The Mediating Role of Grit and Academic Support on the Relationship between Higher-Order Thinking Skills in Mathematics and Numeracy Skills

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Abstract

Low numeracy skills among students remain a critical concern in mathematics education. This study examined the mediating roles of grit and academic support in the relationship between higher-order thinking skills in mathematics (HOTS) and numeracy skills among Grade 7 students. Anchored on the COM-B Model of Behavior, the study employed a quantitative correlational research design using parallel mediation analysis. A total of 229 respondents were selected from four schools under Cluster 11, Marilog District, Davao City, through proportionate stratified sampling. Data were gathered using four validated instruments measuring HOTS, grit, academic support, and numeracy skills, and were analyzed using descriptive statistics, Pearson correlation, and parallel mediation analysis through Jamovi software. Results revealed that HOTS, grit, and academic support were all at a Low level, while numeracy skills were at a Low Proficient level overall. All three predictor variables demonstrated significant, moderately low positive correlations with numeracy skills. Parallel mediation analysis revealed that academic support and grit significantly mediated the relationship between HOTS and numeracy skills. The direct and total effects of HOTS on numeracy skills both remained significant.

Keywords: numeracy skills, higher-order thinking skills, grit, academic support, parallel mediation, COM-B.

1.Introduction

Numeracy skills remain a global problem (Organisation for Economic Co-operation and Development, 2019). The 2023 OECD Survey of Adult Skills found that on average across OECD countries, 18% of adults do not even have the most basic levels of proficiency in literacy, numeracy, or adaptive problem solving (OECD, 2024). This crisis extends to younger learners as well: even before the pandemic, the World Bank and UNESCO reported that 70% of 10-year-olds in low- and middle-income countries were unable to understand a simple written text, a foundational skill closely tied to numeracy development (World Bank, UNESCO, & UNICEF, 2022).

In England, the National Numeracy Organization revealed that over half of working-age adults have numeracy levels below those expected of an eleven-year-old, limiting their employment and financial decision-making capacities (National Numeracy Organization, 2022). This concern has persisted into recent years, as 2023 PIAAC data showed that 52% of adults in England scored at or below OECD Level 2, the numeracy level expected of a primary school leaver (National Numeracy, 2024). Commentators have noted that this widespread innumeracy carries serious consequences, since around a quarter of UK adults struggle with the sort of simple multiplication required for budgeting (Haldane, 2025). Similarly, in Indonesia, Wijaya (2017) found that most secondary students exhibited

low mathematical numeracy and literacy in the 2015 PISA assessment, largely struggling with problem-solving tasks that required reasoning and interpretation beyond computation.

In the Philippines, the Department of Education's PISA 2018 National Report (DepEd, 2019) disclosed that fifteen-year-old Filipino students ranked lowest among 79 participating countries in mathematical literacy, with only one in five students achieving at least the minimum proficiency level. This poor performance persisted in the next assessment cycle, as the Philippines scored two points better in mathematics, moving from 353 in 2018 to 355 in 2022, while ranking sixth-lowest among 81 countries (Philstar, 2023). Education officials acknowledged the severity of the gap, noting that Filipino students appear to trail behind their global counterparts by an average of five to six years' worth of schooling according to DepEd's analysis of the OECD data (Rappler/Philstar, 2023). Specifically, only 16% of Filipino students achieved a proficiency level of at least Level 2 in mathematics, compared to the 69% OECD average (Rappler, 2024).

If students' numeracy skills continue to remain low, the consequences will be far-reaching, affecting individuals, societies, and national economies. At the individual level, poor numeracy restricts access to higher education and skilled employment (World Bank, 2022). Insufficient numeracy undermines workforce productivity and innovation, limiting countries' competitiveness in the global economy (UNESCO, 2020; World Economic Forum, 2023). Continuous underperformance in mathematics impedes students' learning progression in higher-order cognitive subjects (DepEd, 2019). Hence, addressing numeracy deficiencies is both an educational and socio-economic imperative, making research that investigates the underlying factors influencing numeracy achievement timely, urgent, and relevant.

