



## ASSOCIATION BETWEEN MOTIVATION AND PROBLEM-SOLVING ABILITY: A REVIEW OF LITERATURE AND CORRELATIONAL META-ANALYSIS

*Azizul Ghofar Candra Wicaksono<sup>1</sup>, Ismi Nurul Qomariyah<sup>2</sup>*

<sup>1</sup> Department of Biology Education, Faculty of Mathematics, Sciences, and Information Technology Education, Universitas PGRI Semarang, Indonesia

<sup>2</sup> Department of Biology Education, Faculty of Science and Sports, Universitas Insan Budi Utomo, Indonesia

### Abstract

This study was aimed at providing quantitative analysis of correlation between motivation and problem-solving ability. We conducted a systematic review from several published studies from 2000 to 2025. The studies collected in this review were selected from comprehensive search through databases including Google scholar, Science Direct, ERIC, and Research Gate. There are some inclusion criteria for literature selection including the using standardized problem-solving test and motivation questionnaire, and the availability of reported correlation coefficients. A total of 23 studies with 56 different samples were gathered in this review. The study showed that the average correlation from the studies showed low coefficient ( $r = .155$ ,  $z = .157$ ). The majority of studies used self-regulation, self-efficacy, intrinsic, and extrinsic motivation for measuring motivation level of students. Complex problem solving (CPS) was the most used test for assessing problem solving. A higher correlation between motivation and problem-solving ability was seen in the middle school level but shows similar trend over the educational level. Findings from the analysis imply that motivational factors will support problem solving in indirect ways. It gives challenge of instructional design to improve problem solving ability with integration of motivational factors.

**Keywords:** motivation, problem solving, educational level, standardized measurement

**Article History:** Received: March 15<sup>th</sup>, 2026. Revised: Juni 5<sup>th</sup>, 2026. Published: Juni 30<sup>th</sup>, 2026

© 2026 Universitas Negeri Surabaya

### <sup>1</sup>Correspondence Address:

Department of Biology Education, Universitas PGRI Semarang

E-mail: [azizul.wicaksono@upgris.ac.id](mailto:azizul.wicaksono@upgris.ac.id)

p-ISSN: 2527-7537

e-ISSN: 2549-2209

## INTRODUCTION

Studying problem-solving ability is important in this decade. Problem solving is said to be one of 21<sup>st</sup> century's skills that provide individuals to face daily life problems. Even in workplace, many employers demand workers with good problem-solving skills. The complexity of problem solving makes it uncertain and requiring support demand both in cognitive and affective factors (Csapó & Funke, 2017). In the affective domain, motivation is said to be one of the factors that positively correlate with problem solving. Motivation is described as sustained actions and goal orientation based on mental and physical activities in certain events. It is also explained as belief and expectation of individual capabilities for completing some tasks or doing activities. It will drive somebody to engage in certain events because of their belief and value the reason (You et al., 2018). Motivation can be interpreted by internal or external factors that cover several aspects such as preference, interest, and social factors. Motivation plays an important role in determining student's engagement and attainment in the science class. The students with strong motivation will be more adaptive involve actively in every learning activity. Many studies show that motivation and student engagement are central to students' science learning (Schumm & Bogner, 2016). Because problem-solving is one of the learning goals, motivation will give influence in transfers of problem-solving strategies (Bereby-Meyer & Kaplan, 2005). When students get their motivation, they engage and give better performance in problem-solving-based learning.

In favor to make a good explanation about motivation supporting problem solving performance, several meta-analysis have shown that effect sizes attributed to the mediating influence of motivation in self-efficacy on performance has ranged from 0.08 to 0.38 (Hoffman & Schraw, 2009). As assimilator with high competence and belief (intrinsic motivation), people can perform better on certain task when they are not normally do (Martinsen & Furnham, 2019). Moreover, in an educational teaching and learning process, the role of problem solving and motivation act as an equilibrium in which problem solving approach might trigger student's motivation in doing task and shows good performance in learning (Muzayyanah & Wutsqa, 2019).

The purpose of this study is, therefore, to answer the correlation between motivation and problem-solving ability by summarizing the various research papers that explain the relationship between motivation and problem solving. The study about how motivation influences problem solving is important because it gives a contribution to making strategy for

increasing performance during tasks and provides better problem-solving solutions.

Motivation can be distinguished by two main types: intrinsic and extrinsic. Intrinsic factors refer to every action in the individual that they feel interesting and enjoy, while extrinsic motivation refers to individual involvement in something because they want to achieve specific outcomes. In intrinsic motivation, social context, feeling of inner competence and autonomy has a strong effect in driving student to get motivated. For example, the students who choose to take fieldwork and master that work will be more motivated intrinsically than the students who are compelled to do the work. They will show their enthusiasm in working and more engage in every activity. It is important to remember that to make students experience intrinsic motivation they need to get engaged in the learning activity and satisfy with the process. This 'engagement' is a term that represents the action of individual motivation. Thus, Baron & Corbin (2012) define engagement as:

*“the engaged student is the student who has a positive, fulfilling and work-related state of mind that is characterized by vigor, dedication, and absorption and who views him or herself as belonging to, and an active participant in, his or her learning communities”.* (p. 763)

This motivation to engage in activities not only depends on the external reward. Sometimes people are willing to do something because they feel joy or any other feeling. In some cases, this kind of feeling will drive people to participate in work. It also gives a sense of progress when they see that the work is accomplished and gives a positive result or acquiring new knowledge, skills, or experiences. Even the intrinsic motivation is not related to reward or final result, there are some factors that may increase intrinsic motivation, and some of the factors are feeling of challenge, curiosity, control, competition, and recognition.

In addition, external motivation is related to external rewards, such as a reward or doing tasks required to get a good grade in an assignment. In contrast to intrinsic motivation, this extrinsic motivation is said as inherently non-autonomous (Abeysekera & Dawson, 2015). For example, a student tries hard to do their homework and understand their subject because they know that it will be good for their academic qualification needed for a specific job within their selected career. In contrast, another student is doing assignments and work based on the instruction from their teacher. Both behaviors show external motivation that is associated with homework rather than any challenge or enjoyment feeling. In comparison with internal motivation, external

motivation tends to be more effective in making students engage in the learning process for example. Providing interesting rewards will influence people's motivation in a fast way because they want to get the reward. However, In fact, offering excessive rewards can actually lead to a decrease in intrinsic motivation. That means the activity is only focused on getting rewards without feeling to enjoy and develop the inner feeling of doing certain work.

