/10.1016/j.compedu.2010.09.014

Widyastuti, R., & Eliyen, K. (2022). Pengembangan Exercise Berbasis Web Dengan Metode Waterfall (Tipe Soal Realistic Mathematics). *Jurnal PETIK*, *8*(1). Retrieved from https://doi.org/10.31980/petik.v8i1.1246

Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. *Journal of Planning Education and Research*, Vol. 39. https://doi.org/10.1177/0739456X17723971

Yang, T., Fu, H.-T., Hwang, G., & Yang, S. J. H. (2016). Development of an interactive mathematics learning system based on a two-tier test diagnostic and guiding strategy. *Australasian Journal of Educational Technology*. https://doi.org/10.14742/ajet.2154

Zulkardi, & Nieveen, N. (2001). CASCADE-IMEI: Web site support for student teachers learning realistic mathematics education (RME) in Indonesia. *Fifth International Conference on Technology in Mathematics Teaching*. Retrieved from https://repository.unsri.ac.id/6356/1/paperzulkardiICTMT5.pdf

Zulkardi, Z., & Putri, R. I. I. (2010). Pengembangan blog support untuk membantu siswa dan guru

matematika Indonesia belajar pendidikan matematika realistic Indonesia (PMRI). *Jurnal Inovasi Perekayasa Pendidikan (JIPP)*, *2*(1), 1–24. Retrieved from https://repository.unsri.ac.id/6777/