This study is significant as it provides valuable insights for key stakeholders in education while contributing to the broader pursuit of Sustainable Development Goal 4 (Quality Education), which calls for inclusive and equitable education that ensures all learners acquire the knowledge and skills, including numeracy, needed to thrive (United Nations, 2015). For teachers, it offers guidance in designing strategies that enhance higher-order thinking skills while fostering grit and providing effective academic support, in line with HCDC's commitment to nurture a culture of excellence and holiness among educators and learners alike. For students, it highlights the importance of perseverance and support systems in improving numeracy skills, equipping them with foundational competencies that contribute to their integral, liberating formation as envisioned by the institution. Parents can better understand their role in encouraging consistent study habits and providing academic assistance at home, reinforcing the human and Christian learning environment that HCDC seeks to provide beyond the classroom. For schools, particularly institutions like Holy Cross of Davao College, the findings can inform the development of programs and policies that integrate cognitive and socio-emotional learning, supporting its mission to cultivate high-quality Catholic education for all, especially those who are less fortunate and may struggle academically. Lastly, the community may benefit through strengthened educational support systems that contribute to producing numerate and problem-solving individuals prepared for real-life challenges, ultimately helping form effective agents of social transformation who can build a more humane world, consistent with HCDC's vision and the global aspiration for accessible and quality education for all.

This study is anchored on the COM-B Model of Behavior, developed by Michie, van Stralen, and West (2011). The COM-B model represents the observation that at any given moment, a particular behavior will occur only when the person concerned has the capability and opportunity to engage in the behavior and is more motivated to enact that behavior than any other behavior.

In this study, numeracy skill is viewed as the behavior that emerges when learners possess the necessary higher-order thinking skills (capability), are provided with adequate academic support (opportunity), and possess the grit to engage in mathematical tasks (motivation). The COM-B model is therefore relevant in understanding the factors that influence students' numeracy skills and in framing strategies to improve their proficiency.

2. Methodology

2.1. Research Design

This study employed a predictive-explanatory research design, specifically the examination of mediation. A predictive-explanatory design is a quantitative research approach that seeks to identify and explain the relationships among variables, where one or more variables are used to predict and account for the variance in an outcome variable (Creswell & Creswell, 2018). It goes beyond mere description by aiming to explain why and how variables relate to one another, particularly through the identification of mechanisms such as mediating variables, that transmit the effect of an independent variable to a dependent variable (Baron & Kenny, 1986).

2.2. Research Locale and Respondents

The study was conducted in four secondary schools within Cluster 11, Davao City, which consists of 16 schools. The selection of the participating schools was based on geographical accessibility and student enrollment. Schools located in more remote areas and those with relatively smaller student populations were excluded from the study due to logistical constraints and the need to obtain an adequate number of respondents. Consequently, the selected schools served as the locale of the study, providing a practical and representative setting for data collection.

The total population of the study consisted of 537 Grade 7 students from four selected schools. Specifically, School A had 83 students, comprising 45 males and 38 females. School B had 141 students, with 78 males and 63 females. School C had 97 students, composed of 54 males and 43 females. Lastly, School D had the largest population with 216 students, consisting of 96 males and 120 females.

