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Relationships of mathematical proficiency with learning agility in high school students

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ABSTRACT

This research aimed to investigate the relationship between mathematical proficiency and learning agility among high school students in Southern Thailand. The research focused on grade 10 students from two secondary schools in Surat Thani Province during the academic years 2021-2023, with a total sample of 363 students selected through purposive sampling. Mathematical proficiency was assessed through students' academic performance in mathematics, while learning agility was measured using Hallenbeck's (2016) framework, comprising four dimensions: seeking, sensemaking, internalizing, and applying using mathematics test. For data analysis, the research employed quantitative methods, including mean, standard deviation, independent samples t-test, and Pearson's correlation coefficient. The study revealed that students generally demonstrated high levels of learning agility. No significant differences in learning agility were found between the two schools. However, students' learning agility varied significantly based on their academic achievement ($p < 0.05$). Furthermore, a moderate, statistically significant positive correlation ($r = 0.422$; $p = 0.002$) was found between learning agility of applying dimensions and mathematical proficiency. These findings suggest that students with higher mathematical proficiency tend to exhibit stronger learning agility, enabling them to understand and apply mathematical concepts more effectively.

Keywords: mathematical proficiency, learning agility, assessment, correlation analysis

INTRODUCTION

In the 21st century, we are living in what is known as a "knowledge society." New knowledge emerges every day, and technology and innovations continuously flow into our lives. Machines and robots are increasingly being utilized to perform tasks traditionally done by humans. This era demands significant adaptation from humans to develop skills and abilities that surpass and differentiate them from robots. Therefore, we need to possess various skills that machines or robots cannot replicate, such as expertise in complex tasks, adaptability, and the ability to tackle challenging work with determination to succeed. Additionally, we face numerous issues in the economic, social, and political spheres. These changes are often unpredictable and sometimes occur rapidly.

Companies and businesses must manage and advance to keep pace with societal changes and developments to create products or knowledge that align with these shifts. This enables them to compete with the growing number of other businesses. The primary concern for these organizations is the quality of their workforce. They need to select individuals who can perform well under pressure, adapt to changes, solve problems effectively, and drive the company towards success. Therefore, businesses strive to adjust their operations to achieve success. Today's youth are expected to become valuable members of the workforce, requiring critical thinking skills, skepticism, the ability to gather information from various sources for decision-making, and creativity to improve existing solutions. They must work well in teams, listen to others, embrace diversity and cultural differences, accept change, and continually learn new things. These attributes are essential as they are often criteria for employee selection in large companies. However, a common issue with new employees today is their lack of persistence, frequent job changes, and low tolerance for difficulty, which creates challenges for companies that must constantly train new staff. According to Deloitte's (2022) Gen Z and Millennial Survey, which included over 14,000 gen Z and more than 7,400 millennials from 46 countries, revealed similar trends. About 40% of gen Z leave their jobs within two years, and approximately 24% of millennials do the same. One-third of these individuals resign without having another job lined up. In Thailand, over 500,000 individuals enter the workforce annually. According to the National Statistical Office's labor force survey in 2019, the unemployment rate increased from 0.98% in the first

quarter to 1.04% by the third quarter, and many people remain unemployed. With a labor force of around 38 million people, it is crucial for every young person to prepare themselves for the workforce and adapt to changes.

Soft skills are crucial and indispensable in today's world. Adaptability, perseverance, effort, negotiation, self-directed learning, analytical thinking, and creativity are essential qualities everyone should possess. Among these, one skill that is equally important and highly sought after by companies is learning agility. McKinsey (2020) emphasizes the critical role of learning agility in their report reskilling and retraining: The new reality for global workers. The report highlights the need for both organizations and employees to continuously develop new learning skills to effectively adapt to the evolving labor market. Hallenbeck (2016) states that learning agility is vital for future leaders as it enables them to quickly adapt and learn from new experiences. World Economic Forum (2016) emphasizes that this skill is essential for the future workforce, particularly in an era of rapid technological and innovative changes. Deloitte (2017) considers it a critical skill that helps employees learn new skills and adapt to changes in the job market. Similarly, Institute for the Future (2011) notes that learning agility is one of the key skills that help workers adapt and acquire new skills in a rapidly changing technological landscape.

