FWU Journal of Social Sciences, Summer 2023, Vol. 17, No.2, 120-133
DOI: *http://doi.org/10.51709/19951272/Summer2023/9*

The Perceptions of Elementary School Children toward Problem-Solving Abilities

Giang Thi Chau Nguyen, Dao Thi Thai, Tuan Anh Phan and Huong Thi Nguyen
College of Education, Vinh University, Nghe An Province, Vietnam

The objective of this study is to assess the correlation between various factors influencing the problem-solving skills of elementary school students. To achieve this, eight hypotheses were formulated and examined using the General Structural Component Analysis (GSCA) technique. We collected questionnaire responses from 240 elementary school students from diverse locations. Google Forms is used for question creation and administration. The experimental findings validated seven assumptions among the eight anticipated correlations between factors. That is, the teacher's actions affect the learning environment; teachers' actions affect learning motivation; learning motivation affects both learning attitudes and metacognition; learning attitude, metacognition and learning environment all directly affect problem solving abilities. The remaining hypothesis was rejected; metacognition had no effect on problem-solving abilities. Overall, the model explains 59.6% of the variance in the data. The impact of this study has been demonstrated through theoretical and practical implications .

***Keywords*:** problem solving abilities; primary school student; metacognition; learning attitude; learning motivation; study environment

Problem-solving proficiency is regarded as a crucial aptitude in contemporary society. As per a World Economic Forum report, around forty percent of workers are projected to undergo retraining programs lasting less than six months, while an overwhelming ninety-four percent of corporate executives express their desire for employees to acquire new skills while on the job, with emphasis placed on critical thinking, analysis, and problem-solving as the most sought-after abilities (World Economic Forum, 2020). Therefore, it is imperative for the next generation of students to possess problem-solving abilities, ensuring their readiness to enter and thrive in the globally competitive landscape. The notion of a problem is derived from a theoretical or practical challenge or impediment that demands an individual's own efforts to overcome. It is typical for individuals to experience obstacles in life as well as in the classroom. Thus, to enhance their future quality of life, it is crucial that children learn to confront them (Celebi, 2021). There are several approaches to deal with problems, such as providing oneself with conflict resolution skills, communication skills, and physical development (Celebi, 2021). One of the approaches that is emphasized recently is the ability to think critically, be creative, and always find effective answers to life's difficulties. This necessitates the early development of children's skills, particularly problem-solving capabilities (Sungur & Bal, 2016). The significance of fostering problem-solving skills is increasingly emphasized in educational programs worldwide, prompting extensive research on various aspects and concerns related to this competence, including creative problem solving (van Hooijdonk et al., 2020), developing problem-solving skills via courses (Nguyen et al., 2022; Pimta et al., 2009; Rodkroh et al., 2019; Rodríguez-Hernández et al., 2021). Teaching approaches for problem-solving skills were also investigated through a variety of methods such as experiential learning (Hulaikah et al., 2020), exploratory learning (Lubis et al., 2019; Marwazi et

Correspondence concerning this article should be addressed to Giang Thi Chau Nguyen, College of Education, Vinh University, Nghe An province, Vietnam, Email: chaugiang76dhv@gmail.com

al., 2019), question-based learning (Divrik et al., 2020), and online collaborative project teaching (Yunus, Setyosari, Utaya, & Kuswandi, 2021).

In this research, the researchers have provided a wide range of perspectives on successful teaching strategies for fostering problem-solving skills in children. Nonetheless, the viewpoint of affecting factors has not been extensively investigated. There are only a few studies that mention and deeply analyze the impact of each type of factor on problem-solving abilities such as learning environment (Karatas & Baki, 2013), language (Rodríguez-Hernández et al., 2021), metacognition (Aurah et al., 2011), educational technology and learning materials (Serin et al., 2009), attitudes to learning (Zamir et al., 2022). Other researchers showed the relationships between variables such as the relationship between Motivation - Metacognition – Attitude (Yunus, Setyosari, Utaya, & Kuswandi, 2021), factors affecting the ability to solve mathematical problems (Pimta et al., 2009).

However, research on the presence and relationship of factors influencing problem-solving abilities is scarce, particularly at the elementary school level. The aforementioned publications only emphasize the research work at the middle school and university levels. For instance, Pimta et al., (2009) conducted an analysis on the factors that impact the ability of sixth-grade students to solve arithmetic problems. They have found that attitudes about the topic, self-esteem, and the presence of instructors have direct and indirect effects on students' problem-solving abilities. In addition, achievement motivation and self-efficacy have indirect effects on children' ability to solve problems. Similarly, Yunus, Setyosari, Utaya and Kuswandi (2021) examined the relationship between the factors: achievement motivation, metacognition, and learning attitude, using data collected from 148 university students in Indonesia from three schools. Upon scrutinizing the data, the researchers discovered that each factor exhibited a correlation with the students' problem-solving aptitude, and furthermore, all three factors demonstrated a simultaneous connection with their problem-solving ability. A separate study examining the factors that affect the mathematical problem-solving skills of high school students reveals the significant impact of both the teacher's instructional methods and their attitude towards mathematics. Indirectly, achievement motivation influences students' ability to solve arithmetic problems (Malangtupthong et al., 2022).