In the science education context, motivation is described as an internal state that arouses, directs, and sustains science-learning behavior (Glynn et al., 2011). Science motivation has a goal to make students enjoy science subjects, recognize the world through science, get more confidence by learning science and willing to study and learn more about science. **Therefore**, motivation in the science context is one of the most important goals. In a practical context, science motivation is explained in four main features (Glynn et al., 2009). Examples of these components are (1) intrinsic motivation, which involves the inherent satisfaction in learning science for its own sake, (2) self-determination, which refers to the control students believe they have over their learning of science, (3) self-efficacy, which refers to students' belief that they can achieve well in science. It also related ability to organize and execute action for desires outcomes (Hoffman & Schraw, 2009). (4) and extrinsic motivation, which involves learning science as a means to a tangible end, such as a career or a grade. Besides intrinsic and extrinsic motivation, they add self-determination and self-esteem in science motivation scope. Self-determination is defined as autonomy, the need for an individual to act and make real behavior that represents the feeling of freedom. The need for autonomy draws from the notion of locus of causality or being original about the action rather than being pulled and pushed by external forces. For example, if the students are willing to have a break but they feel forced to keep learning in the classroom and having some discussion, their autonomy will be thwarted. Then, for self-esteem, it describes as a feeling of worth that we have ourselves. It is a kind of belief about a self that a person brings with him or herself when facing the world. Self-esteem can be used to evaluate self-understanding that comprehensively exhibit self and recognize cognitive and behavioral facet of ourselves. Some research suggests that self-esteem can facilitate achievement in learning. It was said that people with high self-esteem are able to reach higher goals for themselves and more inclined to continue in dealing with mistakes and failure (Koosha et al., 2016).

Many studies prove that motivation will influence performance in doing task (Moore et al., 2014). Student's motivation can facilitate or help students during learning process in problem solving task with self-regulated way (Baars et al., 2017). The combination between motivation and cognitive or intellectual factors are good in predicting problem solving (Vollmer & Kaufmann, 1975). van Harsel et al (2019) emphasized self-efficacy aspect of motivation that students with higher self-efficacy will give benefits of engaging in the problem-solving performance. Efficacy belief is connected to involvement in the task and significantly influences academic achievement in mathematics. The level of self-efficacy somehow related to intrinsic motivation that influence student's persisting in a learning task and influence their ability and effort to develop problem solving ability (Song & Grabowski, 2006). Motivation also provokes student to engage on problem solving task with the focus on reaching the goals (Bat Or, 2014). Specifically, in self-determination theory of motivation, students use more effort when they find learning materials interesting and bring them satisfaction. For this case, they will put an interest that associated to problem solving performance and better comprehension (Baars et al., 2017). Self-determination theory divide motivation in intrinsic and extrinsic aspects with both can affects achievement and performance related to their learning goals (Cassidy & Giles, 2009). In mastery goal motivation, the students under mastery goals performed better and giving a lot of effort and strategy while solving the problems (Bereby-Meyer & Kaplan, 2005). In specific case, motivation is strongly related to the learning mathematics and categorized as key factor in progressing learning (Gasco Txabari & Villarroel Villamor, 2017). Specific topics need a lot of effort and persistence in achieving better understanding and comprehension. In this sense, motivation was claimed to be more specific in certain domain rather than to general motivation. High motivation is related to high score of mathematics achievement and negatively related to anxiety in mathematics studies. Moreover, in medical studies, motivation plays importance role in learning and academic performance (Kusurkar et al., 2013).

## **METHOD**

### **Data Source**

This review involved studies in problem solving and motivation areas. This review specifically explored the correlation between motivation and problem-solving ability in connected to educational field. The studies gathered in this review are collected from comprehensive research through databases

including Google scholar, Science Direct, ERIC, and Research Gate. All studies involved in this review are published from 2000 to 2025. They are limited for articles publication from journal or proceedings and was written in English. The searching process in databases is varied, but it includes specific keywords such as: “relationship” AND “correlation” AND “problem-solving” AND “problem-solving skills” AND “motivation” AND “education”. Systematic search was conducted with entering the combination of those keywords in the databases website. The literature selection process was shown in Figure 1.

