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Improved Problem-Solving Skills Using Mathematics Module

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Abstrak

Banyaknya peneliti yang telah melakukan penelitian yang berkaitan dengan peningkatan kemampuan pemecahan masalah dengan menggunakan modul matematika. Tujuan dari penelitian ini adalah untuk menganalisis kembali hasil-hasil penelitian pada perbandingan tingkat hasil belajar siswa terhadap pemecahan masalah dengan menggunakan modul matematika, berdasarkan jenjang pendidikan. Metode yang di gunakan dalam penelitian ini adalah Meta-analisis. Hasil penelusuran ditemukan sebanyak 61 data yang memenuhi syarat dan ketentuan dari database Geogle Scolar, DOAJ, dan Scopus dari jumlah peserta didik (N), nilai uji fisher (F), nilai uji student (t), nilai uji korelasi (r) dan ketuntasan klasikal yang diambil bersdasarkan dengan kata kunci. Dan hasil data akan dianalisis menggunakan sofware JASP dengan menginput nilai Effect Size (ES) dan standart Error (SE) dari tiap data. Dari hasil analis data dapat terlihat peningkatan yang signifikan. Hasil analisis data menunjukkan tingkat perbandingan hasil pemecahan masalah menggunakan modul matematika pada semua jenjang, pada jenjang SD sebesar 96% (kategori tinggi), tingkat SMP sebesar 99% (kategori tinggi), tingkat SMA 101% (kategori tinggi) dan PT sebesar 86% (kategori tinggi). Disimpulkan tingkat perbandingan pada jenjang SMA lebih tinggi dibandingkan dengan jenjang SD, SMP, dan PT.
Kata Kunci: Peningkatan; Kemampuan Pemecahan Masalah; Modul.

Abstract

Many researchers have conducted research related to improving mathematical problem-solving skills using mathematical modules. The purpose of this study is to re-analyze the research on the level of comparison of studies learning outcomes to problem-solving skills with mathematics modules, based on the level of education, namely elementary, junior high, high school, and higher education. The method used in this study is Meta-analysis.The search results found as much as 61 data that met the terms and conditions from the Geogle scholar, DOAJ, and Scopus databases fisher test value (F), student test value (t), correlation test value (r), and classical completeness taken based on keywords. And the data results next analyzed using JASP software by inputting the Effect Size (ES) and Standard Error (SE) values from each data. From the results of the data analysis, a significant increase can be seen. Improving problem-solving skills using mathematics modules is more widely used at the high school level compared to the elementary, junior high, and tertiary levels. The results of the data analysis showed that there was a comparative level of problem solving results using mathematics modules at all levels, at the SD level of 96% (high category), SMP level of 99% high (category), SMA level of 101% (high category), and PT level by 86% (high category). It can be concluded that the comparison level at the SMA level is the higher than at the SD, SMP, SMA and PT levels.
Keywords: Improvement; Problem-solving ability; Math Module.

I. INTRODUCTION

Education is a conscious attempt and pursuits to develop human qualities into a purpose-conscious activity (Yuniar, Sumarni, & Adiastuty 2020), activites in educating the it is a job that has a purpose and something that wants to achieved in the work, then in its implementation is in a continuous process of each type and stage education, everything is related in a education system that an integral. According to Bernard (2015), mathematics subjects need to be given to all students from elementary school to high school with equipment the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to cooperate. According to Mulyati (2016) mathematics learning in elementary schools is not only aimed at improving students' ability to count or apply formulas or procedures in solving routine problems, but also at improving students' ability to solve problems, both mathematical problems and other problems that use mathematics to solve them. Chotimah et al (2018) stated that mathematics is a subject that has a very important position in the development of science and technology. Problem-solving skills are essential for students and their future (Sormin & Nurasahara 2019).

Problem-solving skills in mathematics is an important thing that students need to master (Supriyanti, Mastur, & Sugiman 2015). Problem-solving is the main basis for measuring students' ability to think and discover new things to solve this problem. It is in line with Rahman (2016) that problem-solving is a human activity that combines previously acquired conceColleges and rules, and not a genetic skill. The ability to solve problems depends largely on the existence of problems. According to (Kiptiyah, 2016), the problem-solving ability is one of the important elements in learning activities the mathematics that students need to have. Several strategies can be used to improve problem-solving skills, including four steps to solve problems, namely: understanding problems, planning solutions, solving problems according to plan, and checking results (Finariyati, Rahman, and Amalia 2020). Low studying results are the selection of inappropriate studying of methods and media. The teacher has a crucial role to play in helping pupils develop problem-solving abilities by providing high-quality, simple-to-understand facilities (Nurmeidina, Lazwardi, & Nugroho 2021).

Designing learning materials in the form of modules is a method to improve student learning (Taufiq & Agustito, 2021; Husniah & Azka, 2022). (Suprihatiningsih & Annurwanda (2019) states that modules are learning materials that are systematically designed so that users can learn with or without a facilitator or teacher. A module is it can also be said as a book written with the aim that learners can learn independently without the direction or guidance of the teacher. This shows that despite the absence of a teacher in the classroom, modules can be used by students independently in learning.