Although the aforementioned articles have examined each factor impacting problem-solving ability separately, they have not identified the interaction between these variables and the amount of their simultaneous effect on primary school students' problem-solving ability. Certain studies use qualitative approaches. In the current work, we used a distinct methodology and validated the obtained components. Therefore, the objective of our study is to illustrate the interplay among the factors that influence the problem-solving skills of elementary school students. The findings of this research will contribute to the existing body of knowledge in the field and serve as a valuable resource for fellow researchers working in this domain.

Literature review and hypothesis development

Liu and Israel (2022) defined problem-solving as the combination of two or more rules in innovative ways and it requires the use of current knowledge and experience to identify a problem and find a solution. Problem solving, as defined by OECD (2012), is the application of one's cognitive processes to the identification, analysis, and resolution of complex, multidisciplinary issues for which there is no one, universally applicable answer. In this view, OECD emphasizes people' problem-solving skills in real-world circumstances.

According to Liu et al., (2022), a teacher's job is to foster a good learning attitude in their students by encouraging them to engage with the material and each other via the use of effective teaching strategies and a wide range of entertaining and relevant materials. However, a research by

(Chairil et al., 2020; Suparman et al., 2021) showed that the development of instructional materials that prioritize problem-solving is of utmost importance in fostering a problem-based learning atmosphere that enhances students' problem-solving abilities throughout their educational journey. Drawing upon the aforementioned theories and an extensive literature review, this study proposes the following hypothesis:

Hypothesis 1 (H1). *Teachers' competence* has the effect of creating a positive *learning environment* that affects the performance of the problem-solving tasks of primary school students.

There are a number of theoretical models that seek to explain human motivation in activity. For instance, social cognitive theory (Schunk & DiBenedetto, 2020) asserts that self-efficacy is the cornerstone of motivation. A person who lacks confidence in his or her talents is less likely to accomplish success in life than one who is always aware of his or her objectives and who is internally motivated to work towards achieving them. This needs instructors to not only provide objectives for their students, but also to create learning motivation by transforming pedagogical goals into individual student goals (Dole et al., 2016). Thus, instructors' activities indirectly affect students' problem-solving capacities through motivation and learning attitudes (Malangtupthong et al., 2022). Based on this premise, we propose that:

Hypothesis 2 (H2). *Teachers' competence* had an effect of fostering *learning motivation* when confronted with problem-solving situation of elementary school students

The theory of achievement motivation (Anderman, 2020) contends that achievement motivation is the most important factor for students to reinforce confidence, have a good attitude when engaging in activities, and achieve high levels of academic performance. Attitude learning theory (Corneille & Hütter, 2020) refers to "latently motivated" responses that assist learners in obtaining high academic achievement. Students' problem-solving attitude is influenced by their attitude toward learning (Yunus, Setyosari, Utaya, & Kuswandi, 2021). Hence, the following hypothesis was derived:

Hypothesis 3 (H3). *Learning motivation* has a positive effect on *learning attitudes* when faced with problem solving tasks of primary school students.

Metacognitive theory (Larkin et al., 2019) asserts that metacognition, or "thinking about thinking," relates to the perception and capacity to manage one's mental processes, particularly the selection and use of problem-solving strategies. Metacognition consists of three primary components: goal setting, planning, monitoring and modifying the process of issue resolution, and self-evaluation. The empirical findings of (Acosta-Gonzaga & Ramirez-Arellano, 2021) indicate that metacognition and motivation are positively associated. Further research, Tian et al., (2018) demonstrates that metacognition of strategies can predict learning success through intrinsic motivation. Students' intrinsic drive stems from their own unique combination of factors, including but not limited to their own personal values, experiences, and perspectives (Schunk, 2008). Motivations such as epistemological beliefs and self-efficacy affect the development of cognitive and metacognitive abilities. To engage in metacognition, students must have a clear understanding of their cognition, where learning motivation plays a crucial part in self-regulation to boost cognitive and metacognitive techniques. This leads us to the following assumption:

Hypothesis 4 (H4). *Learning motivation* has a positive effect on primary school *students' metacognition* when faced with a problem-solving problem

In a research involving 503 Malaysian university students, M. B. A. Bakar (2002) found a favourable correlation between metacognition and students' learning attitude. These findings align with those of a survey of 200 postgraduate students in India who majored in English literature (Khonamri, 2009). However, Özsoy et al., (2009) examined 221 Turkish fifth-graders to investigate the relationship between their metacognitive level, study habits, and reading attitudes. They discovered that there is a moderately beneficial association between metacognition and learning attitudes, but only among learners with high achievement. The following assumption is proposed on the basis of this premise:

Hypothesis 5 (H5). *Learning attitudes* have a positive effect on the *metacognition* of primary school students when faced with problem solving problems

In his study, Divrik et al. (2020) found that metacognitive methods had an impact on the problem-solving abilities of fourth graders. In the same vein, Izzati and Mahmudi (2018) argue that metacognition plays a crucial role in effectively resolving mathematical problems. Their study unveiled a positive correlation between students' metacognitive proficiency and their problem-solving skills, indicating that pupils with stronger metacognitive abilities displayed greater proficiency in problem-solving. This study proposes the following hypothesis based on the aforementioned perspectives and a review of the metacognition literature:

Hypothesis 6 (H6). Metacognition exerts a direct and beneficial influence on the problem-solving abilities of elementary school students.