Research on learning agility has been ongoing for over a decade, initially sparked by a software company's efforts to address workplace challenges and streamline production processes for faster output. They concluded that the key to an organization's development and efficiency lies in the concept of "agile." While some companies refer to this as adaptability, the English term encompasses agility, swiftness, and nimbleness, which are crucial attributes for all employees. Many experts have defined learning agility. Lombardo and Eichinger (2000) describes it as the ability to learn from experiences and apply that knowledge to new situations. Hoff and Burke (2017) define it as the capacity to use past lessons to solve future problems and perform tasks. Burke (2014) views it as adapting and learning from work experiences. Maric (2015) states that it is the ability to learn and adapt quickly in new situations. McCall (2010) explains it as the ability to explore and understand new scenarios and adapt to changes. In summary, learning agility refers to the ability to learn from experiences and apply that knowledge to new situations quickly and effectively. It includes being open to learning from mistakes, listening to others' feedback, and adapting to challenging and uncertain situations.

Several researchers have explored mathematical proficiency as a factor that may foster student success in mathematics education. Jasim and Faris (2018) investigated the level of mathematical competency among students in faculties of education. The results demonstrated that these students possessed a high level of mathematical proficiency. Similarly, Jade and Oco (2023), examined students' levels of mathematical proficiency, focusing on their abilities for reasoning, communication, problem-solving, and overall performance. The findings revealed that students' mathematical reasoning skills were at a high level, but their problem-solving and general competency skills were at a moderate level. Further, a significant relationship was found between mathematical performance and mathematical skills. Moreover, Saputro et al. (2021) have examined elementary school students' mathematical skills, revealing that primary school students possess strong mathematical abilities. This significant association supports the findings of previous studies. Mathematical proficiency is essential for applying mathematics in real-world contexts, and it is considered a vital skill in the 21st century. Effective problem solvers must be capable of reasoning, analyzing, and making decisions on mathematical issues in practical situations. DeMeuse (2017) noted that learning agility involves the ability and willingness to continuously learn from experiences and adapt to various learning situations. However, recent research on diploma students (Zainudin & Kutty, 2025) indicates that their level of learning agility is relatively low. Eichinger and Lombardo (2004) identified learning agility as a useful predictor of potential and key performance indicators. Therefore, this study specifically explores how students' learning agility is related to their mathematical proficiency.

Numerous studies have explored the relationship between learning agility and various other competencies, including leadership and workplace adaptability. DeRue and Wellman (2009) found a connection between learning agility and the challenges of self-development and openness to feedback. Dries et al. (2012) discovered that learning agility plays a significant role in enabling individuals to perform diverse tasks and have highpotentials within organizations. Mitchinson and Morris (2012) identified a link between learning agility and the ability to adapt and develop in rapidly changing environments. Additionally, Smith and Campbell (2011) found that learning agility is a critical factor in identifying and developing future leaders. In Thailand, research on learning agility primarily focuses on the business sector. For example, Chaiyaphan and Boonchai (2022) studied the relationship between learning agility and employee performance, using a sample of 300 employees from various companies in Thailand. Their findings indicated that learning agility is a key factor in employee performance. Supawongse and Namsuwan (2023) conducted a study with a sample of 150 leaders from multiple organizations, revealing a strong positive correlation between learning agility and leadership. Current research studies in Thailand have not yet examined the relationship between mathematical proficiency and learning agility. This area of study holds significant potential, as it could provide valuable insights for educators and academic personnel in developing young individuals into efficient future workers.

MATERIALS AND METHOD

In this study, the learning agility assessment consisted of 20 items, classified into four dimensions of agile learner indicators including seeking opportunities for development (looking for difficult circumstances), sensemaking (being eager and curious to learn new ideas), internalizing (accepting criticism and comments) and applying (quickly responding to shifts and inefficient methods), mentioned by Hallenbeck (2016) and Byrum et al. (2021). Data for this research were gathered through a survey that rated learning agility on a scale of 7. Mathematical proficiency was identified with the learning and achievement of mathematics courses based on their academic performance. A grade point average is a score (scale of 4) used to verify that a student has reflected on academic performance or met a set of standards.