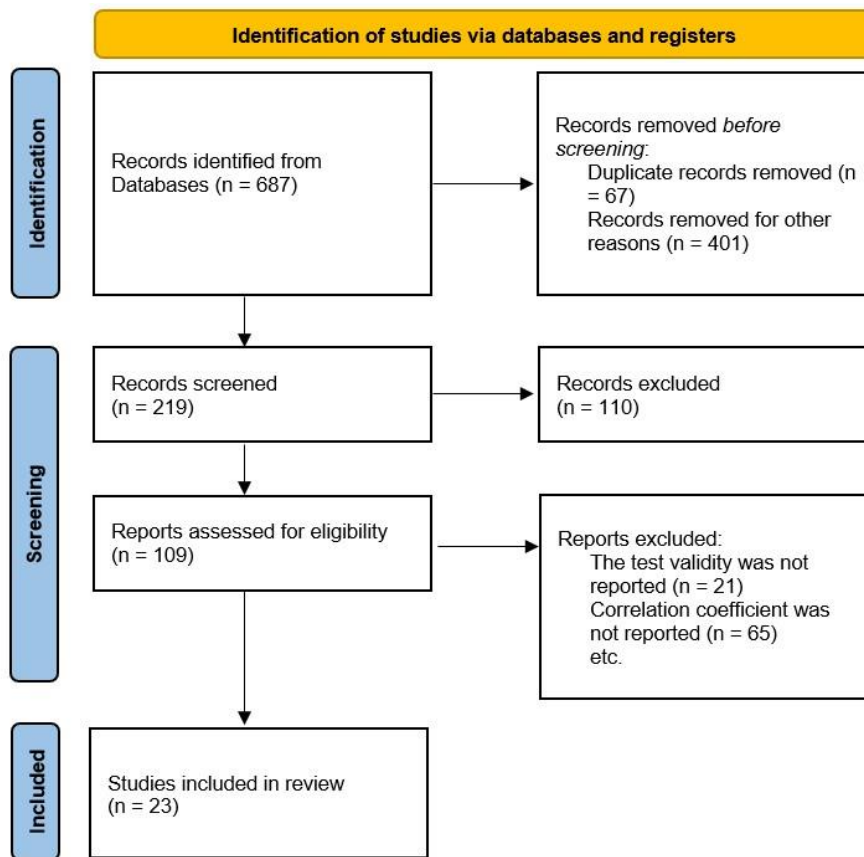
**Inclusion and exclusion criteria**

There are some criteria included in this review: (1) the studies show correlation value

between motivation and problem-solving ability (2) sample number of the study was reported (3) the motivation and problem-solving ability was measured by standardized test and (4) only research/empirical article was included. The total amount of 23 studies with 56 different samples (based on their cohort) and variables in motivation and problem solving were included in the review.

**Data coding and analysis**

The features related to the focus of the study were coded including (a) the coefficient correlation between motivation and problem-solving ability (b) the dimension of motivation and problem-solving ability (c) grade distribution and (d) sample size. Then, all collected studies were analyzed descriptively with SPSS software 25.



**Figure 1.** Literature selection process

**RESULTS AND DISCUSSIONS**

The collected studies involved in this review are given in Table 1. The studies collected varied from 2000 to 2025 for the years of published. Each

study has different types of motivation and problem-solving ability measures with sample numbers ranging from 23 to 942.

**Table 1.** Description of studies involved in the review

No	Author	Year	N	Motivation measure	Problem solving measure	r	Fisher's z
1	Baars et al.	2017	136	self-regulation	problem solving performance	0.04	0.04

No	Author	Year	N	Motivation measure	Problem solving measure	r	Fisher's z
2	Bjørnebekk et al.	2011	314	motives to achieve success	problem solving performance	0.33	0.34
3	Bjørnebekk et al.	2011	314	motives to avoid failure	problem solving performance	-0.26	-0.27
4	Bat Or	2014	126	children motivation	FEATS problem solving scale	0.23	0.23
5	Camacho-Morles et al.	2019	200	enjoyment	CPS	0.34	0.35
6	Camacho-Morles et al.	2019	200	boredom	CPS	-0.34	-0.35
7	Camacho-Morles et al.	2019	200	anger	CPS	-0.32	-0.33
8	Camacho-Morles et al.	2019	200	effort regulation	CPS	0.41	0.44
9	Cho & Lin sample 1	2010	236	intrinsic motivation	CPS	0.39	0.41
10	Cho & Lin sample 1	2010	236	extrinsic motivation	CPS	0.28	0.29
11	Cho & Lin sample 2	2010	328	intrinsic motivation	CPS	0.30	0.31
12	Cho & Lin sample 2	2010	328	extrinsic motivation	CPS	0.08	0.08
13	Cho & Lin sample 3	2010	169	intrinsic motivation	CPS	0.13	0.13
14	Cho & Lin sample 3	2010	169	extrinsic motivation	CPS	0.08	0.08
15	Dermitzaki et al.	2009	168	persisting	problem solving performance	0.16	0.16
16	Dermitzaki et al.	2009	168	working autonomy	problem solving performance	0.06	0.06
17	Dermitzaki et al.	2009	168	maintaining motivation	problem solving performance	0.16	0.16
18	Dermitzaki et al.	2009	168	initiative-activation	problem solving performance	0.18	0.18
19	Dermitzaki et al.	2009	168	concentration	problem solving performance	0.13	0.13
20	Fung et al.	2014	264	attitude belief	fluid intelligence	0.60	0.69
21	Fung et al.	2014	264	effort	fluid intelligence	-0.09	-0.09
22	Fung et al.	2014	264	attitude belief	word problem solving accuracy	0.21	0.21
23	Fung et al.	2014	264	effort	word problem solving accuracy	-0.10	-0.10
24	Hoffman & Schraw	2009	58	Self-efficacy	problem solving performance a	0.08	0.08
25	Hoffman & Schraw	2009	58	Self-efficacy	problem solving performance b	0.29	0.30
26	Hoffman & Schraw	2009	58	Self-efficacy	problem solving performance c	0.41	0.44
27	Hoffman & Schraw	2009	58	Self-efficacy	problem solving performance d	0.40	0.42
28	Kirby & Searle	2015	53	intrinsic motivation	problem solving performance	0.31	0.32
29	Kirby & Searle	2015	53	integrated regulation	problem solving performance	0.15	0.15
30	Kirby & Searle	2015	53	identified regulation	problem solving performance	0.11	0.11
31	Kirby & Searle	2015	53	introjected regulation	problem solving performance	-0.29	-0.30
32	Kirby & Searle	2015	53	external regulation	problem solving performance	-0.05	-0.05
33	Lau et al.	2019	942	volunteer motivation	rational problem solving	0.08	0.08
34	Lau et al.	2019	942	volunteer motivation	positive problem orientation	0.13	0.13
35	Lau et al.	2019	942	volunteer motivation	negative problem orientation	-0.11	-0.11
36	Marcou & Philippou	2005	219	self-efficacy	MPS	0.32	0.33
37	Marcou & Philippou	2005	219	task value belief	MPS	0.13	0.13
38	Marcou & Philippou	2005	219	intrinsic goal orientation	MPS	0.18	0.18
39	Marcou & Philippou	2005	219	extrinsic goal orientation	MPS	-0.02	-0.02
40	Martinsen & Furnham	2019	264	perceived competence	CPS	0.01	0.01
41	Martinsen & Furnham	2019	264	interest	CPS	0.06	0.06
42	Nair & Alkiyumi	2011	360	intrinsic motivation	problem solving ability	0.36	0.38
43	Özcan	2016	232	internal and external motivation	MPS	0.36	0.38
44	Sinnott et al.	2016	41	motivation acquisition	post-formal problem solving	0.40	0.42
45	Song & Grabowski	2006	23	goal orientation	problem representation (performance oriented)	0.39	0.41

