Available online at
https://jcrinn.com/
https://crinn.conferencehunter.com/

Journal of Computing Research and Innovation 9(2) 2024

Journal of Computing Research and Innovation

The Association Between Performance and Mathematical Subjects Among Diploma Students

Ilya Zulaikha Zulkifli[1*], Nor Faezah Mohamad Razi[2], Nor Hazlina Mohammad[3], Nor Aslily Sarkam[4]

[1,2,3,4]*Mathematical Sciences Studies, College of Computing, Informatics and Media, Universiti Teknologi MARA Perak Branch, Tapah Campus, 35400, Tapah Road, Perak Darul Ridzuan, Malaysia*

ARTICLE INFO

Article history:
Received 13 May 2024
Revised 19 July 2024
Accepted 25 July 2024
Online first
Published 1 September 2024

Keywords:
Association
Performance
Mathematics
Chi-Square
Grade

DOI:
10.24191/jcrinn.v9i2.443

ABSTRACT

Over recent semesters, the increasing failure rates in STA108 have raised concerns about this course's teaching and learning environment. This issue has prompted an investigation into potential contributing factors, focusing on three main objectives: examining the students' association between gender and MAT133, exploring the relationship between students' achievements in MAT133 and their Mathematics grades in the Sijil Pelajaran Malaysia (SPM), and assessing the association between STA108 results and their Mathematics grades in the Sijil Pelajaran Malaysia (SPM). The respondents completed 329 online surveys using the purposive sampling approach. The questionnaire with two distinct parts which included the socio-demographic and other pertinent information required for analysing the respondents' profiles. The second component was the primary focus of the study. Chi-Square test was conducted to analyse the data. The test revealed no significant association between gender and MAT133. It also indicates a significant correlation between students' achievements in MAT133 and their SPM Mathematics grades. There is a significant association between STA108 and their SPM Mathematics grades. Our research significantly contributes to the ongoing discussion regarding the relationship between secondary and tertiary mathematics education. It also sets the stage for further research into specific pedagogical approaches that could enhance the effectiveness of mathematics education at the tertiary level.

1. INTRODUCTION

Academic achievement refers to a student's success in meeting the established educational standards and objectives within their academic journey. This encompasses their performance in classroom activities, high scores on standardized tests, mastery of specific skills, personal growth, and overall development. Assessment of academic achievement involves evaluating how effectively students have acquired

[1*] Corresponding author. *E-mail address*: ilya2177@uitm.edu.my
https://dx.doi.org/10.24191/jcrinn.v9i2.443

knowledge and skills with predefined academic standards, ensuring they are on track for future educational and career success.

Nowadays, the assessment of students' achievement is one of the key factors to become excellent. Student achievement in mathematics can be influenced by various factors, including teaching methods, curriculum design, individual student's characteristics, and the overall educational environment. Mathematics is an academic discipline that focuses on the characteristics, connections, and manipulations of numbers, quantities, forms, and patterns. It is an essential component of human understanding and is applied in several fields and daily activities. It is widely recognized that a solid foundation in mathematics is an essential requirement for admission to tertiary institutions across most academic disciplines (Rashid & Karim, 2021).

Mathematics is a mandatory subject at both primary and secondary levels in Malaysia. At the tertiary level, universities offer various Mathematics courses tailored to specific fields of study. One such course, Statistics and Probability (STA108), is offered at Universiti Teknologi MARA (UiTM), particularly targeting students in the Faculty of Applied Sciences. This course entails an introduction to statistical data analysis. To excel in this course, students must possess a solid foundation in mathematics, particularly in Pre-Calculus (MAT133). In particular, there are prominent and in-depth conversations among lecturers and students about gender-related problems in arithmetic proficiency (Mokhtar et al., 2019). This requirement is essential due to the incorporation of applications to broader everyday problems in science and technology, aimed at providing students with a comprehensive understanding of the subject matter and fostering their interest in the course.

In today's data-driven world, the ability to understand and interpret quantitative information is crucial. Mathematics equips students with the skills to analyse data, make informed decisions, and evaluate the validity of arguments based on numerical evidence. Over the past few semesters, there has been a concerning upward trend in the failure rates of STA108. This pattern has raised questions about the teaching and learning environment, as well as the commitment of both lecturers and students. Despite numerous discussions among researchers, the factors contributing to this issue remain unclear. Therefore, this study aims to investigate the underlying causes to enhance the overall academic performance in this course. By identifying and addressing these factors, this research seeks to contribute to the development of more effective teaching strategies and a supportive learning environment, ultimately improving student success rates in STA108 and similar courses. Thus, this study consists of three objectives which are (1) to investigate the student's association between gender and MAT133, (2) to determine the relationship between students' achievement in MAT133 and Mathematics grades in Sijil Pelajaran Malaysia (SPM) and (3) to examine the association between STA108 and Mathematics grades in Sijil Pelajaran Malaysia (SPM) among students in UiTM Tapah.