Some research on improving mathematics problem-solving ability using modules at the elementary level has been conducted by Thuneberg et al., (2018), Twiningsih et al., (2019), Yuniarti &

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Sukestiyarno (2020), Maesari et al., (2020), Al-khateeb (2018), While respondents used in elementary level are 26 students with results of F-counting of 131.86.

Research conducted by Delyana (2015), (Amalia, Sukestiyarno, & Cahyono, 2021), (Arafani, Herlina, & Zanthy, 2019), (Hamid, Aribowo, & Desmira 2017), (Mayasari, Danaryanti, & Kamaliyah, 2018), (Yusri 2018), (Amalia, Tayeb, & Abrar 2019), (Arafani et al. 2019), (Jainuri, 2014), (Aulia & Prahmana, 2022), (Nafisa et al. 2021), (Novintya & Suparman 2018), in (Darsono, Santia, & Jatmiko 2018) research related to improving the algebraic problem-solving ability of junior high school students with a total of 30 students with a calculated score of 6.43.

Research at the high school level is related to improving problem-solving skills using mathematics modules has been done by (Andriani, 2016), (Budhiharti and Suyitno 2017), (Niat et al. 2017), (Masri, Suyono, & Deniyanti 2018), (Karenina, Widoretno, & Prayitno 2020), (Ramadhani & Fitri 2020), (Yaniawati 2021), (Sumandya et al. 2021), (Amaliyah, Sukestiyarno, & Asikin 2021), (Karenina et al. 2020), (Saputra 2019), (Astra, Raihanati, & Mujayanah 2020), (Asfar et al. 2022), (Nursa'ban, Masykuri, & Yamtinah 2019), (Setyawan & Sukestiyarno 2018), (Wahyudi, Rukmini, & Linggar Bharati 2019), (Kusuma, Zaenuri, & Wardono 2021). Improving problem-solving skills by using mathematics modules in the research of Masri et al. (2018) with a total sample of 96 students and an F-count score of 6,621 while the t-count value is 3,063. Meanwhile, at the higher education level, research on improving problem-solving skills using mathematics modules has been done by (Astalini et al. 2021), (Dewi & Mashami 2019), (Risnawati et al. 2019), (Faulkner & Cain 2013), (Moradi et al. 2018), (Khoathane 2021). Research conducted by Febriana, Yusri, and Delyana (2020) with a sample number of 25 students and a t-count value of 13.07.

In this study, using a meta-analysis method with the help of JASP (Jeffery's Amazing Statistics Program software, researchers will analyze the comparative level of student learning outcomes. The purpose of this study is to analyze the level of comparison of problem-solving results using mathematics modules, based on the level of education, namely elementary, junior high, high school, and higher education. But there has been no research that discusses more specifics the results of the comparison. The final results obtained from this study are expected to be used as reference material by subsequent researchers.

II. METHOD

This study used a Meta-analysis method. Meta-analysis is research conducted by researchers by means of collect research data, summarize, review, and analyze Research data from several previously existing research results (As'ari et al., 2022). In this study, thes data sources were collected using how to browse articles in international and national journals online through a database. As for the databases used in Table 1.

Table 1.
Research data sources

Indexer	URL
Scopus	https://www.scopus.com/
DOAJ	https://doaj.org/
WorldCat	https://worldcat.com/
Google Scholar	https://scholar.google.co.id/

The keywords used by researchers in searching for articles are (1) Free Variables: Improvement, Problem-solving ability, Mathematics Module; (2) Bound Variables: Improved Problem-Solving Ability, Mathematics Module and; (3) Additional keywords: using the search interval of 2014-2022. Furthermore, data analysis is carried out in several stages, namely: (1) labeling or numbering the selected articles; (2) writing Fisher test scores (F), students test (t), correlation test (r), and some research subjects (N); (3) convert F and t values to r values; (4) calculate the effect size (ES) and standard error (SE) values; (5) conducting analysis JASP software-assisted data; (6) interpret the results of data analysis or output from JASP software; (7) analyze the results found from the articles to which the data refer; (8) finally, draw conclusions from the results of the study (Mandailina et al. 2021).

From the data that has been collected, there are still loading F and t values which must be changed. These two values must be changed to r values using the following formula (Aldira et al., 2021).

a. Corrals the F and t values into r values with the formula:

$$F = t^2 \quad (1)$$

$$t = \sqrt{F} \quad (2)$$

$$r = \frac{t}{\sqrt{t^2+N-2}} \quad (3)$$

b. Calculating effect size (ES) and standard error (SE) values

$$z = ES = 0{,}5.\, ln\frac{1+r}{1-r} \quad (4)$$

$$SE = \sqrt{\frac{1}{N-2}} \quad (5)$$

c. Conducting simulations and data analysis using JASP software
d. Analyze the results that have been found from the articles that are referenced
e. Concluding the results of meta-analysis research

Effect size is the principle unit in a meta-analysis study that describes the strength of the effect, correlation, or association between two variables (Suparmin & Tamur 2021). The categories' Effect size (SE) and Standard Error (SE) values are in Table 2.