Table 1. Descriptive statistics and comparisons of mean by school

Learning agility		n	Mean	Standard deviation	t	p
Seeking	Overall	363	5.3289	1.13309		
	School I	204	5.2647	0.92886	-1.171	0.243
	School II	159	5.4113	1.34940		
Sensemaking	Overall	363	5.5620	1.07528		
	School I	204	5.5725	0.85433	0.201	0.841
	School II	159	5.5484	1.30805		
Internalizing	Overall	363	5.4606	1.11933		
	School I	204	5.4480	0.92680	-0.232	0.817
	School II	159	5.4767	1.32909		
Applying	Overall	363	5.3950	1.17651		
	School I	204	5.3480	0.99032	-0.828	0.408
	School II	159	5.4553	1.38013		

Table 2. Comparisons of learning agility by level

Learning agility	Level	Mean	Standard deviation	t	p
Seeking	Low (n = 53)	4.811	1.142	-2.965*	0.004
	High (n = 310)	5.417	1.053		
Sensemaking	Low (n = 53)	5.000	1.373	-3.345*	0.001
	High (n = 310)	5.658	0.987		
Internalizing	Low (n = 53)	4.860	1.408	-3.477*	0.001
	High (n = 310)	5.563	1.030		
Applying	Low (n = 53)	4.932	1.466	-2.570*	0.013
	High (n = 310)	5.474	1.103		

Note. *$p < 0.05$

The target group consisted of grade 10 students in high school from Surat Thani Province during the academic years 2021-2023. A total of 363 respondents were students who lived in Surat Thani Province from school I (n = 204) and school II (n = 159). The sampling technique for selecting students was purposive sampling. Statistical analysis used in this research included mean, standard deviation and independent samples t-test. t-tests were used to compare the mean learning agility scores of the different schools, levels. Pearson's correlation coefficient of the participants' learning agility scores and mathematical proficiency were employed to test the relationships between these variables.

Research Design

This research utilized a survey methodology with high school students as participants. Data were collected through standardized assessment instruments. The data were subsequently analyzed using statistical methods to identify key findings and examine the relationship between mathematical abilities and learning agility.

RESULTS

The study involved three hundred and sixty-three participants from two schools (school I and school II). The mean and standard deviation of learning agility were analyzed and displayed in **Table 1**. Independent group t-test results to determine whether students' learning agility differs significantly by school are given in **Table 1**.

As shown in **Table 1**, the overall learning agility scores ranged from 5.3289 to 5.5620, indicating the students' learning agility was high. It was found that the agile learner characteristics were revealed as follows: the mean score of sensemaking was 5.5620, internalizing (mean = 5.3289), applying (mean = 5.3950) and seeking (mean = 5.3289). As can be seen, students in the two schools had similar learning agility scores. The comparison of the mean scores of learning agility and school groups provided insignificant results at 0.05 significance level ($p > 0.05$).

Since the comparisons of means between school I and school II were not different, another comparison of learning agility between students with academic achievement in mathematics was conducted. The classification of the students was made to assign them to two levels by using the grade point average. Students whose GPAs were between 3.00-4.00 were considered to have a high level of learning achievement. The result of the comparison of the students' learning agility by level is reported in **Table 2** and **Figure 1**.

The majority of grade 10 students who excelled academically in mathematics demonstrated high learning agility, scoring higher than 5.000 (**Figure 1**). The results of the analysis revealed that the high achievement needed to develop the sensemaking dimensions (mean = 5.658) in order to increase their learning agility. Moreover, the independent samples t-test to determine whether there are significant differences in students' learning agility by level (**Table 2**). A statistically significant difference ($p < 0.05$) was found in the learning agility of all indicators at different levels. Based on the findings, notable distinctions were found between academic achievement at high and low levels.

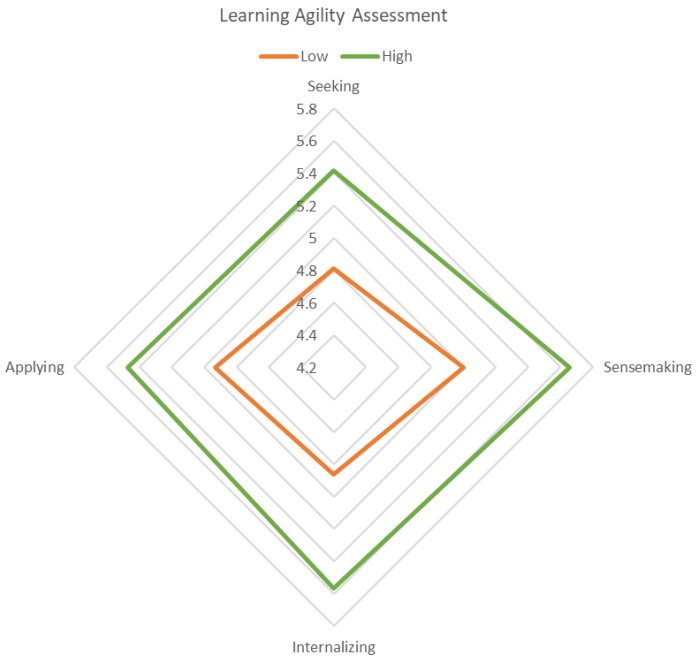


Figure 1. Radar chart of the learning agility by level (Source: Authors' own elaboration)