In a study on math problem solving ability of sixth graders, Pimta et al. (2009) suggested that attitudes towards math have a direct impact on math problem solving of students. Nguyen and Nguyen (2022) also confirmed the role of learning attitude on students' problem-solving ability. On that basis, we propose the following hypothesis

Hypothesis 7 (H7). *Learning attitudes* has a direct positive influence on the *problem-solving abilities* of primary school students

In terms of the learning environment, Brezovszky et al. (2019) suggest that teachers can enhance their instruction in arithmetic problem-solving by integrating a supportive learning environment as a supplementary resource. This approach facilitates the cultivation of flexibility and adaptability in their teaching methodologies (Brezovszky et al., 2019). In addition, Schoenfeld (2016) believes that a problem-based learning environment helps students to develop a comprehensive understanding of mathematics and to pursue their own learning interests. In his study, Albay (2019) highlighted the importance of problem-solving techniques within the learning environment, specifically through student engagement in group discussions. This approach effectively enhances their problem-solving abilities. Thus, the learning environment plays a positive role in fostering the development of students' problem-solving skills (Ahdhianto et al., 2020; Brezovszky et al., 2019). Based on the literature review, we propose the following assumption:

Hypothesis 8 (H8). *Learning environment* has had a direct positive influence on the *problem-solving abilities* of primary school students

The conceptual model developed to test the assumptions is shown in Figure 1. Each contributing factor is displayed by a circular shape, and the hypothesis is shown by an arrow.

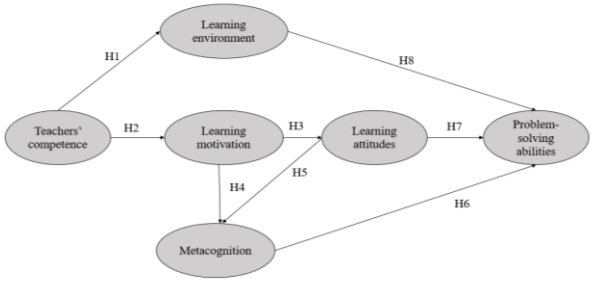

Figure 1 The proposed conceptual model

Method

Participants and Data Collection

We surveyed 571 Vietnamese elementary school children. The survey was conducted from November to December 2022, using the online Google Form. A link to the user's Google form was distributed to parents of elementary school student accounts (e.g., Zalo, Facebook, and Twitter). The questionnaire consists of 2 parts: Part 1 consists of four questions on general information, and Part 2 consists of twenty-four questions about influencing factors and their relationship with problem-solving abilities. Prior to their administration to respondents, rigorous assessments of reliability and validity were conducted for all the questions (Nguyen & Nguyen, 2022; Otoo et al., 2018; Sun et al., 2021) as part of our research. Because parents assist kids in responding to survey questions, we do not gather personally identifiable information; therefore, the study is ethically justified.

Measurement

The answers to the questions in Table 1 are used as a measurement tool to determine the factors that influence the capacity of elementary school children to solve problems. In this investigation, we used the Likert scale, where 1 indicated a complete lack of agreement, 2 indicated disagreement, 3 indicated neutrality, 4 indicated agreement, and 5 indicated strong agreement. This is a relatively widely used scale in similar studies

Table 1

Questionnaires used in the study

Code	Question
Metacognition (MC) (Sun et al., 2021)	
M1	I constantly attempt to identify the problem in difficult questions.
M2	I have remarkable problem-solving capabilities.
M3	I will often assess my progress toward my objective.
M4	I have a frequent tendency to reflect on how I have studied.
Learning attitudes (LA) (Nguyen & Nguyen, 2022)	
A5	I really enjoy answering the teacher's questions
A6	I am constantly attentive to the teacher during class.
A7	I constantly feel that I will accomplish the learning tasks
A8	I always attempt to resolve problems, regardless of their complexity.
Teachers' competence (TC) (Nguyen & Nguyen, 2022)	
C9	Teachers teach us the lessons very well and easy to understand

C10	Teachers arrange really engaging classroom activities frequently.
C11	Teachers comment on my answers very clearly
C12	Teachers are highly encouraging and supportive of my academic endeavors.
Learning environment (SE) (Sun et al., 2021)	
E13	I always feel comfortable in my classroom
E14	I always have the opportunity to discuss with my teachers
E15	I always have the opportunity to discuss with my classmates
E16	Instructional tools and equipment will improve my learning in the classroom
Learning motivation (LM) (Otoo et al., 2018)	
MT17	I am always encouraged and motivated in my studies
MT18	Earning high grades in school is crucial to me.
MT19	Learning enhances the significance of my life
MT20	I desire to increase my academic development.
Problem-solving ability (PSA) (Sun et al., 2021)	
AS21	Before attempting to solve an issue, I believe we must first identify it.
AS22	To solve the problem, I shall determine what is associated with it.
AS23	When confronted with an issue, I will first consider how to overcome it.
AS24	I believe that while tackling an issue, we should examine the solutions that have already been implemented.

