International Journal of Multidisciplinary Research and Publications
ISSN (Online): 2581-6187

Mathematical Disposition and Autonomous Learning as Predictors of Mathematical Literacy of Students

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Abstract*—The primary purpose of this study was to determine whether mathematical disposition and autonomous learning predict the mathematical literacy of students. This study employed a descriptive and correlational research approach. Using stratified random sampling technique, 258 grade 11 students were selected as respondents from three public senior high schools in the Division of Tagum City, Davao del Norte, during the school year 2023-2024. Furthermore, this study employed two adopted survey questionnaires and one researcher-made questionnaire, all validated and pilot-tested. The data were treated using mean, standard deviation, Pearson-r and multiple regression analysis. The results showed that the level of students' mathematical inclination and independent learning is high, and their mathematical literacy is high. The findings also revealed that mathematical disposition and autonomous learning have a significant positive relationship and influence on mathematical literacy of students. These findings underscore that mathematical disposition and autonomous learning of students must be promoted to foster a high level of mathematical literacy. It is recommended that teachers and DepEd officials collaborate to create interventions that focus on fostering positive mathematical disposition and promoting autonomous learning to improve the level of mathematical literacy of students*.

***Keywords*—** *Autonomous learning; Grade 11 students; Mathematical disposition; Mathematical literacy; descriptive and correlational design; Pearson-r; regression analysis; Davao del Norte; Philippines*.

I. INTRODUCTION

Entering the 21st century, the rapidly evolving global landscape necessitates that every citizen, particularly students as the seeds of human resources, possess mathematical literacy. This critical skill profoundly impacts their ability to solve mathematical problems and thrive in a competitive world (Lestari et al., 2019). Unfortunately, recent research indicates a decline in mathematical literacy due to poor attitudes and strategies towards mathematics (Oktaviyanthi & Agus, 2019).

In Indonesia, students' mathematical literacy is alarmingly low, with a PISA 2018 score of 379, significantly below the OECD average of 489, ranking 72nd out of 78 countries (OECD, 2019; PISA, 2018). Turkey, despite curriculum reforms aimed at improving mathematical literacy (MED, 2017), scored only 454, also below the OECD average (PISA, 2018). Similarly, Tanzania and Zimbabwe report poor mathematical literacy, with Tanzania's students averaging 19.54 on national exams (Mosenda, 2020) and Zimbabwean students achieving just 58% in mathematics (Varaidzai et al., 2020).

The Philippines, participating in PISA for the first time, scored an average of 353 in mathematical literacy, placing second to last among 79 countries, with only one in five students meeting the minimum competency level (PISA, 2018). The results of TIMSS 2019 further highlighted the struggle of the Philippines with a score of 297, the lowest among the 58 participating countries (TIMSS, 2019). Locally, in the Division of Tagum City, Davao del Norte, students averaged 71 on summative assessments, failing to meet the minimum passing standard (Samuya, 2022).

Literature suggests that issues in mathematical literacy are linked to mathematical disposition (Gabriel et al., 2018; Genc & Erbas, 2019) and autonomous learning (Wei & Leung, 2020). Previous studies, often using experimental designs, explored these connections (Lestari et al., 2019; Liu & Zhang, 2019). However, the researcher aims to investigate these relationships using a non-experimental design to determine if mathematical disposition and autonomous learning significantly predict mathematical literacy.

The study's findings will offer insights into improving students' mathematical literacy, helping educators understand critical factors and dimensions, and guiding institutions on potential interventions. Given the Philippines' low mathematical literacy levels, this study's outcomes will be shared widely to inform educational practices and policies.

II. RESEARCH OBJECTIVES

The main objective of this study is to determine if mathematical disposition and autonomous learning significantly predict students' mathematical literacy in the Division of Tagum City. The specific study's research objectives were as follows:

1. Determine the level of mathematical disposition of student in terms of:
   a. Nature and usefulness of mathematics
   b. Learning of mathematics
   c. Perseverance in mathematics
2. Determine the level of autonomous learning of students in terms of:
   a. Study habits
   b. Independence of learning
3. Determine the level of mathematical literacy of students in terms of test scores.