No	Author	Year	N	Motivation measure	Problem solving measure	r	Fisher's z
46	Song & Grabowski	2006	23	intrinsic motivation	problem representation (performance oriented)	-0.06	-0.06
47	Stanly	2014	300	general motivation	problem solving ability	0.72	0.91
48	Wieth & Burns	2000	292	Interest	incremental problem	0.26	0.27
49	Wieth & Burns	2000	292	challenge	incremental problem	0.14	0.14
50	Wieth & Burns	2000	292	fear of failure	incremental problem	0.06	0.06
51	Wieth & Burns	2000	292	success	incremental problem	0.10	0.10
52	Rausch et al.	2019	77	interest	domain-specific problem solving	0.38	0.40
53	Chen et al.	2020	31	learning motivation	CPS	0.09	0.09
54	Spoon et al.	2021	102	self-efficacy	CPS	0.02	0.02
55	Sun et al.	2022	267	motivation acquisition	creative problem solving	-0.12	-0.12
56	Tsai et al.	2023	632	self-efficacy	Problem solving ability	0.45	0.49

Note: CPS: complex problem solving, MPS: mathematics problem solving

The measuring scale for determining motivation and problem-solving ability are varied among the studies (Table 2). In motivational studies, there are many differences in their theory and construct. It showed more than 15 different constructs or variables are used for defining motivation. Among those variables, self-efficacy, self-regulation, goal orientation, intrinsic motivation, and extrinsic motivation are mostly used in measuring motivation. Moreover, some theory also involved more psychological variable like emotion, attitude, and belief in studying motivation (Camacho-Morles et al., 2019; Dermitzaki et al., 2009; Fung et al., 2014).

In the problem-solving studies, the assessment tools can be distinguished based on their domain either in general or specific. Both domains have many types and interpretation of measurements based on specific frameworks. The majority of the recent studies in this review used complex problem solving (CPS) tests to measure problem-solving ability. CPS is well-known domain general problem solving that characterized by complex problem situation when the test takers need to make an interconnection between variables (Greiff, 2012). For specific domain problem solving, there are mathematics problem solving (MPS) that emphasizes in making solution based

on mathematics standpoints. An additional problem-solving framework founded in this review includes social problem solving, postformal problem solving and incremental problem ability. Social problem solving is defined as behavioral process for individuals to respond to the problematic situation encountered every day. Social problem solving involves some components and some of them are rational problem solving, positive problem orientation, and negative problem orientation. The other term of problem solving is explained by Sinnott et al. (2016) with postformal problem solving in which it focused on more complex logic that goes beyond formal operational (or scientific) problems. It works based on the deciding process or choosing the “truth” of several applicable formal logical reasoning that has possibility to be used for the problems. Thus, this postformal thought in problem solving has some limitations that is commonly found in adults. Moreover, for incremental problem solving, this type of problem solving is referred to analytic process and grind for the solution because people put deep analysis and keep persisting in solving the task (Wieth & Burns, 2000). That makes the problem solver need to take a number of incremental steps to find the solution.

**Table 2.** Coding measures for motivation scale and problem solving

Motivation	Problem solving measurements
Self-regulation	Complex problem solving (MicroDYN)
Self-efficacy	Problem solving performance
Intrinsic motivation	FEATS problem solving
Extrinsic motivation	Mathematics problem solving (domain-specific)
Motives (to achieve success and avoid failure)	Social problem solving
Emotions (anger, enjoyment, boredom)	- Rational problem solving
Effort regulation	- Positive problem orientation
Attitude belief	

Motivation	Problem solving measurements
Task value belief	- Negative problem orientation
Situational motivation	
- Intrinsic regulation	Postformal problem solving
- Integrated regulation	Incremental problem ability
- Identified regulation	Domain-specific problem solving
- Introjected regulation	Creative problem solving
- External regulation	
Volunteer motivation	
Goal orientation (intrinsic and extrinsic)	
Perceived competence	
Interest	
Challenge	
Success	
Learning motivation	

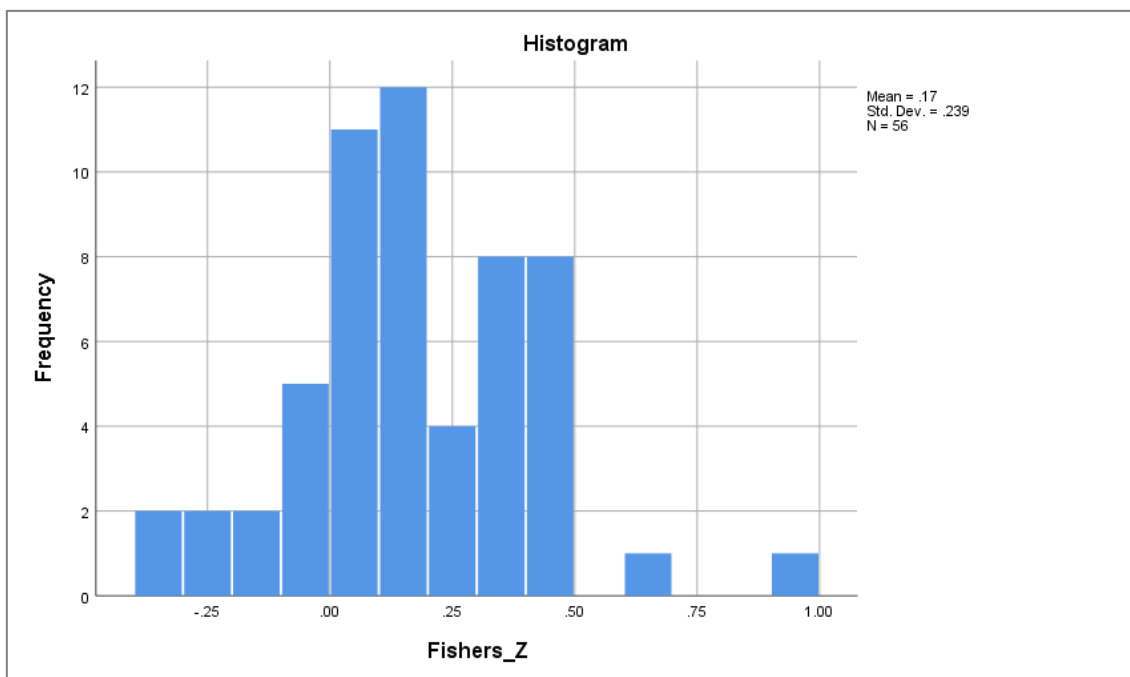
Regarding the identification of effect size, an additional analysis is shown in this review. The identification of effect size is done in using Fisher's  $z$  value correlation between two variables presented in each study. Based on the stem and leaf display, the distribution of the  $z$  value is normal (sig. value 0.205, greater than 0.05 on Shapiro-Wilk) and have a wide coefficient from -.35 to .91. Additional stem-and-leaf plot of effect size is given in table 3 with the distribution of coefficient correlation is given in Figure 2 below. Furthermore, heterogeneity analysis indicated substantial variability among studies,  $Q(55) = 751.64, p <$