2.3. Research Instrument

The researcher utilized four adopted standardized questionnaires to gather data for the study entitled "The Mediating Role of Grit and Academic Support on the Relationship Between Higher-Order Thinking Skills in Mathematics and Numeracy Skills." These instruments measured the variables involved in the study: academic support, higher-order thinking skills in mathematics, numeracy skills, and grit. Each instrument was selected and adopted from validated sources to ensure appropriateness for grade 7. The instruments were subjected to expert validation and pilot testing to establish reliability and content validity. The following instruments were used: Higher-order thinking skills in mathematics (IV_1) - This scale was adopted from Zhou et al. (2024), which assessed students' mathematical reasoning beyond basic procedural knowledge. The MHOTS scale evaluates four major components: Mathematical Critical Thinking, Mathematical Creative Thinking, Problem-Solving Skills, and Metacognitive Skills. The instrument consists of 20 items, using a four-point Likert scale that ranges from 1 (Strongly Disagree) to 4 (Strongly Agree). Academic Support (Mediator 1) - The Academic Support Questionnaire (ASQ) was adopted from the study of Reyes et al. (2022), which measured perceived academic support from teachers, family, and peers. It is a self-report instrument designed to assess the degree of support that students perceive in their academic environment. The ASQ consists of 15 items distributed equally across three domains: Teacher Support, Family Support, and Peer Support. Each item is rated using a four-point Likert scale ranging from 1 (Strongly Disagree) to 4 (Strongly Agree). Grit (Mediator 2) – In assessing the students grit, the short grit scale (Grit–S) was used. The

Short Grit Scale, developed by Duckworth and Quinn (2009), was adopted to measure the level of grit among Grade 7 students. It assesses two dimensions: Perseverance of Effort and Consistency of Interest. The instrument consists of 8 items, each rated on a four-point Likert scale ranging from 1 (Strongly Disagree) to 4 (Strongly Agree). Numeracy Inventory Device (DV) - The numeracy inventory device was adopted from Herrero (2022), which aimed to measure learners' proficiency in fundamental numeracy competencies. The instrument comprises 50 multiple-choice items covering five domains: Whole Numbers, Signed Numbers, Fractions, Decimals, and Percentages. It was designed to assess students' ability to apply quantitative reasoning in mathematical contexts. The test was interpreted using the mean percentage score of each indicator using the interpretation table provided by the ERUNT.

2.4. Data Collection Procedure

The researcher sought approval from the Schools Division Office and the concerned school heads before administering the research instruments. Upon approval, informed consent forms were distributed to both students and their parents or guardians to ensure voluntary participation. After collecting the signed consent forms, the researcher scheduled the administration of the four adopted questionnaires, Mathematical Higher-Order Thinking Skills Scale, Academic Support Questionnaire, Short Grit Scale, and the Numeracy Skills Test, during regular class hours to avoid disrupting school activities. The purpose and instructions for each instrument were explained thoroughly, and the respondents were assured of the confidentiality and anonymity of their responses. The questionnaires were administered in paper-and-pencil format and collected immediately after completion to maintain the integrity of the data. All accomplished questionnaires were securely stored, checked for completeness, and encoded for statistical analysis.

2.5. Data Analysis

Mean and Standard Deviation were used to determine the level of higher-order thinking skills in mathematics, grit, academic support, and numeracy skills of Grade 7 students. Pearson's r — used to determine the strength and direction of the relationship between higher-order thinking skills, grit, and academic support with numeracy skills. Parallel Mediation Analysis (Jamovi software) — used to determine whether grit, and academic support significantly mediate the relationship between higher-order thinking skills and numeracy skills. Bootstrapping was applied to estimate both direct and indirect effects

2.6. Ethical Considerations

Respondents were fully informed about the study's objectives, methods, and their right to withdraw at any time without consequences, and informed consent was obtained before data collection. Their identities remained confidential, with anonymized data stored in secure systems accessible only to the research team, and the data will be permanently deleted from the researcher's system after the required retention period. The study was designed to prevent harm, ensuring that participants understood their rights and could withdraw freely without consequences. The research was conducted with transparency, integrity, and respect, safeguarding participants' privacy and valuing their contributions. Ethical approval was obtained from the SMILE Ethics Board, and the study was authorized by the Department of Education (DepEd). To maximize benefits, minimize risks, and uphold fairness in the research process, appropriate measures were implemented, ensuring transparent sharing of all findings. Any potential conflicts of interest were disclosed to maintain the integrity of the research.