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4. Determine if there is a significant relationshipbetween:
a. Mathematical disposition and mathematicalliteracy
b. Autonomous learning and mathematicalliteracy
5. Determine whether mathematical disposition and autonomous learning significantly predict mathematical literacy.

III. METHODS

Research Design

This quantitative research utilized a descriptive and correlational design, systematically examining phenomena using statistical, mathematical, and computational techniques, with data collected through polls, questionnaires, and surveys. The descriptive approach aimed to characterize the population's attributes, observing behaviours without influencing them, and was employed to gain new insights when little was known about the topic while a correlational technique was used to assess the presence and magnitude of relationships between variables, gathering data to evaluate the degree of association between quantitative factors. In addition, regression analysis was used to determine the relationship between the dependent variable and two independent variables by estimating a linear equation. This research design was suitable for collecting quantitative data to assess mathematical disposition, autonomous learning, and mathematical literacy in students, test hypotheses regarding these relationships, and analyze the data using appropriate statistical methods. Ultimately, the primary objective was to examine how mathematical literacy is influenced by both mathematical disposition and autonomous learning.

Research Respondents

For this study, Grade 11 students from three public senior high schools in the Division of Tagum City, Davao del Norte, during the 2022-2023 school year were selected as participants. The researcher determined a sample size of 258 students from a total student population of 777 using the Online Raosoft calculator, aiming for a 95% confidence level with a 5% margin of error. Stratified random sampling was employed, treating each school as a stratum, with representatives chosen via simple random sampling. Specifically, 59 students were selected from School A (out of 179), 72 from School B (out of 216), and 127 from School C (out of 382), ensuring a representative sample across the schools for the study.

Research Instrument

The study utilized a survey questionnaire sourced from published research to assess mathematical disposition and autonomous learning. In addition, a researcher-developed summative questionnaire was employed to measure mathematical literacy. These instruments, divided into several parts, underwent rigorous validation by a panel of experts and were further refined through pilot testing among students at a public school in Davao Oriental, ensuring their reliability and suitability for the main study. The first part includes the collection of demographic information, while the second part utilized tools to determine the Mathematical Disposition, Autonomous Learning and a researcher-made summative assessment to determine the respondents' mathematical literacy. Mathematical Disposition was assessed using a Mathematical Disposition (MD) scale adapted from Cruz et al. (2019), comprising 30 items grouped into three sequential indicators: the nature and usefulness of mathematics (10 items), learning of mathematics (10 items), and perseverance in mathematics (10 items). The total Cronbach's alpha of the scale was 0.84, indicating a strong internal consistency of the instrument. To measure autonomous learning, a-12 item Autonomous Learning Scale adapted from Macaskill and Taylor (2010) was employed. This scale, grouped into two sequential indicators: study habits (5 items) and independence in learning (7 items), which demonstrated a good level of consistency with a Cronbach's alpha of 0.76. Furthermore, the researcher developed a summative assessment for mathematical literacy focusing on Statistics and Probability, aligning with the DepEd Most Essential Learning Competencies (MELCs) for the third quarter of the school year 2023-2024. This assessment comprised multiple-choice questions structured according to a Table of Specification (TOS) based on revised Bloom's taxonomy. The TOS allocated 20% of items for remembering and understanding, 60% for applying and analyzing, and 20% for evaluating and creating. The assessment underwent validation by experts, item analysis, and reliability testing. It was administered to participants once, and their scores were used to measure their mathematical literacy.