Table 2.
Classification of Glass's effect sizes

Effect size (ES)	Category
$0.15 < ES \leq 0.40$	SHSll effect
$0.40 < ES \leq 0.75$	Medium effect
$0.75 < ES \leq 1.10$	High effect
$1.10 < ES \leq 1.45$	Very high effect

Table 2 presents intervals that show the value categories of effect size to determine the measure of the practical significance of the research results as a measure of the magnitude of a correlation or difference between one variable and another. To find out the adequacy of data analysis, it is indicated that the publication bias If the p-value in the Rank Correlation Test is greater than 0.01, there is no indication of publication bias. That is, the data used is quite representative of the existing population.

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III. RESULT AND DISCUSSION

A. Data analysis results

Search results obtained as many as 101 publication data. The next determination stages are conducted: the value of the correlation test (r), the value of the fisher test (F), the student test (t), the number of research subjects (N), andclassical. However, the number of data that meets the criteria is only 61 data to be used as a sample to obtain effect size (ES) and standard error (SE) values, which are taken from various levels, 6 data are taken from the elementary level, 30 data from the junior high school level, 19 data from the high school level, and 6 data from the higher education level. And There is 41 data did not meet the requirements or criteria to be sampled. Meanwhile, the data about type of research and levels and fields of publication can be used in the process of discussion and further data analysis. The data of the results of the calculations correspond to Table 3.

Table 3.
Effect Size (ES) and Standard Error (SE) Calculation Result

Name	Ladder	N	ES	SE
Gunantara (2014)	ES	28	0.164	0.07
Meidawati (2014)	JHS	119	0.065	0.093
Delyana (2015)	JHS	24	1.092	0.218
Harsani (2015)	JHS	30	0.974	0.192
Kurniawan (2015)	SHS	44	1.975	0.156
Mawaddah (2015)	JHS	28	0.923	0.051
Andriana (2016)	SHS	69	0.253	0.123
Cahyaningrum (2016)	JHS	77	0.513	0.116
Masrokah (2016)	JHS	96	0.767	0.104
Nasution (2016)	SHS	32	0.906	0.052
Taneo (2016)	JHS	339	0.155	0.055
Andriani (2016)	SHS	36	0.352	0.174
Budhiharti (2017)	SHS	36	1.088	0.174
Rahman (2017)	JHS	36	0.803	0.066
Telaumbanua (2017)	SHS	33	0.95	0.038
Hamid (2017)	JHS	118	0.945	0.093
Darsono (2018)	JHS	30	1.026	0.192
Hasibuan (2018)	JHS	29	0.859	0.065
Masri (2018)	SHS	96	0.311	0.104
Mayasari (2018)	JHS	38	0.994	0.169
Thuneberg (2018)	ES	392	1.299	0.051
Yusri (2018)	JHS	439	0.114	0.048
Al-khateeb (2018)	ES	26	1.588	0.209
Anjarwati (2018)	SHS	28	1.248	0.2
Novintya (2018)	JHS	17	2.117	0.267
Moradi (2018)	COLLEGE	47	0.295	0.151
Amalia (2019)	JHS	27	0.852	0.068
Arafani (2019)	JHS	33	0.792	0.183
Djafar (2019)	JHS	29	0.936	0.046
Fitriana (2019)	JHS	20	0.536	0.243
Hamimah (2019)	JHS	39	2.953	0.167
Maesari (2019)	ES	12	0.833	0.108
Saputra (2019)	SHS	32	1.98	0.186
Sormin (2019)	SHS	24	0.8	0.082
Arafani (2019)	JHS	33	0.792	0.183
Dewi (2019)	COLLEGE	20	0.578	0.243
Nursa'ban (2019)	SHS	23	2.431	0.224
Risnawati (2019)	COLLEGE	30	2.08	0.192
Retnowati (2019)	JHS	32	3.14	0.186
Febriana (2020)	COLLEGE	25	1.728	0.213
Finariyati (2020)	SHS	24	0.85	0.073
Karenina (2020)	SHS	37	2.441	0.171
Rangkuti (2020)	JHS	27	1	0.204
Yuniarti (2020)	ES	6	0.913	0.115
Barokah (2020)	JHS	87	1.531	0.109
Ramadhani (2020)	SHS	35	0.674	0.177
Finariyati (2020)	SHS	24	0.8	0.082
La'ia (2021)	JHS	67	0.424	0.125
Palgunadi (2021)	JHS	62	0.281	0.13
Sidik (2021)	ES	11	0.85	0.108
Anggriani (2021)	SHS	35	0.118	0.054
Astalini (2021)	COLLEGE	45	0.3	0.154
Priyonggo (2021)	JHS	23	1.084	0.224
Yuniawati (2021)	SHS	27	0.837	0.204
Faulkner (2021)	COLLEGE	146	0.253	0.084
Nafisa (2021)	JHS	30	1.015	0.192
Amalia (2022)	JHS	27	0.957	0.204
Amaliyah (2022)	SHS	30	0.866	0.192
Aulia (2022)	JHS	15	0.94	0.289
Ardhana K S (2022)	JHS	40	1.274	0.164

Table 3 shows the results of the calculation of ES and SE values that have been calculated using the formula format in Microsoft Excel. The number of data obtained as many as 61 data meet the requirements and criteria, Which are taken from various levels of education, 6 data from the elementary level, 30 data from the junior high school level, 19 data from

the high school level, and 6 data from the higher education level.