3. Results and Discussion

3.1. Descriptive Analysis of the Study Variables

Table 1. Descriptive Statistics of the Study Variables (n = 229)

Variables	SD	Mean	Interpretation

Variables	SD	Mean	Interpretation
Higher-Order Thinking Skills	***0.90***	***2.44***	**Low**
Critical Thinking	0.81	2.43	Low
Creative Thinking	0.93	2.45	Low
Problem-Solving	0.96	2.43	Low
Meta-Cognitive Thinking	0.95	2.42	Low
Academic Support	***0.91***	***2.44***	**Low**
Teacher Support	0.95	2.42	Low
Peer Support	0.97	2.44	Low
Parent Support	0.91	2.44	Low
Grit	***0.71***	***2.44***	***Low***
Perseverance of Effort	0.63	2.44	Low
Consistency of Interest	0.93	2.43	Low
Numeracy Skills	***0.66***	***2.14***	***Low Proficient***
Whole Number	0.78	2.39	Low Proficient
Signed Numbers	0.92	2.23	Low Proficient
Fractions	0.75	2.67	Low Proficient
Decimals	0.68	1.77	Low Proficient
Percentages	0.77	2.16	Low Proficient

3.25-4.00 Very High, 2.50-3.24 High, 1.75-2.49 Low, 1.00-1.74 Very Low (Alico & Guimba, 2015)

Table 1 shows that higher-order thinking skills in mathematics obtained an overall mean of 2.44, SD = 0.90, described as Low; this indicates that the students possessed a low level of mathematical higher-order thinking skills. All four dimensions uniformly rated as Low: Critical Thinking M = 2.43, Creative Thinking M = 2.45, Problem-Solving M = 2.43, and Meta-Cognitive Thinking M = 2.42, with Creative Thinking yielding the highest mean and Meta-Cognitive Thinking recording the lowest. Grit likewise obtained an overall mean of 2.44, SD = 0.71, described as Low, indicating that students exhibited a low level of grit, with Perseverance of Effort having a mean of 2.44 and Consistency of Interest M = 2.43 both rated as Low. Academic support also obtained an overall mean of 2.44, SD = 0.91, described as Low, meaning that students received below-average support from parents, teachers, and peers, with Teacher Support M = 2.42, Peer Support M = 2.44, and Parent Support M = 2.44 all rated as Low and Teacher Support recording the lowest mean. Lastly, numeracy skills obtained an overall mean of 2.14, SD = 0.66, described as Low Proficient, indicating that the

students possessed a low level of numeracy skills, with all five sub-domains rated as Low Proficient: Whole Numbers M = 2.39, Signed Numbers M = 2.23, Fractions M = 2.67, Percentages M = 2.16, and Decimals M = 1.77, with Decimals recording the lowest mean.

Taken together, the descriptive results reveal a consistent pattern in which students' higher-order thinking skills, grit, and academic support are all at a Low level, while their numeracy skills are at a Low Proficient level across all five sub-domains. This suggests that significant cognitive, motivational, and environmental gaps persist and may collectively constrain students' ability to consistently apply and deepen their mathematical proficiency in Cluster 11.

3.2. Relationship Between the Study Variables and Numeracy Skills.

Table 2. Correlation Analysis of the Study Variables (n = 229)

	Numeracy Skills			
	r	**p**	**Decision on Ho**	**Interpretation**
Higher-Order Thinking Skills	0.445	0.000	Reject Ho1	Significant moderately low positive correlation.
Academic Support	0.416	0.000	Reject Ho2	Significant moderately low positive correlation.
Grit	0.367	0.000	Reject Ho3	Significant moderately low positive correlation.