Data Gathering Procedure

To ensure the smooth execution of this study, the researcher followed a series of important steps: seeking permission to conduct the study, seeking the respondent's consent and giving of general orientation, administration and retrieval of the data and checking, collating and processing of data. Initially, approval was obtained from the Research Ethics Committee of Saint Marys' College of Tagum Inc., followed by endorsement from the Dean of the Graduate School. Formal requests were then sent to Tagum City Division and school principals of selected public senior high schools for permission to conduct the study. Participants' consent was sought in accordance with ethical principles, ensuring they understood their voluntary participation rights, with minors requiring parental consent. The researcher administered surveys and tests in a 90-minute session to measure mathematical disposition, autonomous learning, and mathematical literacy. Data collection involved meticulous tallying and tabulation using Excel, followed by rigorous validation and organization. Data analysis was conducted by a graduate school statistician using SPSS software, with results presented in tables and interpreted descriptively. Strict measures were taken to secure and confidentially handle data, including proper disposal after the designated storage period.

Statistical Treatment

The data collected in this study underwent several statistical analyses to derive meaningful insights. Mean calculations were used to determine the average levels of

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mathematical disposition, autonomous learning, and mathematical literacy among the students. Standard deviation measurements assessed how closely the data clustered around these means, indicating the variability within each measurement. Pearson correlation coefficients were computed to evaluate the strength and significance of relationships between mathematical disposition, autonomous learning, and mathematical literacy. Additionally, multiple regression analysis was employed to ascertain whether mathematical disposition and autonomous learning could predict mathematical literacy outcomes effectively. These statistical tools collectively provided a comprehensive understanding of the interrelationships and predictive factors within the study variables.

Ethical Consideration

Throughout this study, ethical considerations were predominant in ensuring the safety and well-being of participants. The researcher obtained approvals from the Research Ethics Committee of Saint Marys' College of Tagum Inc., sought endorsements from the Graduate School Dean, and secured permissions from Tagum City Division and school principals before initiating the study. Participants, both legal age and minors with parental consent, were fully informed through Informed Consent Forms, emphasizing voluntary participation and the right to withdraw at any time. Data collection, managed by the researcher in person, adhered to strict ethical guidelines, including privacy protection and COVID-19 safety measures. The study's social value focused on enhancing educational policies through insights into mathematical literacy predictors, benefiting educators, policymakers, and students. Transparency and justice were upheld through fair treatment of participants, clear communication of study aims and outcomes, and adequate compensation for their involvement. The researcher's qualifications in education and mathematics, supported by expert guidance, ensured the study's rigor and quality. Data confidentiality was rigorously maintained, and facilities, including research databases and internet access, were utilized effectively. Community involvement was integral, ensuring the study's relevance and broad dissemination of findings to educational stakeholders through various platforms.

IV. Results and Discussion

TABLE 1. Level of Mathematical Disposition of Students

Indicators	SD	Mean	Descriptive Equivalent
Nature and Usefulness of Mathematics	0.91	4.07	High
Learning of Mathematics	0.93	3.92	High
Perseverance in Mathematics	0.89	3.94	High
Overall	**0.91**	**3.98**	**High**

The results for every indicator of the level of mathematical disposition are shown in Table 1. Table 1 highlights the level of mathematical disposition among the students, focusing on three key indicators: nature and usefulness of mathematics, perseverance in mathematics, and learning of mathematics. The nature and usefulness of mathematics had the highest mean score of 4.07, categorized as high. This was followed by perseverance in mathematics with a mean of 3.94, also labeled as high, and learning of mathematics with a mean of 3.92, again rated high. The overall mean score for mathematical disposition was 3.98 with a standard deviation of 0.91, indicating a high-level descriptive equivalent. These results suggest that students hold mathematics in high esteem, recognizing its inherent value and practical applications. They appreciate the importance of learning math and understand that perseverance is crucial to mastering the subject. This high level of mathematical disposition implies that students are willing to engage in diverse mathematical activities and can efficiently solve various mathematical problems.