Table 3. Correlation coefficients (p-value) between the variables (low level)

	Proficiency	Seeking	Sensemaking	Internalizing	Applying
Proficiency	1.000	0.377**	0.340*	0.388**	0.422**
		(0.005)	(0.013)	(0.004)	(0.002)
Seeking		1.000	0.925**	0.933**	0.893**
			(0.000)	(0.000)	(0.000)
Sensemaking			1.000	0.951**	0.855**
				(0.000)	(0.000)
Internalizing				1.000	0.911**
					(0.000)
Applying					1.000

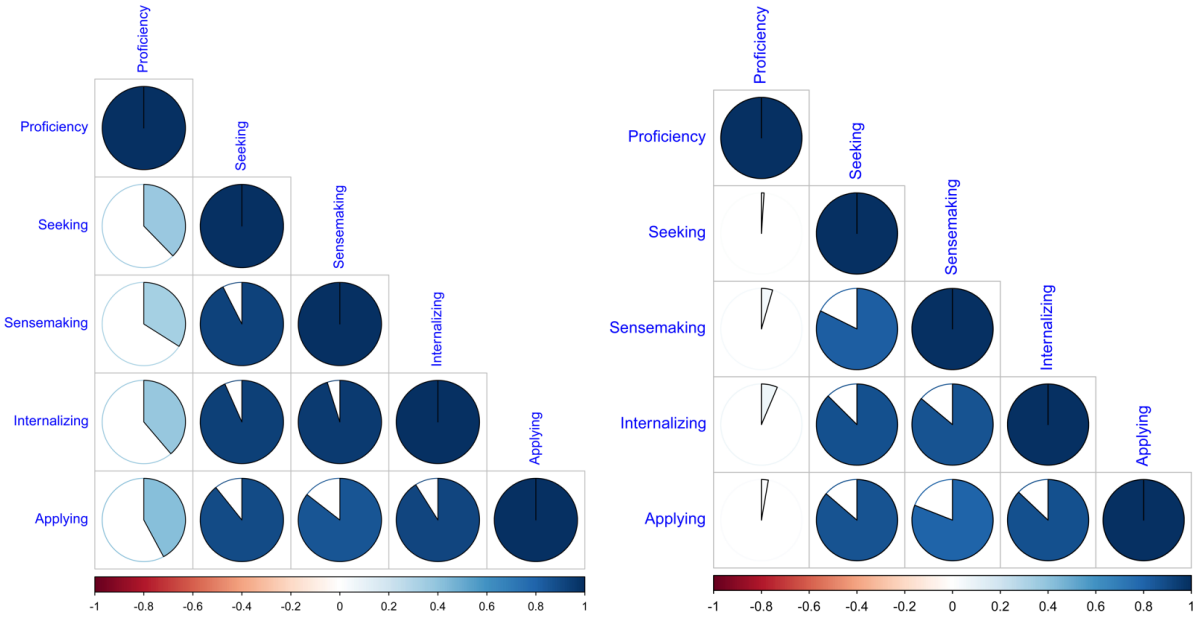
Note. *Correlation is significant at the 0.05 & **Correlation is significant at the 0.01

A correlation analysis was carried out to investigate the associations between proficiency in mathematics and learning agility for both high and low levels, since it is vital to realize that a high learning agility score corresponds to an excellent level of proficiency in mathematics

The correlation coefficients between underlying indicators of learning agility and mathematical proficiency were displayed in **Table 3** and **Figure 2**. According to the results, significant correlation coefficients varied from 0.340 to 0.951 (low-level) while they ranged from 0.011 to 0.874 (high level). As a results in high level, the four learning agility dimensions were not significantly correlated with proficiency in mathematics. For low level, there was a moderately positive correlation and significant relationship ($r = 0.422$; $p = 0.002$) between the learning agility of applying dimensions and proficiency in mathematics at the statistically significant level of 0.05. Moreover, the other indicators consisting of internalizing dimensions ($r = 0.388$; $p = 0.004$), seeking dimensions ($r = 0.377$; $p = 0.005$), sensemaking dimensions ($r = 0.340$; $p = 0.013$) were found to be correlated with proficiency in mathematics. In addition, there is a positive correlation between proficiency in mathematics and learning agility; indicating learners with high learning agility often have the ability to adapt new concepts and use what they have learned to improve their mathematics skills. Higher learning agility is exhibited by students who are successful in mathematics. Mathematical proficiency can facilitate learning in other areas, and high learning agility accelerates the process of understanding mathematical concepts.