Level of Significance: 0.05
Decision Rule: Reject H_o if $p < 0.05$

Table 2 shows that all three predictor variables were significantly correlated with numeracy skills. The correlation between higher-order thinking skills and numeracy skills obtained an r-value of 0.445 and a p-value of 0.000, which is lower than the 0.05 level of significance; hence, the Ho_1 hypothesis was rejected, indicating a significant moderately low positive correlation between the two variables. Similarly, the correlation between academic support and numeracy skills produced an r-value of 0.416 and a p-value of 0.000, which is lower than the 0.05 level of significance therefore, the null hypothesis was rejected, confirming a significant moderately low positive correlation. Likewise, the correlation between grit and numeracy skills yielded an r-value of 0.367 and a p-value of 0.000, which is below the 0.05 level of significance; consequently, the null hypothesis was rejected, confirming a statistically significant moderately low positive correlation.
Overall, all three predictor variables demonstrated significant positive relationships with numeracy skills. Among the three, higher-order thinking skills yielded the strongest correlation r = 0.445, followed by academic support r = 0.416 and grit r = 0.367, indicating that cognitive, motivational, and environmental factors each contribute meaningfully to students' numeracy skills.

3.3. Mediation analysis.

Table 3. Parallel Mediation Analysis (n = 229)

Type	Effect	Estimate	SE	β	Z	p	Decision on Ho	Interpretation
Total	HOTS ⇒ NS	0.326	0.044	0.445	7.50	0.000	Reject Ho4	Significant
	HOTS ⇒ AS ⇒ NS	0.078	0.027	0.107	2.88	0.004	Reject Ho5	Significant
Indirect	HOTS ⇒ GRIT ⇒ NS	0.047	0.024	0.064	1.97	0.049	Reject Ho6	Significant
Direct	HOTS ⇒ NS	0.201	0.051	0.274	3.99	0.000	Reject Ho7	Significant

The total effect of HOTS on numeracy skills yielded a Beta of 0.445 with a p-value of 0.000, which is lower than the 0.05 level of significance. Hence, the null hypothesis was rejected, confirming that the total influence of higher-order thinking skills on numeracy skills, inclusive of both direct and indirect pathways, is statistically significant and positive. In summary, the parallel mediation analysis reveals that both grit and academic support serve as significant mediators in the relationship between higher-order thinking skills and numeracy skills, while the direct effect of HOTS on numeracy skills also remains independently significant, confirming partial mediation through both mediators.The indirect effect of HOTS on numeracy skills through academic support (HOTS to AS to NS) obtained an estimated Beta of 0.107 with a p-value of 0.004, which is lower than the 0.05 level of significance. Hence, the null hypothesis was rejected, indicating that academic support significantly mediates the relationship between HOTS and numeracy skills. The component paths further confirm this: HOTS significantly predicts academic support Beta = 0.504, p = 0.000 and academic support significantly predicts numeracy skills Beta = 0.212, p = 0.002, establishing a coherent and statistically supported mediated pathway.The indirect effect of HOTS on numeracy skills through grit (HOTS to GRIT to NS) yielded an estimated Beta of 0.064 with a p-value of 0.049. Since the p-value is less than or equal to the 0.05 level of significance, the null hypothesis was rejected, indicating that this indirect effect is statistically significant. The component paths support this finding: HOTS significantly predicts grit Beta = 0.465, p = 0.000 and grit significantly predicts numeracy skills Beta = 0.138, p = 0.042, establishing that grit significantly mediates the relationship between higher-order thinking skills and numeracy skills.The direct effect of HOTS on numeracy skills, controlling for both mediators, yielded a Beta of 0.274 with a p-value of 0.000. Since the p-value is less than the 0.05 level of significance, the null hypothesis was rejected, indicating that HOTS has a significant direct effect on numeracy skills even after accounting for the mediating roles of grit and academic support.

Conclusion

The study concludes that higher-order thinking skills, grit, and academic support each significantly correlate with the numeracy skills of Grade 7 students, with higher-order thinking skills yielding the strongest

association. Both grit and academic support significantly mediate the relationship between higher-order thinking skills and numeracy skills, and the direct effect of higher-order thinking skills on numeracy skills remained significant after controlling for both mediators, confirming partial mediation.