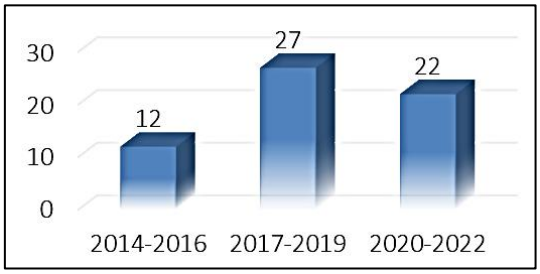

Figure 1. The amount of data

Figure 1, show that the interval of the publication year, namely in 2017-2019 with a total of 27 data, the value of 1.19% is included in the very high category. In the interval 2014-2016 with a total of 12 data and obtained a value of 67% including the sufficient category, while in 2020-2022 as many as 88% included the high category. So, the interval in 2017-2019 is significantly larger.

B. Hypothesis Testing

Next, researchers conduct hypothesis tests and bias publication tests on the data already collected. In the meta-analysis using JASP software, it can be seen in concluding, namely the z and p values in the coefficient table. The hypothesis is Hypothesis I: Improved problem-solving ability in using mathematical modules; Hypothesis II: No publication bias from the data used. In the first stage, a heterogeneity test is carried out to see the category of data whether it uses fixed or random effects as for the results in Table 4.

Table 4.
Fixed and Random Effects

	Q	df	P
Omnibus test of Model Coefficients	122.687	1	< .001
Test of Residual Heterogeneity	1420.765	60	< .001
Note. *p* -values are approximate.			

Table 4 of the JASP output obtained on improving problem-solving ability using mathematical modules has been analyzed showing that the data are heterogeneous with a magnitude of Q = 1420.765 and a p-value of <.001. Furthermore, it is seen the estimate of the improvement in problem-solving ability using mathematical modules according to Table 5.

Table 5.
Coefficients

	Estimate	Standard Error	Z	P	Lower	Upper
InterceCollege	0.977	0.088	11.076	< .001	0.804	1.149
Note. Wald test.						

In Table 5 it can be seen that the z-value is 11.076 and the p-value is 0.001, which means it is less than the significance value of 5% (0.05). This means that the hypothesis is acceCollegeed, in this case, the true effect size is not equal to 0, then, in other words, overall mathematics learning based on improving problem-solving ability using mathematics modules has a significant influence on increasing problem-solving ability by 97.7%, while that is influenced by other factors by 2.3%.

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C. Bias Publication Test

Furthermore, a publication bias test was carried out. This test is carried out to see whether the data that has been collected can be used as a representative of the population. This test, can be seen by using the values in the Rank Correlation output and the Regression test. Which is based on the results using JASP obtained the results according to Table 6 and Table 7 below.

Table 6.
Rank correlation test for Funnel plot asymmetry

Kendall's τ	p	
Rank test	0.175	0.049

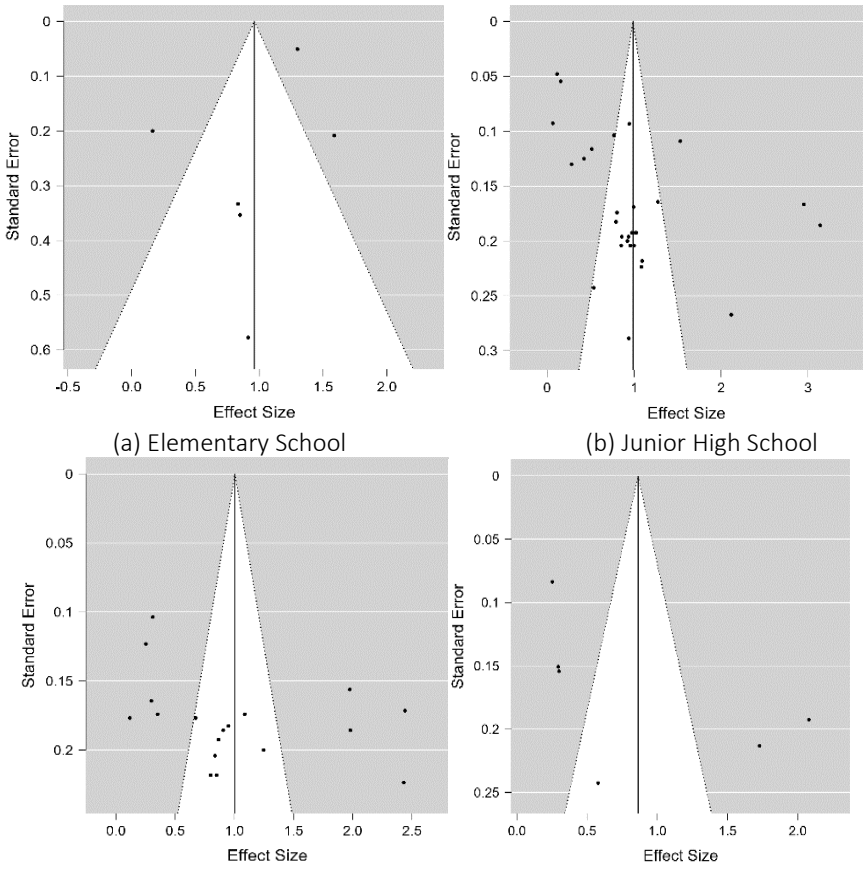
Table 7.
Regression test for Funnel plot asymmetry ("Egger's test")

	Z	P
Sei	1.638	0.101

In Table 6 related to Rank correlation and regression, Kendall's value can be seen in the ranking of problem-solving ability using a mathematical module of 0.175 which determines the magnitude of the correlation coefficient between effect size and variance. In Table 7 the z value which is the magnitude of the regression coefficient of 1.638 and the p-value of 0.101 is greater than the value of 0.05 which shows that the second hypothesis is accepted in other words not identified publication bias.