The findings in this study align with previous research, such as the work by Fadillah and Wahyudin (2022), who reported that students generally have high mathematical dispositions. Students at this level are more inclined to participate actively in mathematical activities and tackle mathematical challenges with greater efficacy. Additionally, the research by Leyva et al. (2022) supports the notion that students who perceive mathematics as relevant to their lives and future careers tend to develop a more positive disposition towards the subject. This positive disposition is crucial for fostering a conducive learning environment where students are motivated to engage deeply with mathematical concepts. It underscores the importance of helping students see the relevance of mathematics in real-world applications and their future careers, thereby enhancing their willingness to persevere and succeed in the subject.

Furthermore, the high level of mathematical disposition among students, as indicated by the study, reflects a strong foundation for mathematical literacy and suggests that educational strategies focusing on relevance, perseverance, and practical applications can further enhance students' engagement and performance in mathematics.

TABLE 2. Level of Autonomous Learning of Students

Indicators	SD	Mean	Descriptive Equivalent
Study Habits	0.79	4.10	High
Independence of Learning	0.82	3.87	High
Overall Mean	**0.81**	**3.99**	**High**

The results of the level of autonomous learning among the students is shown in Table 2. The autonomous learning is evaluated through two primary indicators: study habits and independence of learning. The study habits indicator achieved the highest mean score of 4.10 (SD = 0.79), categorized as high. This was followed by independence of learning, which had a mean score of 3.87 (SD = 0.82), also labeled as high. The overall mean score for autonomous learning was 3.99, with a standard deviation of 0.81, indicating a high-level descriptive equivalent. These results demonstrate that students exhibit a high level of autonomous learning, taking pride in their study habits and valuing their ability to learn independently. This suggests that students appreciate the importance of disciplined study routines and the confidence that comes with self-directed learning.

The findings in this study are consistent with previous research. For instance, Samusenkov et al. (2021) reported high levels of autonomous learning among students, noting that such students can effectively design their own learning goals, identify resources, choose methods and strategies, and evaluate their own learning performance. This high level of autonomy in learning suggests that students are well-equipped to take charge of their educational journeys, leading to more effective and personalized learning experiences. Bakar and Ismail (2019) further emphasized that enabling students to explore and discover mathematical concepts independently enhances their conceptual understanding of the subject. This independence not only fosters a deeper comprehension of mathematical ideas but also cultivates critical thinking and problem-solving skills, which are essential for academic success and lifelong learning. Moreover, Zhang et al. (2021) highlighted the importance of creating an environment that fosters students' autonomy. They suggested that educators should use pedagogical strategies that support self-directed learning processes. This includes providing opportunities for students to make choices about their learning, encouraging self-assessment and reflection, and offering guidance that helps students develop effective study habits and independent learning skills.

In overall, the high level of autonomous learning observed in this study indicates that students are capable of managing their own learning processes effectively. This suggests that by promoting disciplined study routines and fostering an environment that supports independent learning, educators can enhance students' autonomy, leading to improved educational outcomes and a more engaging learning experience.

TABLE 3. Level of Mathematical Literacy of Students in terms of Test Scores

Variable	SD	Mean	DescriptiveEquivalent
Mathematical Literacy	19.20	72.57	High

Table 3 presents the level of mathematical literacy among the students as measured by their test scores. The average percentage score was 72.57, with a standard deviation of 19.20, and was rated as high. This indicates that the students' mathematical literacy is very satisfactory, suggesting that they have a strong grasp of the mathematical concepts covered in their curriculum. The high-test scores reflect effective learning strategies and the ability to apply mathematical knowledge to solve complex problems.