DISCUSSION AND CONCLUSION

According to the study, there was a moderately positive and statistically significant relationship between learning agility and mathematical proficiency. Students who demonstrate high levels of mathematical proficiency tend to exhibit a correspondingly high degree of learning agility. These findings are consistent with prior research highlighting the relationship between learning agility and a range of cognitive skills. Previous studies have particularly examined its connection to leadership effectiveness and adaptability in professional. Similarly, the findings revealed a significant relationship between mathematical proficiency and learning agility, supporting the results of previous studies (Jade & Oco, 2023; Saputro et al., 2021). DeRue and Wellman (2009) found that learning agility is linked to self-development challenges and openness to feedback. Dries et al. (2012) noted that learning agility plays a vital role in handling diverse job roles and being recognized as high-potential within organizations.



(a) low level (b) high level

Figure 2. Correlogram of learning agility and mathematical proficiency (Source: Authors' own elaboration)

Mitchinson and Morris (2012) showed that learning agility is closely tied to the ability to adapt and grow in rapidly changing environments. Smith and Campbell (2012) also highlighted that learning agility is key to identifying and nurturing future leaders. Chaiyaphan and Boonchai (2022) found that learning agility significantly influences employee competencies. Likewise, Supawongse and Namsuwan (2023) finding a strong positive relationship between learning agility and leadership effectiveness.

Uncovering the link between mathematical abilities and learning agility offers numerous advantages:

1. **Improved educational approaches:** Understanding this connection enables educators to create more effective teaching strategies that simultaneously develop mathematical skills and learning agility, leading to better student outcomes.
2. **Targeted support programs:** Schools can implement interventions for students struggling in either area, providing customized assistance that addresses both mathematical challenges and agility in learning.
3. **Curriculum development insights:** These findings can guide curriculum designers in developing programs that blend mathematical problem-solving with activities aimed at enhancing learning agility, resulting in a more well-rounded education.
4. **Personalized learning:** By leveraging insights from this relationship, educators can tailor learning experiences to help students strengthen their abilities in one domain to improve the other.
5. **Career preparation:** Cultivating both mathematical proficiency and learning agility is essential for equipping students with the analytical and adaptive skills needed for future careers.
6. **Opportunities for further research:** This relationship presents an opportunity to explore how various cognitive abilities interact and contribute to both academic and professional achievements.

Educational institutions and organizations can apply these findings to refine their learning strategies and curricula, ultimately helping to prepare a more capable workforce for future demands. This study makes a significant contribution to the growing body of knowledge on the relationship between mathematical proficiency and learning agility among high school students remains underexplored in the context of Thailand. Drawing on Hallenbeck's (2016) framework, the study employed a four-dimensional model of learning agility seeking, sensemaking, internalizing, and applying, which proved appropriate for evaluating learner characteristics at the secondary level. These dimensions reflect essential traits of high-potential learners in the 21st century. The findings revealed a moderate but statistically significant positive correlation between students' mathematical proficiency and their learning agility, indicating that students with stronger mathematical foundations tend to be more adaptable and agile learners. This research contributes to the field of education by offering insights into student attributes that support academic and adaptive success. It also provides guidance for designing instructional activities that integrate both cognitive development and learning agility. Furthermore, the results serve as a valuable resource for educators, researchers, and policymakers aiming to enhance student potential in a rapidly evolving digital era.

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Ethical statement: The authors stated that the study was conducted in accordance with the principles of human research ethics. The research involved minimal risk to participants, meaning the level of risk did not exceed that of daily life activities (not greater than minimal risk). The study was a one-time opinion survey, and no medical procedures, diagnostic interventions, or treatments were involved. Therefore, written informed consent was not required. Instead, participants were provided with clear information about the study purpose, and their voluntary

participation implied consent. No personally identifiable information was collected, and all responses were recorded anonymously. Sensitive or confidential data were handled with strict confidentiality and used solely for research purposes. The authors further stated that the study was exempt from formal ethical approval, as it did not involve interventions or the collection of personal data that could compromise participants' privacy or well-being. Additionally, the researcher, Ms. Bunyisa Saelo, successfully completed certified training in Human Research Ethics prior to conducting this study.

AI statement: The authors stated that AI was used in this research papers to proofread and correct grammar as an expert writer in academic text.