.001,  $I^2 = 92.68\%, \tau^2 = 0.056$ . Because heterogeneity exceeded the commonly accepted threshold of 75%, a random-effects model was considered appropriate. The overall weighted effect size under the fixed-effect model was  $r = .155 (z = .157)$ , indicating a small positive association between motivation and problem-solving performance. The additional features also added in this review with the distribution of coefficient correlation between motivation and problem-solving ability in different grades (elementary school, middle school, high school, and university level).

**Table 3.** Stem and leaf display of Fisher's  $z$  value from the sample

Frequency	Stem	Leaf
4.00	-0.	2333
7.00	-0.	0000111
23.00	0.	0000000000111111111111
12.00	0.	222233333333
8.00	0.	44444444
1.00	0.	6
1.00	Extremes	( $\leq .9$ )

Note: stem width = 1.00, each leaf = 1 case

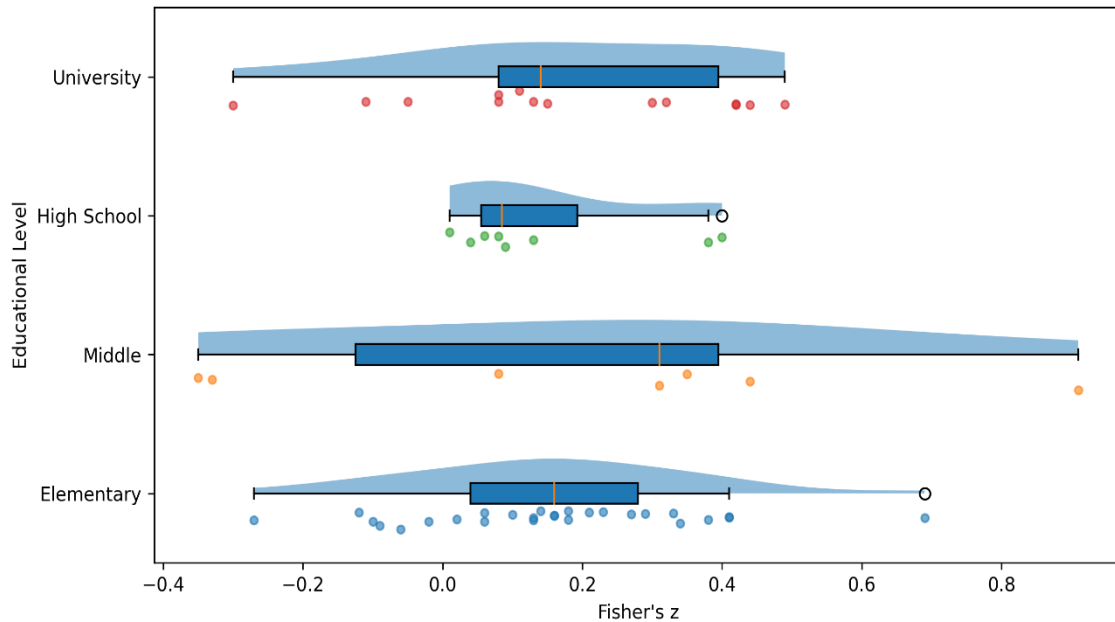


**Figure 2.** The distribution of Fisher's  $z$  value from literature

The explanation about the correlation between motivation and problem-solving ability appears to be demanding in the context of the study. In overall result, motivation has been proven to be connected to problem solving even if the correlation is not strong. We can assume there are some factors that also contribute in building people's problem solving ability in addition of motivation. Hesse et al. (2015) mentioned that some factors are essential to CPS, including social skills, participation, and their perspective in talking. Moreover, Stadler et al. (2015) also conducted meta-analysis proving inductive reasoning also have connection in problem solving acquisition. However the connection between motivation and problem solving is still needed to be emphasized as Wieth & Burns, (2000) suggested that motivation will keep people to persist with good strategy to solve the problem and doing task instead of trying to find a shortcut. Motivation helps individuals persist when doing activities, engaging in learning activities, and helps to reach goals (Bodin, 2012). In facing a problematic situation, motivation will reinforce and push an individual to keep looking for a solution.

The pattern of relationship distribution between motivation and problem solving is

different among educational levels (Figure 3). In elementary school studies, the Fisher's  $z$  value range is about -0.27 to 0.69, with a high frequency around 0.18 (low), which means that in the early stage of learning in school, motivation has a weak correlation on students' performance in problem solving. In the middle school level, the Fisher's  $z$  value range is about -0.35 to 0.91. This range is wider than that in elementary school, and the high frequency is around 0.31, meaning that the relationship between motivation and problem solving is increasing from elementary to middle school. In high school, the Fisher's  $z$  value ranges from 0.01 to 0.40. The maximum score is lower than those scores in elementary and middle school. The highest frequency is also seen in the score range below 0.08. Furthermore, for the university level, the trend is changing when the range of Fisher's  $z$  value is about -0.30 to 0.49, with the highest frequency at 0.13, showing a slight increase. This relationship distribution between motivation and problem solving shows dynamic results, in which the effect of motivation on problem solving is changing from elementary school to university level.