Data Analysis

In the literature, structural equation modeling (SEM) is a prominent technique used to better comprehend the complicated interactions between factors (Osman et al., 2022; Prasetyo et al., 2022). The two most common methods for analyzing data using SEM are covariance-based SEM (CB-SEM) and partial least-squares structural equation modeling (PLS-SEM). Instead of using PLS-SEM to analyze the hypothesized research model, this study opted to use Generalized Structured Component Analysis (GSCA) (Hwang & Takane, 2014). GSCA was preferred due to its flexibility in handling small datasets that may not strictly adhere to normal distribution requirements. GSCA has been recognized and applied in a number of fields (Jung et al., 2021; Nguyen et al., 2022; Nguyen, 2022).

Results

Descriptive analysis

Overall, 571 answers were collected in total from participants. 331 items were omitted from the data during the data cleansing procedure, leaving 240 items eligible for study (see **Table 2**). In terms of sample size, literature work (Hair, 2009; Kline, 2015; Tabachnick et al., 2007) suggested that the minimum number of observations to variable should be five to one. In the context of our study, the ratio is 240:24 or 10:1, indicating a good ratio.

Data from Table 2 showed that there is parity between males (49.6%) and females (50.4%). Regarding grade level, 37.5% of children are in third grade, 43.3% are in fourth grade, and the remainder are in fifth grade. The majority of participants reside in rural or mountainous areas (53.4%), followed by city (32.9%) and district (13.7%) living conditions. In terms of parental occupations, more than half of pupils' parents are laborers (53.3%), followed by workers (24.2%), education (10%), unemployed (6.7%), and the military (5.5%).

Table 2

General information about participants (N = 240)

Variable		Frequency	Percent
Gender	Male	119	49.6
	Female	121	50.4
Grade	Grade 3	90	37.5
	Grade 4	104	43.3
	Grade 5	46	19.2
Living area	Rural, mountainous	128	53.4
	City, Province	79	32.9
	District	33	13.7
Parental professions	Military	14	5.8
	Worker	58	24.2
	Families covered by the policy	16	6.7
	Teachers	24	10
	Labor	128	53.3
Total		**240**	**100.0**

Table **3** provides a summary of the descriptive statistics for each of the six different constructs. The construct has means that vary from 3.313 to 4.367, which are both greater than the mid scale's value of 2.5. The range of possible standard deviations is from 0.945 to 1.143.

Table 3

Means and standard deviations of the measures (N = 240)

Construct	Item	Mean	Std
Metacognition	M1	3.538	1.050
	M2	3.313	1.005
	M3	3.704	1.143
	M4	3.633	1.101
Learning attitudes	A5	4.083	1.064
	A6	4.042	1.112
	A7	3.904	1.061
	A8	3.638	0.945

Teachers' competence	C9	4.363	1.018
	C10	4.296	1.071
	C11	4.125	1.035
	C12	4.246	1.036
Learning environment	E13	4.092	1.105
	E14	3.713	1.088
	E15	4.079	1.085
	E16	4.067	1.041
Learning motivation	MT17	4.042	1.050
	MT18	4.238	1.030
	MT19	4.367	0.989
	MT20	4.304	1.012
Problem-solving ability	AS21	4.079	1.030
	AS22	3.992	1.006
	AS23	3.996	0.979
	AS24	4.133	0.963

Quantitative Analysis

In

Table **4**, the estimated loadings were accompanied with standard error (SE), a 95% confidence interval with lower and upper bounds, and the standard error (SE). In this case, the estimated parameters were regarded statistically significant if the lower and upper limits of the confidence interval did not include zero.

Table **4** displays experimental data that demonstrate all items are viable indicators since they do not have a zero value inside the constructs.