D. Plotting results based on the education level

As for the plotting results from the JASP output, the distribution of data is based on the level of education as shown in Figure 2.



(a) Elementary School (b) Junior High School

(c) Senior High School (d) College

Figure 2. Plotting results of each data

Figure 2 is the result of plotting publications from each level of education, in figure a) the distribution of data based on the elementary level shows black circles that spread and do not gather on triangles this shows that the use of mathematics modules in elementary schools is not very implemented in learning, b) At the junior high school level the distribution results obtained are the distribution of black circle data gathered very much in triangles and spread but not pursed, then the use of mathematical modules has already been implemented but still not effective, c) at the high school level, the distribution of black circle data is widely in the triangle and spread so that the use at this level has been used effectively, so this shows that the use of mathematics modules is very much carried out at the high school level, d) At the higher education level, the distribution of data obtained, namely black circles spread and does not shrink, so this states that the use of mathematics modules at the Higher Education level is not very applied.

E. Test Moderator Variables

Finally, researchers conducted a moderator variable test to see the level of influence of several other variables such as the year of publication, the number of participants, and the level of education. Then the output is obtained according to Table 8.

Table 8.
JASP output based on moderator variables

Variabel	Interval	N	Coefficient	p-rank test	RE Model	Forest Plot	Category
Level of education	ES	6	0.962	1.000	0.96	0.96 [0.51, 1.42]	High
	JHS	30	0.987	0.148	0.99	0.99 [0.74,1.24]	High
	SHS	19	1.005	0.276	1.01	1.01 [0.68,1.33]	High
	C	6	0.863	0.136	0.86	0.86 [0.21,1.51]	High
Year of publication	2014-2016	12	0.668	0.149	0.67	0.67 [0.36,0.98]	Medium
	2017-2019	27	1.194	0.722	1.19	1.19 [0.90,1.49]	Very high
	2020-2022	22	0.877	0.235	0.88	0.88 [0.64,1.11]	High
Sample	<50	48	1.107	0.350	1.11	1.11 [0.91,1.30]	Very high
	>50	13	0.532	0.359	0.53	0.53 [0.28,0.79]	Medium
	>100	6	0.472	0.469	0.47	0.47[0.05,0.89]	Medium

Table 8 shows the influence of using mathematics modules in improving problem-solving ability based on the education level with output from JASP from the elementary level with the amount of N = 6 and coefficient as much as 96% with high category, at the junior high school level with the number of N = 30 and coefficient as much as 99% with (high category), at the high school level with the amount of N = 19 and coefficient as much as 101% with (high category), while at the higher education level with the number of N = 6 and coefficient as much as 86% with a (high category). This result is also strengthened by the results of research by Sormin and Nurasahara (2019) Views based on the results of the student's mathematical problem-solving ability test in trial I, there were 18 students or 60% of the 30 students who took the test whose level of problem-solving ability was in the

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minimum category of "sufficient". While in trial II there were 24 students or 80%. So problem-based modules can improve students' mathematical problem-solving ability in solving math problems. Thus, learning mathematics through problem-based modules can improve students' mathematical problem-solving skills very widely used at the high school level. At intervals of publication years, increased problem-solving possibilities by using the mathematics module in the 2014-2016 interval obtained a score of 67% of the (Medium category), in 2017-2019 as much as 119% of the (very high category), while in 2020-2022 as much as 88% of the (high category), so that the interval in 2017-2019 was significantly larger. In the participant interval with data ≤50 the value obtained was 111% (very high category), while the ≥50 data was 53% sufficient category, and ≥100 value was 47% sufficient category. So the improvement of problem-solving capabilities using modules affects the number of participants ≤50.

IV. CONCLUSION

Based on the results of data analysis, this study using the Mathematics Module is very influential in improving problem-solving ability where the research results from data analysis obtained from JASP software show that there is a significant value influence on improving problem-solving ability in high school is more dominant than other levels such as at the elementary, junior high and tertiary levels. The dominant significant value is 101% including the high category, while from the elementary level as much as 96% of the high category, at the junior high school level as much as 99% of the high category, and at the higher education level as much as 86% of the high category so, the mathematics module is very widely used at the high school level.

Further it can be recommended as follows: (1) Teachers can use mathematics modules to improve capabilities in problem-solving skills in the learning process and arrange them systematically and as attractively as possible and also provide student and group activity sheets to make it easier for students to understand the material (2) Students can use mathematics modules in order to learn independently. (3). recommended to other researchers to readers or other researchers to be able to be able to produce more interesting learning modules and spread more widely not only in schools. The math module is really beneficial for learning, hence.

REFERENCES

Aldira, S. H., Syaharuddin, S., Sulistina, L., Rahmatin, A., & Sucipto, L. (2021). Adobe flash sebagai media pembelajaran matematika berbasis android dalam meningkatkan hasil belajar: Sebuah meta analisis. *Jurnal Pemikiran dan Penelitian Pendidikan Matematika (JP3M)*, *4*(2), 71-80.