These findings support the COM-B Model of Behavior, which posits that numeracy performance emerges from the interaction of capability (HOTS), opportunity (academic support), and motivation (grit). The significant mediation through both grit and academic support confirms that motivational and environmental factors serve as meaningful transmission mechanisms linking higher-order thinking to numeracy outcomes. The model is partially validated, with both mediators contributing to the HOTS and numeracy relationship among Grade 7 students in the far-flung schools of Cluster 11, Marilog District, Davao City.

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References

Appendix A. Çömez, C. B., & Benzer, E. (2025). Scientific stories in the assessment of higher order thinking skills. Cogent Education, 12(1), Article 2460226. https://doi.org/10.1080/2331186X.2025.2460226

Appendix B. Credé, M., Tynan, M. C., & Harms, P. D. (2017). Much ado about grit: A meta-analytic synthesis of the grit literature. Journal of Personality and Social Psychology, 113(3), 492–511. https://doi.org/10.1037/pspp0000102

Appendix C. Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approach (4th ed.). SAGE Publications.

Appendix D. Datu, J. A. D., Buenconsejo, J. U., Shek, C. Y. C., Choy, Y. L. E., & Sou, K. L. E. (2023). Grit, academic engagement in math and science, and well-being outcomes in children during the COVID-19 pandemic: A study in Hong Kong and Macau. School Psychology International, 44(4), 489–512. https://doi.org/10.1177/01430343221147273

Appendix E. Datu, J. A. D., & Fincham, F. D. (2022). The relational and mental health payoffs of staying gritty during the COVID-19 pandemic: A cross-cultural study in the Philippines and the United States. Journal of Social and Personal Relationships, 39(3), 459–480.

Appendix F. Datu, J. A. D., Yang, L., & Mateo, N. J. (2021). Are gritty students academically engaged in math and science? School Psychology, 36(3), 190–195. https://doi.org/10.1037/spq0000433

Appendix G. Department of Education. (2019). PISA 2018 Philippine national report. https://www.deped.gov.ph/wp-content/uploads/2019/12/PISA-2018-Philippine-National-Report.pdf

Appendix H. Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the Short Grit Scale (Grit–S). Journal of Personality Assessment, 91(2), 166–174. https://doi.org/10.1080/00223890802634290

Appendix I. Fostering higher-order thinking skills in mathematics education: Strategies, challenges, and classroom practices. (2025). ResearchGate. https://www.researchgate.net/publication/390692456

Appendix J. Frontiers in Psychology. (2025). The relationship between perceived peer support and academic adjustment among higher vocational college students: The chain mediating effects of academic hope and professional identity. Frontiers in Psychology, 16. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2025.1534883/full

Appendix K. Gradini, E., et al. (2025). Fostering higher-order thinking skills in mathematics education: Strategies, challenges, and classroom practices. Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA, 13(2).

Appendix L. Haldane, A. (2025, May 21). The UK is a financial world leader, so why are our numeracy levels so poor? CityAM. https://www.cityam.com/the-uk-is-a-financial-world-leader-so-why-are-our-numeracy-levels-so-poor/

Appendix M. Herrero, R. A. (2022). Numeracy Inventory Device (NID): Basis for crafting Strategic Intervention Materials (SIM) in mathematics. International Journal of Research Publications, 101(1), 208–225. https://doi.org/10.47119/IJRP1001011520223149

Appendix N. Hoferichter, F., Kulakow, S., & Hufenbach, M. C. (2021). Support from parents, peers, and teachers is differently associated with middle school students' well-being. Frontiers in Psychology, 12, Article 758226. https://doi.org/10.3389/fpsyg.2021.758226

Appendix O. Kaya, S., & Karakoc, D. (2022). Math mindsets and academic grit: How are they related to primary math achievement? European Journal of Science and Mathematics Education, 10(3), 298–309. https://doi.org/10.30935/scimath/11881