Table 4

Estimate of loadings

	Estimate	**SE**	**95%_LB**	**95%_UB**
M1	0.738	0.058	0.608	0.82
M2	0.708	0.052	0.579	0.781
M3	0.779	0.028	0.723	0.825
M4	0.706	0.053	0.587	0.787
A5	0.736	0.054	0.614	0.823
A6	0.78	0.042	0.683	0.85
A7	0.825	0.037	0.749	0.89
A8	0.768	0.041	0.659	0.84
C9	0.846	0.032	0.778	0.901
C10	0.825	0.036	0.73	0.884
C11	0.814	0.043	0.677	0.871
C12	0.76	0.05	0.679	0.849
E13	0.682	0.063	0.539	0.8
E14	0.716	0.047	0.615	0.803
E15	0.794	0.039	0.705	0.866
E16	0.821	0.031	0.746	0.878
MT17	0.764	0.049	0.637	0.855
MT18	0.801	0.047	0.703	0.863
MT19	0.888	0.024	0.841	0.925
MT20	0.841	0.035	0.733	0.892
AS21	0.881	0.018	0.849	0.913
AS22	0.863	0.022	0.814	0.896
AS23	0.818	0.039	0.741	0.891
AS24	0.798	0.039	0.711	0.85

This study employed Dillon-rho Goldstein's (RHO) to evaluate the internal consistency and validity of each concept. According to

Table **5**, all RHOs have values larger than 0.7, indicating that they consistently exceed the suggested threshold (Hwang & Takane, 2014). The amount of convergence may be determined in a variety of methods, including by calculating the Average Extracted Variance (AVE). According to Hair (2009), an AVE value greater than or equal to 0.5 indicates that the latent variable will account for more than half of the variance of its observables and that the scale has high convergence. The findings of the studies indicate that every AVE value is more than 0.5, indicating that the value converges (Hair, 2009; Hwang & Takane, 2014).

Table 5

Validity and reliability of the construct

Construct	Item	Rho	AVE
Teachers' competence (TC)	4	0.8897	0.7293
Learning motivation (LM)	4	0.8547	0.6624
Learning environment (SE)	4	0.8897	0.7293
Learning attitudes (LA)	4	0.8897	0.7293
Metacognition (MC)	4	0.8547	0.6624
Problem-solving abilities (PSA)	4	0.8897	0.7293

Overall, the proposed model explained 59.6% amount of variance in the dataset (FIT = 0.596, AFIT = 0.592, GFI = 0.99, SRMR = 0.046). The Goodness of Fit (GFI) is a statistical metric that assesses how well a model's predicted covariance matrix corresponds to the observed covariance matrix. It was suggested that this index should exceed 0.90 for a suitable fit. The Standardized Root Mean Squared Residual (SRMR) has the opposite meaning of the GFI, and it is preferable that this number be as near to zero as feasible. Based on our experimental findings, GFI is near to one (or more than 0.90) while SRMR is close to zero.

Table 6 shows that the majority of the tests performed virtually definitely support the hypothesis. Except for H6 (Metacognition → Problem Solving), which does not get support owing to the presence of zero values in the CI, all hypotheses are significant at the 95% level.

Table 6

Estimates of path coefficients.

Hypothesis	Estimate	SE	95%_LB	95%_UB	Decision
H1: TC → LE	0.808	0.037	0.728	0.878	Confirmed
H2: TC → LM	0.832	0.04	0.735	0.888	Confirmed
H3: LM → LA	0.717	0.052	0.587	0.804	Confirmed
H4: LA → MC	0.126	0.089	0.094	0.258	Confirmed
H5: LA → MC	0.571	0.06	0.449	0.71	Confirmed
H6: MC → PSA	0.061	0.065	-0.062	0.201	Rejected
H7: LA → PSA	0.391	0.079	0.241	0.567	Confirmed
H8: LE → PSA	0.36	0.073	0.18	0.487	Confirmed

Discussion

Theoretical implications

The acquired results have significant theoretical relevance as they contribute additional insights to previous research. This study verified 7 out of 8 hypotheses. The findings of these studies are consistent with previous studies: teacher's competency affects the learning environment (Ahdhianto et al., 2020; Brezovszky et al., 2019), teacher's competence affects learning motivation (Malangtupthong et al., 2022), learning motivation affects learning attitude (Yunus, Setyosari, Utaya, & Kuswandi, 2021), learning motivation affects students' metacognition (Acosta-Gonzaga & Ramirez-Arellano, 2021), learning attitude affects students' metacognition (M. A. Bakar, 2002), learning attitude affects problem-solving abilities (Zamir et al., 2022), learning environment affects problem-solving abilities (Karatas & Baki, 2013), learning environment and learning attitude directly affect problem-solving ability (Pimta et al., 2009), learning motivation has a direct impact on problem-solving ability (Pimta et al., 2009). The findings of the quantitative analysis of the study also strongly and correctly corroborate the qualitative results of the previous study. In addition, the results of this study show that learning attitudes, learning environment, and learning motivation influence primary students' problem-solving skills not only in mathematics but also in other areas. This adds to the study conducted by (Pimta et al., 2009), which discovered this relationship exclusively in Mathematics. The findings also indicate that the learning attitude has a favourable effect on the metacognition of primary school pupils when confronted with a problem-solving activity. This study supports the research of (M. A. Bakar, 2002) and (Yunus, Setyosari, Utaya, Kuswandi, et al., 2021), which discovered this relationship exclusively among college students. The most important contribution of this study is the confirmation of the correctness of the relationship between the simultaneous effects of factors on problem-solving ability and the identification of which factors have direct versus indirect effects on the problem-solving ability of elementary school students.