Al-Khateeb, M. (2018). The effect of teaching mathematical problems solving through using mobile learning on the seventh grade students' ability to solve them in Jordan. *iJIM, 12*(3), 178–91. doi: https://doi.org/10.3991/ijim.v12i3.87

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Amalia, P. R., Sukestiyarno, Y. L., & Cahyono, A. N. (2021). Problem-solving skill based on learning independence through assistance in independent learning with entrepreneurial-nuanced modules. *Unnes Journal of Mathematics Education Research*, *10*(A).

Amalia, R., Tayeb, T., & Abrar, A. I. P. (2019). Pengembangan Modul Berbasis Masalah untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa Kelas VII SMP. *Al asma: Journal of Islamic Education*, *1*(2), 136-147.

Amaliyah, F., Sukestiyarno, Y. L., & Asikin, M. (2021). Mathematical Problem Solving Ability in Self-Directed Learning with Module From Studentsâ€™ Self-Regulated Learning. *Unnes Journal of Mathematics Education Research*, *10*(A), 181-188.

Andriani, L. (2016). Pengaruh Pembelajaran Matematika Menggunakan Strategi Inkuiri Terhadap Kemampuan Pemecahan Masalah Matematika. *Suska Journal of Mathematics Education*, *2*(1), 52-56.

Arafani, E. L., Herlina, E., & Zanthy, L. S. (2019). Peningkatan Kemampuan memecahkan masalah matematik siswa SMP dengan pendekatan kontekstual. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *3*(2), 323-332. doi: 10.31004/cendekia.v3i2.112

As' ari, W., Dirganti, D. D., Syaharuddin, S., Ibrahim, M., Negara, H. R. P., & Sucipto, L. (2022). Perbandingan hasil belajar berdasarkan penggunaan software Maple dan Geogebra: Sebuah meta analisis. *Justek: Jurnal Sains dan Teknologi*, *5*(1), 01-10.

Asfar, N. U., Permana, D., Fauzan, A., & Yarman, Y. (2022). Improving Students Mathematical Critical Thinking Ability With Learning Modules Using Brain-Based Learning Models. *Numerical: Jurnal Matematika dan Pendidikan Matematika*, 91-100.

Astalini, A., Darmaji, D., Kurniawan, D. A., & Wulandari, M. (2021). Male or Female, who is better? Students' Perceptions of Mathematics Physics E-Module Based on Gender. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, *3*(3), 207-224. doi: 10.23917/ijolae.v3i3.14830.

Astra, I. M., Raihanati, R., & Mujayanah, N. (2020). Development of electronic module using creative problem-solving model equipped with HOTS problems on the kinetic theory of gases material. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *6*(2), 181-194. doi: 10.21009/1.06205

Aulia, E. T., & Prahmana, R. C. I. (2022). Developing interactive e-module based on realistic mathematics education approach and mathematical literacy ability. *Jurnal Elemen*, *8*(1), 231-249. doi: 10.29408/jel.v8i1.4569.

Bernard, M. (2015). Meningkatkan kemampuan komunikasi dan penalaran serta disposisi matematik siswa SMK dengan pendekatan kontekstual melalui game adobe flash cs 4.0. *Infinity Journal*, *4*(2), 197-222. doi: 10.22460/infinity.v4i2.84.

p-ISSN: 2086-4280
e-ISSN: 2527-8827

Budhiharti, S. J., & Suyitno, H. (2017). Analisis kemampuan pemecahan masalah matematika ditinjau dari karakter kreatif dalam pembelajaran MEA berbantuan modul scientific. *Unnes Journal of Mathematics Education Research*, *6*(1), 38-47.

Chotimah, S., Bernard, M., & Wulandari, S. M. (2018). Contextual approach using VBA learning media to improve students' mathematical displacement and disposition ability. In *Journal of Physics: Conference Series* (Vol. 948, No. 1, p. 012025). IOP Publishing.

Darsono, D., Santia, I., & Jatmiko, J. (2018). Peningkatan Kemampuan Pemecahan Masalah Aljabar Siswa SMP Melalui Pembelajaran Modul Aljabar Berbasis Relational Thinking. *JIPM (Jurnal Ilmiah Pendidikan Matematika)*, *6*(2), 119-124. doi: 10.25273/jipm.v6i2.1517.

Delyana, H. (2015). Peningkatan kemampuan pemecahan masalah matematika siswa kelas VII melalui penerapan pendekatan open ended. *Lemma*, *2*(1), 144859. doi: https://doi.org/10.22202/jl.2015.v2i1.523.

Dewi, C. A., & Mashami, R. A. (2019). The effect of chemo-entrepreneurship oriented inquiry module on improving students' creative thinking ability. *Journal of Turkish science education*, *16*(2), 253-263. doi: 10.12973/tused.10279a.

Faulkner, V. N., & Cain, C. R. (2013). Improving the mathematical content knowledge of general and special educators: Evaluating a professional development module that focuses on number sense. *Teacher Education and Special Education*, *36*(2), 115-131. doi: 10.1177/0888406413479613.