These findings align with previous research, such as Rahmawati et al. (2021), who also reported high levels of mathematical literacy among students. Their study showed that students were capable of calculating mathematical problems across various contexts, using appropriate procedures, and effectively communicating their interpretations, results, and actions. This ability to engage with mathematical problems at a high level demonstrates a robust understanding of mathematical concepts and the practical application of mathematical knowledge. Similarly, Rahmadhani et al. (2021) found that students with high levels of mathematical literacy could formulate, employ, and interpret advanced mathematical problems. This indicates that these students not only understand basic mathematical concepts but can also tackle more complex and abstract mathematical challenges. Their proficiency in mathematics enables them to approach problems critically and creatively, which is essential for higher-level mathematics and related fields. Kharis et al. (2021) further asserted that students with proficient mathematical literacy possess a deep understanding of mathematical concepts and strong mathematical reasoning skills. This deep understanding is crucial for success in both academic and real-world settings, as it allows students to apply mathematical principles to a variety of situations and problems.

In summary, the high level of mathematical literacy observed in this study indicates that students are well-prepared and capable in mathematics. Their strong performance on tests reflects not only their knowledge of mathematical concepts but also their ability to use this knowledge effectively. To sustain and further enhance this level of literacy, educators should continue to promote effective learning strategies, provide opportunities for students to engage with complex problems, and foster an environment that encourages the practical application of mathematical skills.

The relationship between mathematical disposition, autonomous learning, and mathematical literacy is shown in Table 4. The correlation between mathematical disposition and mathematical literacy has an R-value of 0.697, indicating a moderate positive linear relationship. The p-value of 0.000, being less than 0.05, leads to the rejection of the null hypothesis, confirming a significant relationship between these variables. This suggests that a positive math attitude significantly improves math skills. The findings align with previous research by Fadillah et al. (2020) which reported a similar correlation, highlighting that students with a positive mathematical disposition tend to exhibit higher showed mathematical literacy.

TABLE 4. Significance of the Relationship Between the Variables

Variables Correlated	r	p-value	Decision on Ho	Decision on Relationship
MathematicalDisposition & MathematicalLiteracy	0.697	0.000	Rejected	Significant
AutonomousLearning & Mathematical Literacy	0.695	0.000	Rejected	Significant

This relationship highlights the importance of fostering positive attitudes towards mathematics in order to improve literacy in this area. Yaniawati et al. (2019) emphasized that a positive mathematical disposition is an essential desire, awareness, inclination and strong commitment to learning mathematics. These characteristics are critical for students to engage deeply with mathematical content, persevere through challenges, and achieve higher levels of mathematical understanding. Similarly, the correlation between autonomous learning and mathematical literacy has an R-value of 0.695, also indicating a moderate positive linear relationship. With a p-value of 0.000, the null hypothesis is again rejected, confirming a significant relationship between autonomous learning and mathematical literacy. This implies that students

who are more self-directed in their learning tend to achieve higher levels of mathematical literacy.

These results are consistent with the propositions of Hwang and Ham (2021), who found a significant positive relationship between autonomous learning and mathematical literacy. Students who engage in autonomous learning activities, such as independently exploring mathematical concepts and seeking additional practice opportunities, show improved mathematical literacy. This finding is further supported by Roick and Ringeisen (2018), who asserted that autonomous learning fosters a deeper understanding of mathematical concepts and enhances students' ability to apply these concepts to solve problems.

TABLE 5. Regression Analysis on Mathematical Disposition and Autonomous Learning as Predictors of Mathematical Literacy of Students

Independent Variable	**Unstandardized Coefficients**		**Standardized Coefficients**	**t-stat**	**p-value**	**Decision@ α = 0.05**
	β	**Standard Error**	**Beta**			
(Constant)	-46.901	6.672		7.030	0.000	
Mathematical Disposition	15.288	2.287	0.406	6.685	0.000	Rejected
Autonomous Learning	14.645	2.229	0.399	6.571	0.000	Rejected
Dependent Variable: Mathematical Literacy ***Adjusted R Square***: 0.557 ***F-ratio***: 162.722 ***p-value***: 0.000						

The significant relationships identified in this study highlight the importance of both mathematical disposition and autonomous learning in enhancing mathematical literacy. Educators should focus on strategies that promote a positive attitude towards mathematics and encourage self-directed learning. This can be achieved through creating engaging and relevant mathematical experiences, providing opportunities for independent exploration, and supporting students in developing effective study habits and perseverance. By understanding and leveraging the interplay between mathematical disposition and autonomous learning, educators can better support students in achieving higher levels of mathematical literacy. This holistic approach not only improves academic outcomes but also prepares students for future challenges by equipping them with the skills and attitudes necessary for lifelong learning in mathematics.