In summary, this research added significantly to the body of knowledge in two distinct aspects according to the results of the experiments conducted. First, it supported seven of the original eight assumptions about the relationships between variables that affect problem-solving skills. This verification raises the number of verified hypotheses, which is helpful for teachers who want to replicate the study using the same variables. Second, the lack of statistical significance for unexpected experimental findings calls for more study.

Practical implications

The obtained research findings indicate that the model's explanatory power is quite high (FIT = 0.596), indicating that the suggested research model would work effectively. In addition, seven study hypotheses were confirmed, demonstrating the simultaneous influence of teacher teaching skill, learning environment, learning attitude, and learning motivation on problem-solving ability. In order for primary school pupils to acquire problem-solving skills, educators must focus on influencing all of these aspects, not just one at a time.

In addition, the relationship H1 (teachers' competence → learning environment) has the highest impact coefficient, H2 (teachers' competence → learning motivation) is the second highest. This is also very meaningful. Among the relationships that indirectly affect the problem-solving capacity, the teacher's competence is the most influential factor. Therefore, educators need to pay attention to this factor when developing problem solving capacity for elementary school students. In the teaching process, teachers need to use appropriate methods, diverse and rich

content, and appropriate learning materials (Liu et al., 2022) to create favourable conditions for students to develop problem-solving abilities.

Limitations

While this study has produced valuable findings that can assist teachers and future researchers in identifying specific activities to enhance problem-solving skills in elementary school students, it is important to acknowledge its limitations. Firstly, the survey utilized in the study only consisted of 24 items, potentially leaving out other variables that could have been relevant. This calls for further research to expand the scope of the investigation. Secondly, the research did not employ additional statistical approaches which could have provided more comprehensive insights into the factors influencing the problem-solving abilities of primary school students.

Conclusion

This research examined the factors that affect the problem-solving capacity of elementary school children. The survey findings validated seven out of eight hypotheses on the relationships between the influencing factors, based on a study of 240 elementary school students from diverse regions. In other words, teacher competency influences the learning environment, teacher competence influences learning motivation, learning motivation influences both learning attitudes and metacognition, and learning attitude and learning environment have a direct effect on problem-solving capacity. The last hypothesis is not supported, namely that metacognition has no direct effect on the problem-solving capacity of elementary school students. Overall, the model accounts for 59.6% of the data's variability. This study's significance has been demonstrated by its theoretical and practical implications.

References

Acosta-Gonzaga, E., & Ramirez-Arellano, A. (2021). The influence of motivation, emotions, cognition, and metacognition on students' learning performance: A comparative study in higher education in blended and traditional contexts. *Sage Open*, *11*(2), 21582440211027561. https://doi.org/10.1177/21582440211027561

Ahdhianto, E., Marsigit, H., & Nurfauzi, Y. (2020). Improving fifth-grade students' mathematical problem-solving and critical thinking skills using problem-based learning. *Universal Journal of Educational Research*, *8*(5), 2012-2021. https://doi.org/10.13189/ujer.2020.080539

Albay, E. M. (2019). Analyzing the effects of the problem solving approach to the performance and attitude of first year university students. *Social Sciences & Humanities Open*, *1*(1), 100006. https://doi.org/10.1016/j.ssaho.2019.100006

Anderman, E. M. (2020). Achievement motivation theory: Balancing precision and utility. *Contemporary Educational Psychology*, *61*, 101864. https://doi.org/10.1016/j.cedpsych.2020.101864

Aurah, C. M., Koloi-Keaikitse, S., Isaacs, C., & Finch, H. (2011). The role of metacognition in everyday problem solving among primary students in Kenya. *Problems of Education in the 21st Century*, *30*(2011), 9-21. https://journals.indexcopernicus.com/search/article?icid=943466

Bakar, M. A. (2002). *Metacognition, a Study Approaches and Reading Attitude Towards Improving Reading Efficiency in English* Universiti Putra Malaysia].

Bakar, M. B. A. (2002). *Metacognition, a Study Approaches and Reading Attitude Towards Improving Reading Efficiency in English* Universiti Putra Malaysia]. Universiti putra malaysia institutional repository. http://psasir.upm.edu.my/id/eprint/10172/

Brezovszky, B., McMullen, J., Veermans, K., Hannula-Sormunen, M. M., Rodríguez-Aflecht, G., Pongsakdi, N., Laakkonen, E., & Lehtinen, E. (2019). Effects of a mathematics game-based learning environment on primary school students' adaptive number knowledge. *Computers & Education*, *128*, 63-74. https://doi.org/10.1016/j.compedu.2018.09.011

Celebi, E. F. (2021). Interpersonal Problem-solving Skills Analysis: 5–8 Years Old Children's Different Variables. *European Journal of Educational Sciences*, *8*(3), 28-41.