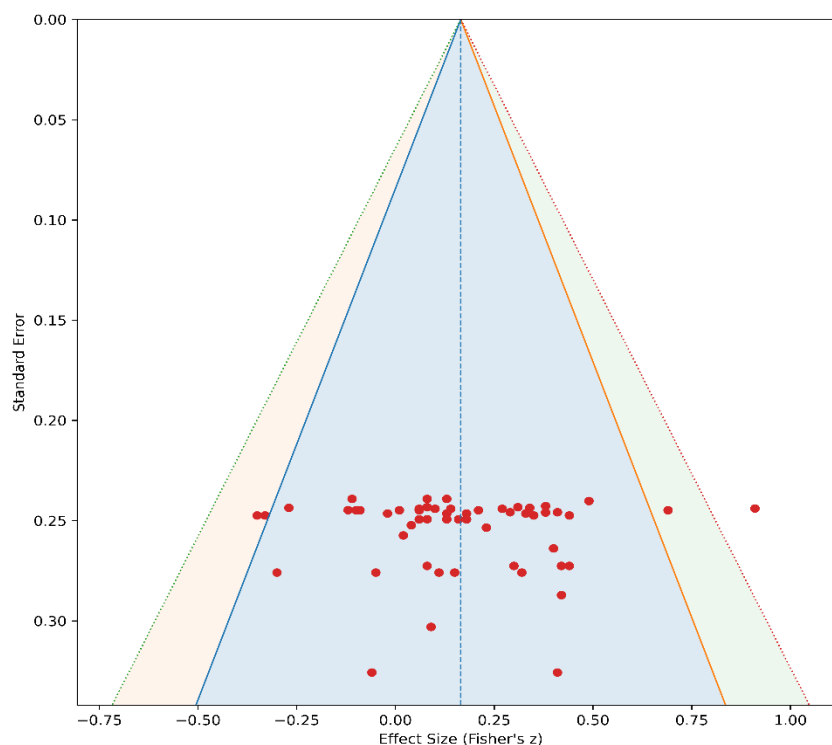


**Figure 3.** Distribution of Fisher's z effect sizes for the motivation–problem solving relationship across educational levels

This result is supported by Martin (2009) finding that the younger students entered the school, the higher level of motivation, performance, and engagement compared to late students. MacIntyre et al (2002) found that the students showed different mean motivation in different grades with the highest mean score in lower grades. Other study also revealed that the intrinsic and extrinsic motivation tends to decrease along the grade (Lepper et al., 2005). Students' motivation is likely to drop during their time spent learning in the school. In contrast with motivation, problem solving ability tends to increase over the grade. The ability to make solution from a problem is significantly different between younger and older students which older students got higher result in problem solving (Swanson, 2004). As example in the grade 2 to 4, the students problem solving accuracy is increasing simultaneously (Zheng et al., 2011). The contrast development of motivation and problem-solving ability across the grade will make the correlation of both variables become weaker because the increasing value of one is not administered by the others. However, at the university level, the correlation between motivation and problem solving is getting higher. Thus, it assumed that the conditions at each school level have a role in affecting the relationship between motivation and problem-solving ability.

In addition, publication bias was assessed using a funnel plot and Egger's regression test under a random-effects model. Visual inspection of the funnel plot revealed a relatively symmetrical distribution of effect sizes around the pooled estimate (Figure 4). Egger's regression test did not indicate statistically significant funnel plot asymmetry (intercept = 1.164,  $p = .059$ ). Therefore, there was no strong evidence of publication bias.

The results of this study should be interpreted in light of several limitations regarding generalizability. Substantial heterogeneity was observed among the included studies, indicating variability in the participants, measurement instruments, and study contexts. Secondly, potential publication bias may have influenced the pooled effect size because studies with significant findings are more likely to be published. Thus, future research could include more diverse studies with detailed distinctions in the measurement of motivation and problem-solving ability, using standardized and well-validated instruments to improve comparability across studies. Further investigations should also examine potential moderator and mediator variables that may influence the relationship between motivation and problem-solving ability.



**Figure 4.** Funnel plot of the relationship between motivation and problem solving

## CONCLUSION

In summary, the result of this review shows the correlation between motivation and problem-solving ability. The substantial coefficient correlation is in a low level in the different level of study, the correlation trend is decreasing from elementary to high school student, but it increased moderately during university study. There are several aspects of motivation and problem-solving measurement in this study with all of them gathered and showing the normal distribution. Furthermore, the analysis of moderator variable is needed to explore comprehensive relationship between motivation and problem-solving ability. It is also important to involve more motivation and problem-solving measurement to get complex understanding. Hence, motivational studies are important to improve problem solving ability and performance for educational purposes and general daily activities.

## REFERENCES

- Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research. *Higher Education Research & Development*, 34(1), 1–14. <https://doi.org/10.1080/07294360.2014.934336>
- Baars, M., Wijnia, L., & Paas, F. (2017). The Association between Motivation, Affect, and Self-regulated Learning When Solving Problems. *Frontiers in Psychology*, 8. <https://doi.org/10.3389/fpsyg.2017.01346>
- Baron, P., & Corbin, L. (2012). Student engagement: rhetoric and reality. *Higher Education Research & Development*, 31(6), 759–772. <https://doi.org/10.1080/07294360.2012.655711>
- Bat Or, M. (2014). FEATS Problem-Solving Scale in PPAT of children aged 5–6.5 as related to their executive functions and motivation. *The Arts in Psychotherapy*, 41(1), 27–35. <https://doi.org/10.1016/j.aip.2013.11.008>
- Bereby-Meyer, Y., & Kaplan, A. (2005). Motivational influences on transfer of problem-solving strategies. *Contemporary Educational Psychology*, 30(1), 1–22. <https://doi.org/10.1016/j.cedpsych.2004.06.003>
- Bjørnebekk, G., Gjesme, T., & Ulriksen, R. (2011). Achievement motives and emotional processes in children during problem-solving: Two experimental studies of their relation to performance in different achievement goal conditions. *Motivation and Emotion*, 35(4), 351–367. <https://doi.org/10.1007/s11031-011-9224-y>
- Bodin, M. (2012). *Computational problem solving in university physics education: Students' beliefs, knowledge, and motivation* [Umeå universitet]. <https://www.diva-portal.org/smash/record.jsf?dswid=->