Appendix P. Lin, S., Ivcevic, Z., Kashdan, T. B., & Kaufman, J. C. (2024). [Title on grit, perseverance, and creative achievement]. Retrieved from https://scottbarrykaufman.com/wp-content/uploads/2024/01/Lin-Ivcevic-Kashdan-Kaufman-2024.pdf

Appendix Q. Lin, W., Liu, J., Xiang, S., Cai, J., Xu, J., & Lian, R. (2024). The relationship between a positive parenting style and Chinese adolescents' academic grit: A parallel mediating model. Current Psychology, 43(1), 272–280. https://doi.org/10.1007/s12144-023-04249-1

Appendix R. Magbanua, R., Magbanua, J., Calumag, H., Del Rosario, S. M., Del Rosario, R., & Manejero, C. M. (2023). Project Pagbasa Kag Pagsuma (3Ps): Bridging the learning gaps of Grade 7 students in numeracy levels. Philippine eJournals. https://ejournals.ph/article.php?id=22137

Appendix S. Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implementation Science, 6, Article 42. https://doi.org/10.1186/1748-5908-6-42

Appendix T. National Numeracy Organization. (2022). The number confidence charity. https://www.nationalnumeracy.org.uk/

Appendix U. National Numeracy. (2022). New survey shows Brits are not as good at maths as they think. https://www.nationalnumeracy.org.uk/news/new-survey-uk-numeracy

Appendix V. National Numeracy. (2024). New OECD data shows a positive shift in numeracy levels in England. https://www.nationalnumeracy.org.uk/news/new-oecd-data

Appendix W. OECD. (2023). PISA 2022 results (Volume I): The state of learning and equity in education. OECD Publishing. https://doi.org/10.1787/53f23881-en

Appendix X. OECD. (2024). Do adults have the skills they need to thrive in a changing world? The Survey of Adult Skills 2023. OECD Publishing.

Appendix Y. Organisation for Economic Co-operation and Development. (2019). PISA 2018 results (Volume I): What students know and can do. OECD Publishing. https://doi.org/10.1787/5f07c754-en

Appendix Z. Organisation for Economic Co-operation and Development. (2024). Do adults have the skills they need to thrive in a changing world? The 2023 survey of adult skills. OECD Publishing. https://www.oecd.org/en/publications/2024/12/do-adults-have-the-skills-they-need-to-thrive-in-a-changing-world_4396f1f1.html

Appendix AA. Park, H. S., Kang, S., & Kim, S. (2023). Support from parents, peers, and teachers is differently associated with middle school students' well-being. Frontiers in Psychology, 14, Article 1068554. https://doi.org/10.3389/fpsyg.2023.1068554

Appendix AB. Philstar.com. (2023, December 9). Philippines still lags behind world in math, reading and science — PISA 2022. https://www.philstar.com/headlines/2023/12/06/2316732/philippines-still-lags-behind-world-math-reading-and-science-pisa-2022

Appendix AC. Pitogo, S. D., & Oco, R. M. (2023). Pupils' numeracy skills and mathematics performance. International Journal of Multidisciplinary Research and Publications, 6(2), 333–340.

Appendix AD. Rappler. (2024, February 9). PH still among lowest in math, science, reading in global student assessment. https://www.rappler.com/philippines/for-second-time-ph-ranks-among-lowest-pisa-2022/

Appendix AE. Reyes, B., Martínez-Gregorio, S., Galiana, L., & De los Santos, S. (2022). Validation of Perceived Academic Support Questionnaire (PASQ): A study using a sample of Dominican Republic high-school students. Journal of Child and Family Studies, 31, 3425–3434. https://doi.org/10.1007/s10826-022-02473-0

Appendix AF. Second Congressional Commission on Education (EDCOM 2). (2026, February 11). Student proficiency rates plunge from 30% in Grade 3 to 0.47% in Grade 12. https://edcom2.gov.ph/student-proficiency-rates-plunge-from-30-in-grade-3-to-0-47-in-grade-12/

Appendix AG. Segal, H., & Kalfon-Hakhmigari, M. (2025). Grit as a moderator of the association between cognitive abilities and STEM achievements in high school. International Journal of STEM Education, 12, Article 25. https://doi.org/10.1186/s40594-025-00536-4

Appendix AH. Sepriyanti, N. (2022). The effect of 21st-century learning on higher-order thinking skills (HOTS) and numerical literacy of science students in Indonesia based on gender. Jurnal Pendidikan IPA Indonesia, 12(2).