Corneille, O., & Hütter, M. (2020). Implicit? What do you mean? A comprehensive review of the delusive implicitness construct in attitude research. *Personality and Social Psychology Review*, *24*(3), 212-232. https://doi.org/10.1177/1088868320911325

Chairil Hikayat, S., Hairun, Y., & Suharna, H. (2020). Design of Realistic Mathematics Education Approach to Improve Critical Thinking Skills. *Universal Journal of Educational Research*, *8*(6), 2232-2244. https://doi.org/10.13189/ujer.2020.080606

Divrik, R., Pilten, P., & Tas, A. M. (2020). Effect of Inquiry-Based Learning Method Supported by Metacognitive Strategies on Fourth-Grade Students' Problem-Solving and Problem-Posing Skills: A Mixed Methods Research. *International Electronic Journal of Elementary Education*, *13*(2), 287-308. https://doi.org/10.26822/iejee.2021.191

Dole, S., Bloom, L., & Kowalske, K. (2016). Transforming pedagogy: Changing perspectives from teacher-centered to learner-centered. *Interdisciplinary Journal of Problem-Based Learning*, *10*(1), 1. https://doi.org/10.7771/1541-5015.1538

Hair, J. F. (2009). *Multivariate data analysis (7th ed.)*. Pearson.

Hulaikah, M., Degeng, I., & Murwani, F. D. (2020). The Effect of Experiential Learning and Adversity Quotient on Problem Solving Ability. *International Journal of Instruction*, *13*(1), 869-884.

Hwang, H., & Takane, Y. (2014). *Generalized structured component analysis: A component-based approach to structural equation modeling*. CRC Press.

Izzati, L., & Mahmudi, A. (2018). The influence of metacognition in mathematical problem solving. Journal of Physics: Conference Series,

Jung, K., Nguyen, V. T., & Lee, J. (2021). Blocklyxr: An interactive extended reality toolkit for digital storytelling. *Applied Sciences*, *11*(3), 1073. https://doi.org/10.3390/app11031073

Karatas, I., & Baki, A. (2013). The effect of learning environments based on problem solving on students' achievements of problem solving. *International Electronic Journal of Elementary Education*, *5*(3), 249-268.

Kline, R. B. (2015). *Principles and Practice of Structural Equation Modeling*. Guilford publications.

Khonamri, F. (2009). The Role of Beliefs and Metacognitive Awareness in the Strategic Reading Behavior of ESL Learners. *The Journal of Modern Thoughts in Education*, *4*(4), 140-111. https://jmte.riau.ac.ir/article_901.html

Larkin, S., Freathy, R., Doney, J., & Freathy, G. (2019). *Metacognition, Worldviews and Religious Education: A Practical Guide for Teachers*. Routledge.

Liu, H.-Y., Hsu, D.-Y., Han, H.-M., Wang, I.-T., Chen, N.-H., Han, C.-Y., Wu, S.-M., Chen, H.-F., & Huang, D.-H. (2022). Effectiveness of interdisciplinary teaching on creativity: A quasi-experimental study. *International Journal of Environmental Research and Public Health*, *19*(10), 5875. https://doi.org/10.3390/ijerph19105875

Liu, T., & Israel, M. (2022). Uncovering students' problem-solving processes in game-based learning environments. *Computers & Education*, *182*, 104462. https://doi.org/10.1016/j.compedu.2022.104462

Lubis, A. B., Miaz, Y., & Putri, I. E. (2019). Influence of the Guided Discovery Learning Model on Primary School Students' Mathematical Problem-Solving Skills. *Mimbar Sekolah Dasar*, *6*(2), 253-266. https://doi.org/10.17509/mimbar-sd.v6i2.17984

Malangtupthong, P., Nurittamont, W., & Phayaphrom, B. (2022). Factors influencing Mathematical problem-solving competency: A case study on high school students. *PSAKU International Journal of Interdisciplinary Research*, *11*(2), 1-18.

Marwazi, M., Masrukan, M., & Putra, N. M. D. (2019). Analysis of problem solving ability based on field dependent cognitive style in discovery learning models. *Journal of Primary Education*, *8*(2), 127-134.

Nguyen, C., & Nguyen, N. T. (2022). Determinants of Problem-Solving Skills in Natural and Social Subjects of Primary School Students in Vietnam. *International Journal of Social Science And Human Research*, *5*(7), 3218-3224. https://doi.org/10.47191/ijsshr/v5-i7-62

Nguyen, N. T., Chu, A. T., Tran, L. H., Pham, S. X., Nguyen, H. N., & Nguyen, V. T. (2022). Factors Influencing Elementary Teachers' Readiness in Delivering Sex Education amidst Covid-19 pandemic. *International Journal of Learning, Teaching and Educational Research*, *21*(2). https://doi.org/10.26803/ijlter.21.2.18

Nguyen, V. T. (2022). The perceptions of social media users of digital detox apps considering personality traits. *Education and Information Technologies*, 1-24. https://doi.org/10.1007/s10639-022-11022-7