- 2979&pid=diva2%3A511248
- Camacho-Morles, J., Slemp, G. R., Oades, L. G., Morrish, L., & Scoular, C. (2019). The role of achievement emotions in the collaborative problem-solving performance of adolescents. *Learning and Individual Differences*, *70*, 169–181. <https://doi.org/10.1016/j.lindif.2019.02.005>
- Cassidy, T., & Giles, M. (2009). Achievement Motivation, Problem-solving style, and Performance in Higher Education. *The Irish Journal of Psychology*, *30*(3–4), 211–222. <https://doi.org/10.1080/03033910.2009.10446311>
- Chen, L., Inoue, K., Goda, Y., Okubo, F., Taniguchi, Y., Oi, M., Konomi, S., Ogata, H., & Yamada, M. (2020). Exploring Factors that Influence Collaborative Problem Solving Awareness in Science Education. *Technlogy, Knowledge and Learning*, *25*(2), 337–366. <https://doi.org/10.1007/s10758-020-09436-8>
- Cho, S., & Lin, C.-Y. (2010). Influence of Family Processes, Motivation, and Beliefs About Intelligence on Creative Problem Solving of Scientifically Talented Individuals. *Roeper Review*, *33*(1), 46–58. <https://doi.org/10.1080/02783193.2011.530206>
- Csapó, B., & Funke, J. (2017). *The Nature of Problem Solving* (B. Csapó & J. Funke (eds.)). OECD. <https://doi.org/10.1787/9789264273955-en>
- Dermitzaki, I., Leondari, A., & Goudas, M. (2009). Relations between young students' strategic behaviours, domain-specific self-concept, and performance in a problem-solving situation. *Learning and Instruction*, *19*(2), 144–157. <https://doi.org/10.1016/j.learninstruc.2008.03.002>
- Fung, W. W., Swanson, H. L., & Orosco, M. J. (2014). Influence of reading and calculation on children at risk and not at risk for word problem solving: Is math motivation a mediator? *Learning and Individual Differences*, *36*, 84–91. <https://doi.org/10.1016/j.lindif.2014.10.011>
- Gasco Txabbarri, J., & Villarroel Villamor, J. D. (2017). La Motivación en la Resolución de Problemas Aritmético-algebraicos. Un Estudio con Alumnado de Educación Secundaria. *Electronic Journal of Research in Education Psychology*, *12*(32), 83–106. <https://doi.org/10.14204/ejrep.32.13076>
- Glynn, S. M., Brickman, P., Armstrong, N., & Taasobshirazi, G. (2011). Science motivation questionnaire II: Validation with science majors and nonscience majors. *Journal of Research in Science Teaching*, *48*(10), 1159–1176. <https://doi.org/10.1002/tea.20442>
- Glynn, S. M., Taasobshirazi, G., & Brickman, P. (2009). Science Motivation Questionnaire: Construct validation with nonscience majors. *Journal of Research in Science Teaching*, *46*(2), 127–146. <https://doi.org/10.1002/tea.20267>
- Greiff, S. (2012). Assessment and Theory in Complex Problem Solving - A Continuing Contradiction? *Journal of Educational and Developmental Psychology*, *2*(1). <https://doi.org/10.5539/jedp.v2n1p49>
- Hesse, F., Care, E., Buder, J., Sassenberg, K., & Griffin, P. (2015). A framework for teachable collaborative problem solving skills. In *Assessment and teaching of 21st century skills* (pp. 37–56). Springer.
- Hoffman, B., & Schraw, G. (2009). The influence of self-efficacy and working memory capacity on problem-solving efficiency. *Learning and Individual Differences*, *19*(1), 91–100. <https://doi.org/10.1016/j.lindif.2008.08.001>
- Kirby, L., & Searle, B. (2015). Proactivity and Motivation in Solving Work Problems: A Test of Methodology. *Business Creativity and the Creative Economy*, *1*(1), 41–51. <https://doi.org/10.18536/bcce.2015.07.1.1.06>
- Koosha, M., Abdollahi, A., & Karimi, F. (2016). The Relationship among EFL Learners' Self-esteem, Autonomy, and Reading Comprehension. *Theory and Practice in Language Studies*, *6*(1), 68. <https://doi.org/10.17507/tpls.060109>
- Kusurkar, R. A., Ten Cate, T. J., Vos, C. M. P., Westers, P., & Croiset, G. (2013). How motivation affects academic performance: a structural equation modelling analysis. *Advances in Health Sciences Education*, *18*(1), 57–69. <https://doi.org/10.1007/s10459-012-9354-3>
- Lau, Y., Fang, L., Cheng, L. J., & Kwong, H. K. D. (2019). Volunteer motivation, social problem solving, self-efficacy, and mental health: a structural equation model approach. *Educational Psychology*, *39*(1), 112–132. <https://doi.org/10.1080/01443410.2018.1514102>
- Lepper, M. R., Corpus, J. H., & Iyengar, S. S. (2005). Intrinsic and Extrinsic Motivational Orientations in the Classroom: Age Differences and Academic Correlates.