Febriana, R., Yusri, R., & Delyana, H. (2020). Modul Geometri Ruang Berbasis Problem Based Learning Terhadap Kreativitas Pemecahan Masalah. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *9*(1), 93. doi: 10.24127/ajpm.v9i1.2591.

Finariyati, F., Rahman, A. A., & Amalia, Y. (2020). Pengembangan Modul Matematika Berbasis Etnomatematika Untuk Meningkatkan Kemampuan Pemecahan Masalah Siswa. *MAJU: Jurnal Ilmiah Pendidikan Matematika*, *7*(1).

Hamid, A., Aribowo, M., & Desmira, D. (2017). Development of learning modules of basic electronics-based problem solving in Vocational Secondary School. *Jurnal Pendidikan Vokasi*, *7*(2), 149-157. doi: 10.21831/jpv.v7i2.12986.

Husniah, A., & Azka, R. (2022). Modul Matematika dengan Model Pembelajaran Problem Based Learning untuk Memfasilitasi Kemampuan Penalaran Matematis Siswa. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(2), 327-338.

Jainuri, M. (2014). Kemampuan Pemecahan Masalah. *Academia Edu*.

Karenina, A., Widoretno, S., & Prayitno, B. A. (2020, April). Effectiveness of problem solving-based module to improve analytical thinking. In *Journal of Physics: Conference Series* (Vol.

1511, No. 1, p. 012093). IOP Publishing. doi: 10.1088/1742-6596/1511/1/012093.

Khoathane, M. C. (2021). Improvement of first year mathematics modules with a success rate of less than 50%.

Kiptiyah, S. M. (2016, February). Model PBL Berbasis Etnomatematika Berbantuan ICT untuk Meningkatkan Pemecahan Masalah Siswa Kelas VII Materi Bangun Datar. In *PRISMA, Prosiding Seminar Nasional Matematika* (pp. 170-176).

Kusuma, D. (2021, June). Mathematic creative thinking ability based on student metacognition in blended learning model with e-module. In *Journal of Physics: Conference Series* (Vol. 1918, No. 4, p. 042103). IOP Publishing. doi: 10.1088/1742-6596/1918/4/042103.

Maesari, C., Marta, R., & Yusnira, Y. (2020). Penerapan model pembelajaran problem solving untuk meningkatkan kemampuan pemecahan masalah matematika siswa sekolah dasar. *Jurnal Pendidikan Dan Konseling (JPDK)*, *2*(1), 12-20. doi: 10.31004/jote.v1i1.508.

Mandailina, V., Syaharuddin, S., Pramita, D., Ibrahim, I., & Haifaturrahmah, H. (2021). Pembelajaran daring dalam meningkatkan motivasi dan hasil belajar peserta didik selama pandemi COVID-19: Sebuah meta-analisis. *Indonesian Journal of Educational Science (IJES)*, *3*(2), 120-129. doi: 10.31605/ijes.v3i2.955.

Masri, M. F., Suyono, S., & Deniyanti, P. (2018). Pengaruh metode pembelajaran berbasis masalah terhadap self-efficacy dan kemampuan pemecahan masalah matematis ditinjau dari kemampuan awal matematika siswa SMA. *JPPM (Jurnal Penelitian dan Pembelajaran Matematika)*, *11*(1). doi: 10.30870/jppm.v11i1.2990.

Mayasari, B. A., Danaryanti, A., & Kamaliyah, K. (2018). Kemampuan pemecahan masalah matematis siswa melalui model pembelajaran inkuiri.

Moradi, M., Liu, L., Luchies, C., Patterson, M. M., & Darban, B. (2018). Enhancing teaching-learning effectiveness by creating online interactive instructional modules for fundamental concepts of physics and mathematics. *Education Sciences*, *8*(3), 109. doi: 10.3390/educsci8030109.

Mulyati, T. (2016). Kemampuan pemecahan masalah matematis siswa sekolah dasar. *EduHumaniora| Jurnal Pendidikan Dasar Kampus Cibiru*, *3*(2).

Nafisa, D., & Hidayah, I. (2021). Critical thinking skill seen from curiosity on independent learning assisted by module. *Unnes Journal of Mathematics Education Research*, *10*(A), 168-174.

Niat, Y., Sinaga, B., Sihombing, H., & Surya, E. (2017). Development of Mathematics Module Based on Metacognitive Strategy inImproving Students' Mathematical Problem Solving Ability at High School. *Journal of Education and Practice*, *8*(19), 73-80.

Novintya, H. T., & Suparman, S. (2018). Mathematics-Based Development Module Problem-Based Learning

p-ISSN: 2086-4280
e-ISSN: 2527-8827

Model to Improve Critical Thinking Ability. *International Summit on Science Technology and Humanity (ISETH 2018)* (Iseth):193–200.

Nurmeidina, R., Lazwardi, A., & Nugroho, A. G. (2021). Pengembangan modul trigonometri untuk mengembangkan kemampuan pemecahan masalah matematika. *Aksioma: Jurnal program studi pendidikan Matematika*, *10*(1), 15-27. doi: 10.24127/ajpm.v10i1.3375.

Nursa'ban, E., Masykuri, M., & Yamtinah, S. (2019). Improving student learning outcomes in science subjects through the implementation of PBL-based module. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *5*(2), 269-276. doi: 10.22219/jpbi.v5i2.7534.