OECD. (2012). *Pisa 2012 assessment and analytical framework. Mathematics, reading, science, problem solving and financial literacy*. https://doi.org/10.1787/9789264190511-en

Osman, S., Cheng, K. W., & Wider, W. (2022). Factors Affecting the Halal Cosmetics Purchasing Behaviour in Klang Valley, Malaysia. *FWU Journal of Social Sciences*, *16*(4), 102-120. https://doi.org/10.51709/19951272/Winter2022/8

Otoo, D., Iddrisu, W. A., Kessie, J. A., & Larbi, E. (2018). Structural model of students' interest and self-motivation to learning mathematics. *Education Research International*, *2018*, 1-10. https://doi.org/10.1155/2018/9417109

Özsoy, G., Memiş, A., & Temur, T. (2009). Metacognition, study habits and attitudes. *International Electronic Journal of Elementary Education*, *2*(1), 154-166.

Pimta, S., Tayraukham, S., & Nuangchalerm, P. (2009). Factors Influencing Mathematic Problem-Solving Ability of Sixth Grade Students. *Online Submission*, *5*(4), 381-385. https://eric.ed.gov/?id=ED506983

Prasetyo, A., Tamrin, A., & Estriyanto, Y. (2022). A Successful Model of Microsoft Teams Online Learning Platform in Vocational High School. *FWU Journal of Social Sciences*, *16*(2), 18-32. https://doi.org/10.51709/19951272/Summer2022/2

Rodkroh, P., Suwannatthachote, P., & Kaemkate, W. (2019). Effects of Using Problem-Based Learning Digital Game on Problem-Solving ability for Science subject of Primary Students. *Veridian E-Journal, Silpakorn University (Humanities, Social Sciences and arts)*, *12*(5), 762-777.

Rodríguez-Hernández, M., Pruneda, R., & Rodríguez-Díaz, J. (2021). Statistical Analysis of the Evolutive Effects of Language Development in the Resolution of Mathematical Problems in Primary School Education. *Mathematics*, *9*(10), 1081.

Schoenfeld, A. H. (2016). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics (Reprint). *Journal of education*, *196*(2), 1-38.

Schunk, D. H. (2008). Metacognition, self-regulation, and self-regulated learning: Research recommendations. *Educational psychology review*, *20*, 463-467. https://doi.org/10.1007/s10648-008-9086-3

Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, *60*, 101832.

Serin, O., Serin, N. B., & Saygılı, G. (2009). The effect of educational technologies and material supported science and technology teaching on the problem solving skills of 5th grade primary school student. *Procedia-Social and Behavioral Sciences*, *1*(1), 665-670.

Sun, F.-R., Pan, L.-F., Wan, R.-G., Li, H., & Wu, S.-J. (2021). Detecting the effect of student engagement in an SVVR school-based course on higher level competence development in elementary schools by SEM. *Interactive Learning Environments*, *29*(1), 3-16.

Sungur, G., & Bal, P. N. (2016). Analysis of 4th Grade Students' Problem Solving Skills in Terms of Several Variables. *Journal of Education and Practice*, *7*(14), 1-9. https://eric.ed.gov/?id=EJ1102973

Suparman, S., Yohannes, Y., & Arifin, N. (2021). Enhancing mathematical problem-solving skills of Indonesian junior high school students through problem-based learning: a systematic review and meta-analysis. *Al-Jabar: Jurnal Pendidikan Matematika*, *12*(1), 1-16.

Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2007). *Using multivariate statistics* (Vol. 5). pearson Boston, MA.

Tian, Y., Fang, Y., & Li, J. (2018). The effect of metacognitive knowledge on mathematics performance in self-regulated learning framework—multiple mediation of self-efficacy and motivation. *Frontiers in psychology*, *9*, 2518.

van Hooijdonk, M., Mainhard, T., Kroesbergen, E. H., & van Tartwijk, J. (2020). Creative problem solving in primary education: Exploring the role of fact finding, problem finding, and solution finding across tasks. *Thinking Skills and Creativity*, *37*, 100665.

World Economic Forum, V. (2020). *The future of jobs report 2020* (Retrieved from Geneva, Issue. https://www.weforum.org/reports/the-future-of-jobs-report-2020

Yunus, M., Setyosari, P., Utaya, S., & Kuswandi, D. (2021). The Influence of Online Project Collaborative Learning and Achievement Motivation on Problem-Solving Ability. *European Journal of Educational Research*, *10*(2), 813-823.

Yunus, M., Setyosari, P., Utaya, S., Kuswandi, D., Amirullah, A., & Rusdi, M. (2021). The relationship between achievement motivation, metacognitive awareness, attitudes and problem-solving abilities in students. *Cypriot Journal of Educational Sciences*, *16*(1), 32-45.

Zamir, S., Yang, Z., Wenwu, H., & Sarwar, U. (2022). Assessing the attitude and problem-based learning in mathematics through PLS-SEM modeling. *PloS one*, *17*(5), e0266363. https://doi.org/10.1371/journal.pone.0266363