Appendix AI. Tanujaya, B., Mumu, J., & Margono, G. (2017). The relationship between higher order thinking skills and academic performance of student in mathematics instruction. International Education Studies, 10(11), 78–85. https://doi.org/10.5539/ies.v10n11p78

Appendix AJ. Temel, N., Temel, S., & Çevik Kansu, C. (2023). Examination of the relationship between academic grit and their academic success of fourth grade students in primary school. International Online Journal of Primary Education, 12(1), 42–60. https://doi.org/10.55020/iojpe.1097470

Appendix AK. Turney, S. (2024). Pearson correlation coefficient (r) | Guide & examples. Scribbr. https://www.scribbr.com/statistics/pearson-correlation-coefficient/

Appendix AL. UNESCO. (2020). Global education monitoring report 2020: Inclusion and education – All means all. UNESCO Publishing. https://doi.org/10.54676/JLPQ4128

Appendix AM. United Nations. (2015). Transforming our world: The 2030 Agenda for Sustainable Development. United Nations.

Appendix AN. Wijaya, A. (2017). The relationships between Indonesian fourth graders' difficulties in fractions and the opportunity to learn fractions: A snapshot of TIMSS results. International Journal of Instruction, 10(4), 221–236. https://doi.org/10.12973/iji.2017.

Appendix AO. Wijaya, T. T., Rahmadi, I. F., Chotimah, S., Jailani, J., & Wutsqa, D. U. (2022). A case study of factors that affect secondary school mathematics achievement: Teacher-parent support, stress levels, and students' well-being. International Journal of Environmental Research and Public Health, 19(23), Article 16247. https://doi.org/10.3390/ijerph192316247

Appendix AP. World Bank. (2022). The state of global learning poverty: 2022 update. World Bank Group. https://www.worldbank.org/en/topic/education/publication/state-of-global-learning-poverty

Appendix AQ. World Bank, UNESCO, & UNICEF. (2022). The state of the global education crisis: A path to recovery. World Bank, UNESCO, and UNICEF.

Appendix AR. World Economic Forum. (2023). The future of jobs report 2023. World Economic Forum. https://www.weforum.org/reports/the-future-of-jobs-report-2023/

Appendix AS. Yu, Y., Hua, L., Feng, X., Wang, Y., Yu, Z., Zi, T., Zhao, Y., & Li, J. (2021). True grit in learning math: The math anxiety-achievement link is mediated by math-specific grit. Frontiers in Psychology, 12, Article 645793. https://doi.org/10.3389/fpsyg.2021.645793

Appendix AT. Zhang, K., & He, W.-J. (2025). Teachers' growth mindset, perceived school climate, and perceived parental autonomy support moderate the relationship between students' growth mindset and academic achievement. Journal of Intelligence, 13(1), Article 8. https://doi.org/10.3390/jintelligence13010008

Appendix AU. Zhou, X., Ning, B., Chen, W., Zhang, L., & Wijaya, T. T. (2024). Development and validation of a Mathematical Higher-Order Thinking Scale for high school students. Psychology in the Schools, 61(9), 3160–3192. https://doi.org/10.1002/pits.23213

Appendix AV. Zhou, Y., Ning, Y., Gan, L., Wijaya, T. T., et al. (2024). Development and validation of Mathematical Higher-Order Thinking Scale for high school students. Psychology in the Schools, 61, 3160–3192. https://doi.org/10.1002/pits.23213