Rahman, A. A. (2016). *Pengembangan Perangkat Pembelajaran Berbasis Pendekatan Realistik Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Dan Self-Efficacy Siswa Smpn 3 Langsa* (Doctoral dissertation, UNIMED).

Ramadhani, R., & Fitri, Y. (2020). A Project-based learning into flipped classroom for ePUB3 electronic mathematics learning module (eMLM)-based on course design and implementation. *Universal Journal of Educational Research*, *8*(7), 3119-3135. doi: 10.13189/ujer.2020.080740.

Ramadhani, R., & Fitri, Y. (2021). EPUB3 based mathematical e-modules using the sigil application as a solution in teaching and learning process through Covid-19 Pandemic. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *11*(1). doi: 10.30998/formatif.v11i1.6826.

Risnawati, R., Andrian, D., Azmi, M. P., Amir, Z., & Nurdin, E. (2019). Development of a definition maps-based plane geometry module to improve the student teachers' mathematical reasoning ability. *International Journal of Instruction*, *12*(3), 541-560. doi: 10.29333/iji.2019.12333a.

Saputra, R. A. K., Sukestiyarno, S., & Dwidayati, N. K. (2021). Self regelated through mathematics in contexts (MiC) approach based on local culture module to improve math representation. *Unnes Journal of Mathematics Education Research*, *10*(A), 55-61.

Saputra, A. E. (2019, August). Efektivitas Model Pembelajaran Jigsaw dan Think Pair Share Berbantu E-Modul Bervideo terhadap Kemampuan Pemecahan Masalah Siswa Kelas X SMK. In *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika* (Vol. 4, pp. 85-99).

Setyawan, A. B., & Sukestiyarno, S. (2018). Metacognition Development Through Stad Learning Assisted With Module by Using Diagnostic Assessment to Improve The Problem Solving Ability. *Unnes Journal of Mathematics Education Research*, *7*(1), 167-173.

Sormin, M. A., & Nurasahara, N. (2019). Pengembangan Modul Matematika Berbasis Masalah untuk Meningkatkan Kemampuan Pemecahan Masalah Matematik Siswa. *EKSAKTA: Jurnal*

Penelitian dan Pembelajaran MIPA, *4*(1), 41-48. doi: 10.31604/eksakta.v4i1.41-48.

Sumandya, I. W., Candiasa, I., Suharta, I., & Sugiarta, I. (2021). Development Of A Vocational Based Mathematics E-Module. *International Journal of Scientific & Technology Research*, *10*(6), 303-309.

Suprihatiningsih, S., & Annurwanda, P. (2019). Pengembangan Modul Matematika Berbasis Masalah Pada Materi Sistem Persamaan Linear Dua Variabel. *Jurnal Karya Pendidikan Matematika*, *6*(1), 57-63.

Supriyanti, S., Mastur, Z., & Sugiman, S. (2015). Keefektifan model pembelajaran arias berbasis etnomatematika terhadap kemampuan pemecahan masalah siswa kelas VII. *Unnes Journal of Mathematics Education*, *4*(2).

Taufiq, I., & Agustito, D. (2021). Uji Kelayakan Modul Trigonometri Berbasis Ajaran Tamansiswa. *Mosharafa: Jurnal Pendidikan Matematika*, *10*(2), 281-290.

Thuneberg, H. M., Salmi, H. S., & Bogner, F. X. (2018). How creativity, autonomy and visual reasoning contribute to cognitive learning in a STEAM hands-on inquiry-based math module. *Thinking Skills and Creativity*, *29*, 153-160. doi: 10.1016/j.tsc.2018.07.003.

Twiningsih, A., Sajidan, S., & Riyadi, R. (2019). The effectiveness of problem-based thematic learning module to improve primary school student's critical thinking skills. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *5*(1), 117-126. doi: 10.22219/jpbi.v5i1.7539.

Wahyudi, R., Rukmini, D., & Bharati, D. A. L. (2019). Developing Discovery Learning-Based Assessment Module to Stimulate Critical Thinking and Creativity of Studentsâ€™ Speaking Performance. *English Education Journal*, *9*(2), 172-180. doi: 10.15294/eej.v9i2.28992.

Yaniawati, P., Jasem, A. L., Supianti, I. I., Osman, S. Z. M., & Malik, A. S. (2021). Using of sigil software in math education: e-module development and effects on self-regulated learning skills. *Journal for the Education of Gifted Young Scientists*, *9*(3), 251-268.

Yuniarti, D., & Sukestiyarno, Y. L. (2020, February). Pembentukan Karakter Kerja Keras dan Kemampuan Pemecahan Masalah Melalui Pembelajaran Berbantuan Modul Etnomatematika dan Pendampingan dengan Teknik Scaffolding. In *PRISMA, Prosiding Seminar Nasional Matematika* (Vol. 3, pp. 279-284).

Yusri, A. Y. (2018). Pengaruh Model Pembelajaran Problem Based Learning Terhadap Kemampuan Pemecahan Masalah Matematika Siswa Kelas VII Di JHS Negeri Pangkajene. *Mosharafa: Jurnal Pendidikan Matematika, 7*(1), 51–62. doi: 10.31980/mosharafa.v7i1.341.