The regression analysis presented in Table 5 demonstrates the significant influence of mathematical disposition and autonomous learning on students' mathematical literacy. The analysis reveals that both independent variables—mathematical disposition and autonomous learning—have statistically significant positive impacts on mathematical literacy, as indicated by their p-values, which are less than the 0.05 threshold. Specifically, the unstandardized beta coefficients suggest that for each unit increase in mathematical disposition, there is a corresponding 15.288 unit increase in mathematical literacy. Similarly, each unit increase in autonomous learning results in a 14.645 unit increase in mathematical literacy. Furthermore, the coefficient of determination of analysis (denoted as R Square) of 0.557 indicates that mathematical disposition and autonomous learning together explain 55.7% of the variance in mathematical literacy among students. This substantial percentage underscores the critical roles that both factors play in enhancing students' mathematical understanding and skills. However, the remaining 44.3% variance suggests the presence of other influencing factors not covered in this study, providing a fertile ground for future research to identify additional variables that may impact mathematical literacy.

The findings align with previous research by Hutajulu et al. (2019), who emphasized that a positive mathematical disposition, characterized by confidence, interest in learning, and perseverance, significantly contributes to higher achievement in mathematics. This correlation suggests that students who view mathematics positively are more likely to engage in mathematical tasks, exhibit resilience in the face of challenges, and persist in problem-solving activities. Carraher et al. (2018) support this by highlighting that a strong mathematical disposition is crucial for students' willingness to participate in math-related activities and their capacity to learn and retain mathematical concepts. Students with a positive disposition are not only more engaged in math tasks but also more inclined to take risks and explore various problem-solving strategies, which enhances their overall mathematical literacy. Similarly, the positive influence of autonomous learning on mathematical literacy is corroborated by Haara (2018), who found that autonomous learners consistently exhibit higher levels of mathematical literacy. Autonomous learning fosters essential skills such as problem-solving, mathematical reasoning, and conceptual understanding. Students who engage in autonomous learning are more likely to develop a deeper understanding of mathematical concepts and demonstrate better problem-solving abilities. This aligns with the findings of El-Adl and Alkharusi (2020), who noted that students with higher levels of autonomous learning tend to exhibit greater mathematical literacy over time. Autonomous learners are better equipped to navigate mathematical challenges independently, seek out resources, and apply their knowledge in various contexts, leading to improved mathematical literacy.

In conclusion, the regression analysis confirms the significant positive effects of both mathematical disposition and autonomous learning on students' mathematical literacy. These findings highlight the importance of fostering positive attitudes towards mathematics and promoting autonomous learning behaviors among students. Educators and policymakers such as DepEd officials should consider these factors when designing curricula and instructional strategies to enhance students' mathematical literacy. By creating supportive learning environments that encourage positive mathematical dispositions and autonomous learning, educators can help students achieve higher levels of mathematical literacy and prepare them for future academic and professional success.

V. CONCLUSION AND RECOMMENDATION

The study revealed that a high level of mathematical disposition of students corresponds to a high level of mathematical literacy. Similarly, high level autonomous

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learning corresponds also to a high-level mathematical literacy of students. The mathematical literacy of students will be improved when the students have a positive mathematical disposition and evident autonomous learning

Moreover, recommendations arising from these insights include promoting student counseling for positive mindset development, fostering supportive classroom environments, enhancing teacher strategies through varied teaching methods and immediate feedback, advocating for professional development among educators and administrators, and urging future research to explore additional factors impacting mathematical literacy, particularly in light of the Philippines' current educational challenges in mathematics.