Declaration of interest: No conflict of interest is declared by the authors.

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REFERENCES

Burke, W. W. (2014). *Organization change: Theory and practice*. SAGE.

Byrum, C., Usaho, C., & Siribanpitak, P. (2021). Management innovation for Thai language and culture program of international schools in Thailand based on concept of agile learner characteristics. *Asian Social Science, 17*(4), 10-23. https://doi.org/10.5539/ass.v17n4p10

Chaiyaphan, P., & Boonchai, C. (2022). The role of learning agility in enhancing employee performance. *Journal of Business Research, 58*(3), 123-138.

Deloitte. (2017). *Global human capital trends 2017: Rewriting the rules for the digital age*. https://www2.deloitte.com/us/en/insights/focus/human-capital-trends/2017.html

Deloitte. (2022). *Gen Z and millennial survey*. https://www.deloitte.com/global/en/issues/work/genz-millennial-survey.html

DeMeuse, K. P. (2017). Learning agility: Its evolution as a psychological construct and its empirical relationship to leader success. *Consulting Psychology Journal, 69*(4), 267-295. https://doi.org/10.1037/cpb0000100

DeRue, D. S., & Wellman, N. (2009). Developing leaders via experience: The role of developmental challenge, learning orientation, and feedback availability. *Journal of Applied Psychology, 94*(4), 859-875. https://doi.org/10.1037/a0015317

Dries, N., Vantilborgh, T., & Pepermans, R. (2012). The role of learning agility and career variety in the identification and development of high potential employees. *Personnel Review, 41*(3), 340-358. https://doi.org/10.1108/00483481211212977

Eichinger, R. W., & Lombardo, M. M. (2004). Learning agility as a prime indicator of potential. *Human Resource Management, 43*(4), 337-344.

Hallenbeck, G. (2016). *Learning agility: Unlock the lessons of experience*. Center for Creative Leadership.

Hoff, D., & Burke, W. W. (2017). *Learning agility: The key to leader potential*. Columbia University Press.

Institute for the Future. (2011). Future work skills 2020. *IFTF*. www.iftf.org/futureworkskills2020

Jade, S., & Oco, R. (2023). Students' mathematical skills and performance. *International Journal of Multidisciplinary Research and Publications, 6*(2), 328-332.

Jasim, N. M., & Faris, I. J. (2018). The mathematical proficiency of the students of the mathematics department. *Opción, 34*(16), 1273-1304.

Lombardo, M. M., & Eichinger, R. W. (2000). High potentials as high learners. *Human Resource Management, 39*(4), 321-329. https://doi.org/10.1002/1099-050X(200024)39:4<321::AID-HRM4>3.0.CO;2-1

Maric, M. (2015). Developing learning agility for talent management. *Journal of Management Development, 34*(5), 605-618.

McCall, M. W. (2010). Recasting leadership development. *Industrial and Organizational Psychology, 3*(1), 3-19. https://doi.org/10.1111/j.1754-9434.2009.01189.x

McKinsey. (2020). Reskilling and retraining: The new reality for global workers. *McKinsey*. https://www.mckinsey.com/featured-insights/future-of-work

Mitchinson, A., & Morris, R. (2012). *Learning about learning agility*. Center for Creative Leadership. https://doi.org/10.5465/AMBPP.2012.288

Saputro, P., Herman, W., Herman, T. (2021). Mathematical proficiency profiles of elementary school student: Preliminary study. *Journal of Physics: Conference Series, 1842*, Article 012075. https://doi.org/10.1088/1742-6596/1842/1/012075

Smith, B. A., & Campbell, D. P. (2011). Learning agility: The X factor in identifying and developing future leaders. *Industrial and Organizational Psychology, 4*(2), 227-230. https://doi.org/10.1111/j.1754-9434.2012.01435.x

Smith, B. A., & Campbell, D. P. (2012). Identifying and developing agile leaders. *Industrial and Organizational Psychology, 5*(3), 312-316.

Supawongse, S., & Namsuwan, P. (2023). Developing learning agility to enhance leadership effectiveness. *Leadership & Organization Development Journal, 44*(1), 47-63.

World Economic Forum. (2016). The future of jobs report 2016. *World Economic Forum*. https://www.weforum.org/reports/the-future-of-jobs-report-2020

Zainudin, A. W., & Kutty, F. M. (2025). Learning agility level among diploma students. *International Journal of Academic Research in Business and Social Sciences, 15*(1), 1384-1401. https://doi.org/10.6007/IJARBSS/v15-i1/24423