- Journal of Educational Psychology*, 97(2), 184–196. <https://doi.org/10.1037/0022-0663.97.2.184>
- MacIntyre, P. D., Baker, S. C., Clément, R., & Donovan, L. A. (2002). Sex and Age Effects on Willingness to Communicate, Anxiety, Perceived Competence, and L2 Motivation Among Junior High School French Immersion Students. *Language Learning*, 52(3), 537–564. <https://doi.org/10.1111/1467-9922.00194>
- Marcou, A., & Philippou, G. (2005). Motivational beliefs, self-regulated learning and mathematical problem solving. *Proceedings of the 29th Conference of the International Group for the Psychology of Mathematics Education*, 297–304.
- Martin, A. J. (2009). Age appropriateness and motivation, engagement, and performance in high school: Effects of age within cohort, grade retention, and delayed school entry. *Journal of Educational Psychology*, 101(1), 101–114. <https://doi.org/10.1037/a0013100>
- Martinsen, Ø. L., & Furnham, A. (2019). Cognitive style and competence motivation in creative problem solving. *Personality and Individual Differences*, 139, 241–246. <https://doi.org/10.1016/j.paid.2018.11.023>
- Moore, A. M., Rudig, N. O., & Ashcraft, M. H. (2014). *Affect, Motivation, Working Memory, and Mathematics* (R. Cohen Kadosh & A. Dowker (eds.); Vol. 1). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199642342.013.004>
- Muzayyanah, A., & Wutsqa, D. U. (2019). Effectiveness of problem posing and investigation in terms of problem solving abilities, motivation and achievement in mathematics. *Annals of Mathematical Modelling*, 1(2), 47–63. <https://doi.org/http://dx.doi.org/10.33292/ammm.v1i2.27>
- Nair, S., & Alkiyumi, M. T. (2011). Investigation the relationship between intrinsic motivation and creative production on solving real problems. *Sosiohumanika*, 4(2), 185–196. <https://doi.org/https://doi.org/10.2121/sosiohumanika.v4i2.446>
- Özcan, Z. Ç. (2016). The relationship between mathematical problem-solving skills and self-regulated learning through homework behaviours, motivation, and metacognition. *International Journal of Mathematical Education in Science and Technology*, 47(3), 408–420. <https://doi.org/10.1080/0020739X.2015.1080313>
- Rausch, A., Kögler, K., & Seifried, J. (2019). Validation of Embedded Experience Sampling (EES) for Measuring Non-cognitive Facets of Problem-Solving Competence in Scenario-Based Assessments. *Frontiers in Psychology*, 10. <https://doi.org/10.3389/fpsyg.2019.01200>
- Schumm, M. F., & Bogner, F. X. (2016). Measuring adolescent science motivation. *International Journal of Science Education*, 38(3), 434–449. <https://doi.org/10.1080/09500693.2016.1147659>
- Sigus, H., & Mädamürk, K. (2025). Students' motivation as a mediator between extra-mathematical knowledge and word problem-solving. *Discover Education*, 4(147), 1–14. <https://doi.org/https://doi.org/10.1007/s44217-025-00595-3>
- Sinnott, J., Hilton, S., Wood, M., Spanos, E., & Topel, R. (2016). Does Motivation Affect Emerging Adults' Intelligence and Complex Postformal Problem Solving? *Journal of Adult Development*, 23(2), 69–78. <https://doi.org/10.1007/s10804-015-9222-5>
- Song, H.-D., & Grabowski, B. L. (2006). Stimulating Intrinsic Motivation for Problem Solving Using Goal-Oriented Contexts and Peer Group Composition. *Educational Technology Research and Development*, 54(5), 445–466. <https://doi.org/10.1007/s11423-006-0128-6>
- Spoon, R., Rubenstein, L. D., & Terwilligar, S. R. (2021). Team effectiveness in creative problem solving: Examining the role of students' motivational beliefs and task analyses in team performance. *Thinking Skills and Creativity*, 40, 100792. <https://doi.org/10.1016/j.tsc.2021.100792>
- Stadler, M., Becker, N., Gödker, M., Leutner, D., & Greiff, S. (2015). Complex problem solving and intelligence: A meta-analysis. *Intelligence*, 53, 92–101. <https://doi.org/10.1016/j.intell.2015.09.005>
- Stanly, S. L. (2014). A Study on Achievement Motivation and Problem Solving Ability In Mathematics of Ix Standard Students in Relation to Their Sex and Type of School. *Indian Journal of Applied Research*, 4(12), 186–188.
- Sun, C.-T., Chou, K.-T., & Yu, H. C. (2022). Relationship between digital game experience and problem-solving performance according to a PISA framework. *Computers & Education*, 186, 104534.

- <https://doi.org/10.1016/j.compedu.2022.104534>
- Swanson, H. L. (2004). Working memory and phonological processing as predictors of children's mathematical problem solving at different ages. *Memory & Cognition*, 32(4), 648–661.  
<https://doi.org/10.3758/BF03195856>
- Tsai, C.-A., Song, M.-Y. W., Lo, Y.-F., & Lo, C.-C. (2023). Design thinking with constructivist learning increases the learning motivation and wicked problem-solving capability—An empirical research in Taiwan. *Thinking Skills and Creativity*, 50, 101385.  
<https://doi.org/10.1016/j.tsc.2023.101385>
- van Harsel, M., Hoogerheide, V., Verkoeijen, P., & van Gog, T. (2019). Effects of different sequences of examples and problems on motivation and learning. *Contemporary Educational Psychology*, 58, 260–275.  
<https://doi.org/10.1016/j.cedpsych.2019.03.005>
- Vollmer, F., & Kaufmann, G. (1975). Achievement motivation and problem solving. *Scandinavian Journal of Psychology*, 16(1), 323–326. <https://doi.org/10.1111/j.1467-9450.1975.tb00200.x>
- Wieth, M., & Burns, B. D. (2000). Motivation in insight versus incremental problem solving. *Proceedings of the Annual Meeting of the Cognitive Science Society*. <https://escholarship.org/content/qt581019r0/qt581019r0.pdf>
- You, H. S., Kim, K., Black, K., & Min, K. W. (2018). Assessing Science Motivation for College Students: Validation of the Science Motivation Questionnaire II using the Rasch-Andrich Rating Scale Model. *EURASIA Journal of Mathematics, Science and Technology Education*, 14(4). <https://doi.org/10.29333/ejmste/81821>
- Zheng, X., Swanson, H. L., & Marcoulides, G. A. (2011). Working memory components as predictors of children's mathematical word problem solving. *Journal of Experimental Child Psychology*, 110(4), 481–498. <https://doi.org/10.1016/j.jecp.2011.06.001>