ACKNOWLEDGMENT

The researchers want to express their profound gratitude and appreciation to everyone who contributed and gave their valuable time to help them complete this study.

REFERENCES

[1] Bakar, M. A. A., & Ismail, N. (2019). Metacognitive learning strategies in mathematics classroom intervention: a review of implementation and operational design aspect. *International Electronic Journal of Mathematics Education*, *15*(1), em0555.

[2] Carraher, D. W., Schliemann, A. D., & Schwartz, J. L. (2018). Early algebra and mathematical disposition. In P. Liljedahl, C. Nicol, S. Oesterle, & D. Allan (Eds.), *Proceedings of the 41st Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (Vol. 1, pp. 17-36). Vancouver, Canada: PME-NA.

[3] Cruz, J.M., Wilson, A.T., & Wang, X. (2019). Connections between pre-service teachers' mathematical dispositions and self-efficacy for teaching mathematics. International Journal of Research in Education and Science (IJRES), 5(2), 400-420.

[4] El-Adl, A., & Alkharusi, H. (2020). Relationships between self-regulated learning strategies, learning motivation and mathematics achievement. Cypriot Journal of Educational Sciences, 15(1), 104-111.

[5] Fadillah, A., Nopitasari, D., & Pradja, B. P. (2020). Blended learning model during the covid-19 pandemic: analysis of student's' mathematical disposition. Jurnal Teori dan Aplikasi Matematika (JTAM), 4(2), 173-181.

[6] Fadillah, I., & Wahyudin, W. (2022). Mathematical problem solving ability viewed from students' mathematical disposition. Formatif: Jurnal Ilmiah Pendidikan MIPA, 12(1).

[7] Gabriel, F., Signolet, J., & Westwell, M. (2018). A machine learning approach to investigating the effects of mathematics dispositions on mathematical literacy. International Journal of Research & Method in Education, 41(3), 306-327.

[8] Genc, M., & Erbas, A. K. (2019). Secondary mathematics teachers' conceptions of mathematical literacy. *International Journal of Education in Mathematics, Science and Technology*, *7*(3), 222-237.

[9] Haara, F. O. (2018). Pedagogical entrepreneurship in school mathematics: an approach for students' development of mathematical literacy. International journal for mathematics teaching and learning, 19(2), 253-268.

[10] Hutajulu, M., Wijaya, T. T., & Hidayat, W. (2019). The effect of mathematical disposition and learning motivation on problem solving: an analysis. *Infinity Journal*, 8(2), 229-238.

[11] Hwang, J., & Ham, Y. (2021). Relationship between Mathematical Literacy and Opportunity to Learn with Different Types of Mathematical Tasks. *Journal on Mathematics Education*, *12*(2), 199-222.

[12] Kharis, S. A. A., Salsabila, E., & Haeruman, L. D. (2021, February). Effect of mathematical concept understanding and mathematical reasoning on mathematical literacy abilities. *In Journal of Physics: Conference Series* (*Vol. 1747*, No. 1, p. 012042). IOP Publishing.

[13] Lestari, S. D., Kartono, K., & Mulyono, M. (2019). Mathematical Literacy Ability and Mathematical Disposition on Team Assisted Individualization Learning with RME Approach and Recitation. *Unnes Journal of Mathematics Education Research*, 8(2), 157-164

[14] Leung, S. S., & Mak, P. S. (2019). The relationship between students' perceptions of mathematics and their mathematical performance: A meta-analysis. *International Journal of Science and Mathematics Education*, 17(7), 1273-1291.

[15] Leyva, E., Walkington, C., Perera, H., & Bernacki, M. (2022). Making mathematics relevant: An examination of student interest in mathematics, interest in STEM careers, and perceived relevance. International Journal of Research in Undergraduate Mathematics Education, 8(3), 612-641.

[16] Liu, S., & Liu, S. (2019). The effectiveness of using digital technology in autonomous learning: A meta-analysis. *Educational Technology Research and Development*, 67(6), 1539-1559.

[17] Liu, X., & Zhang, S. (2019). The impact of autonomous learning on mathematical literacy: An experimental study. International Journal of Mathematical Education in Science and Technology, 50(7), 973-983. doi: 10.1080/0020739X.2019.1569832

[18] Macaskill, A., & Taylor, E. (2010). The development of a brief measure of learning autonomy in university students. *Studies in Higher Education*, 35(3), 351– 359.

[19] Ministry of Education. (2017). Middle school mathematics (5th, 6th, 7th, & 8th grade) curriculum

[20] Mosenda, J. (2022). Top 10 science students in Form Six exams 2022. *The Citizen*. Retrieved from https://www.thecitizen.co.tz/tanzania/news/national/top-10-science-students-in-form-six-exams-2022-3869804

[21] OECD (2019). PISA 2018 Assessment and Analytical Framework.OECD. https://doi.org/10.1787/b25efab8-en

[22] Oktaviyanthi, R., & Agus, R. N. (2019). Eksplorasi kemampuan pemecahan masalah berdasarkan kategori proses literasi matematis. Jurnal Pendidikan Matematika, 13(2). https://doi.org/10.22342/jpm.13.2.7066.163-184

[23] Programme for International Student Assessment (PISA). (2018). Assessment and Analytical Framework. OECD Publishing, https://doi.org/10.1787/b25efab8-en

[24] Ramadhani, W. P., Nur, A. S., Marlissa, I., Kamariah, K., & Palobo, M., (2021). Mathematics education research in Indonesia: A scoping review. Beta: Jurnal Tadris Matematika, 14(2), 154-174.

[25] Rahmawati, W. A., Usodo, B., & Fitriana, L. (2021, November). Mathematical Literacy of Students Who Have High Mathematical Disposition in Solving PISA-Like Mathematics Problems. *In International Conference of Mathematics and Mathematics Education* (I-CMME 2021) (pp. 281-287). Atlantis Press.

[26] Roick, J., & Ringeisen, T. (2018). Students' math performance in higher education: Examining the role of self-regulated learning and self-efficacy. *Learning and individual differences*, 65, 148-158.

[27] Samusenkov, V., Klyushin, V., Prasolov, V., & Sokolovskiy, K. (2021). The Intelligent Platform of Autonomous Learning in Post-Secondary Education. *International Journal of Interactive Mobile Technologies*, *15*(10).

[28] Samuya, J. (2022). Mediating effect of learning engagement on the relationship between the students' school burnout and their academic achievement in mathematics [Master's Thesis]. Saint Mary's College of Tagum, Inc.

[29] TIMSS (2019). Trends in International Mathematics and Science Study. *International Association for the Evaluation of Educational Achievement* (IEA), 60-78. Retrieved from https://www.iea.nl/sites/default/files/2021-01/TIMSS%202019-International-Results-in-Mathematics-and-Science.pdf

[30] Wei, M., & Leung, F. K. S. (2020). Autonomous Learning and Mathematical Literacy: A Study of Chinese University Students. *Journal of Studies in International Education*, 24(2), 170–186. https://doi.org/10.1177/1028315319898689

[31] Varaidzai, P., & Makondo, D. (2020). Causes of poor academic performance in mathematics at ordinary level: A case of Mavuzani High School, Zimbabwe. *International Journal of Humanities and Social Science Invention (IJHSSI)*, 9(6), 10-18[1]

[32] Yaniawati, R. P., Indrawan, R., & Setiawan, G. (2019). Core Model on Improving Mathematical Communication and Connection, Analysis of Students' Mathematical Disposition. *International Journal of Instruction*, *12*(4), 639-654.

[33] Zhang, Y., Li, Y., & Zhang, Y. (2021). Teacher Support and Students' Autonomous Learning: The Mediating Role of Self-Regulation and Metacognition. *Educational Psychology*, 41(3), 386-402.