2. LITERATURE REVIEW

2.1 Gender and Achievement in Mathematics

Gender disparities persist in mathematics achievement despite efforts for equity. Gender disparities have persisted in mathematics achievement, with males typically outperforming females, especially in standardized tests and advanced coursework (Hyde & Mertz, 2009; Balart & Oosterveen, 2019; Zhang & Peng, 2023). While some attributes give differences to biological factors like brain structure or cognitive abilities, research increasingly emphasizes the role of social and environmental factors. These factors encompass stereotypes, biases, peer influences, and unequal access to educational resources and opportunities (Spencer et al., 1999; Rodríguez et al., 2020; Dersch et al., 2022). Negative stereotypes about women's mathematical abilities can significantly impact their performance and confidence, perpetuating the gender gap in mathematics (Xie & Liu, 2023).

https://dx.doi.org/10.24191/jcrinn.v9i2.443

One crucial factor contributing to gender disparities in mathematics achievement is stereotype threat, wherein individuals fear confirming negative stereotypes about their group. Studies have shown that stereotype threat undermines women's performance in mathematics, particularly when reminded of gender stereotypes related to math ability (Good et al., 2003; Dersch et al., 2022). Consequently, efforts to address stereotype threats are essential for creating equitable learning environments where all students can thrive regardless of gender. Additionally, self-concept and beliefs about mathematical abilities play a significant role in shaping gender differences in mathematics achievement. Research indicates that girls often underestimate their mathematical abilities compared to boys, highlighting the importance of promoting positive self-perception to bolster girls' confidence and engagement in mathematics (Nosek et al., 2002; Bertoletti et al., 2023; Andersen & Smith, 2023).

To prevent gender disparities in mathematics achievement, various interventions and strategies have been proposed. These include fostering a growth mindset, providing positive role models, and implementing interventions specifically designed to reduce stereotype threat in educational settings. By encouraging a growth mindset, students are taught to view challenges as opportunities for growth and learning, rather than fixed indicators of ability. Positive role models, particularly female mathematicians and scientists can inspire girls and challenge traditional gender stereotypes about math and science fields. Moreover, interventions aimed at reducing stereotype threat, such as reframing task instructions to emphasize competence and belongingness, have shown promising results in improving female students' performance and confidence in mathematics (Lee et al., 2021; Malespina et al., 2022; Song, 2022).

Efforts to increase female representation in STEM fields and promote gender equity in education resources are crucial for addressing gender disparities in mathematics achievement comprehensively (Diekman et al., 2016; van Hoeve et al., 2023). By providing equal opportunities and resources to all students regardless of gender, educational institutions can create an inclusive environment where every student has the support and encouragement needed to excel in mathematics and other STEM disciplines. Furthermore, fostering collaboration between educators, policymakers, and researchers is essential for developing evidence-based interventions and policies that effectively address gender disparities in mathematics achievement and promote gender equity in education (Zilka et al., 2023).

In conclusion, gender disparities in mathematics achievement persist despite ongoing efforts to promote gender equity in education. Social and environmental factors, including stereotypes, biases, and unequal access to resources, contribute significantly to these disparities. Addressing stereotype threat, promoting positive self-perception, and implementing interventions to reduce gender biases are essential steps toward creating equitable learning environments where all students, regardless of gender, can thrive in mathematics and other STEM disciplines. By working collaboratively to implement evidence-based interventions and policies, we can strive towards closing the gender gap in mathematics achievement and fostering gender equity in education.

2.2 Mathematics Grade in SPM and Mathematics Achievement at Tertiary Level

Mathematics has a crucial role in academics and different businesses, performing as the foundation for scientific and industrial pursuits, with arithmetic and logic serving as fundamental principles. Therefore, to develop students' competence in mathematics subjects, calculations and problem-solving, which are crucial abilities for achieving success in advanced education and future professional endeavours. Nevertheless, educators have recently observed a surge in issues among students, including those who recently began college. This raise concerns over the readiness of students when they are entering higher education and invites an investigation into the potential influence of education systems that have varied levels of differentiation between schools.

In Michaelowa (2007) and Grassini (2023), they suggest that education systems which enable significant variety among schools may exhibit distinct performance outcomes at the tertiary level in comparison to systems with less differentiation. Moreover, the high occurrence of underperforming students in mathematics classes, especially in Asian countries, is frequently linked to instructional

https://dx.doi.org/10.24191/jcrinn.v9i2.443

approaches that rely heavily on memorization, as emphasized by Yeh et al. (2019), Zakariya (2022) and Amirah et al. (2023).

Furthermore, mathematics courses are essential not just in academics but also in several fields of study, especially those related to science and technology, as they are required prerequisites. Shaari et al. (2023) and Mian et al. (2022) highlight the enduring positive correlation between achieving higher education and experiencing reduced rates of unemployment. They emphasize the significant influence of mathematics education in defining career prospects.

Saha et al. (2024) gives additional understanding of the elements that impact grades in underperforming mathematics courses. Their research identified SPM Additional Mathematics as a strong indicator of success in Pre-Calculus and other underperforming Mathematics courses, highlighting the crucial role of grasping fundamental ideas (Guo et al., 2020).

It is proven that on SPM 2022 result analysis report between 2021 and 2022 in Malaysia. Figure 1 and Figure 2 also shows the achievement trend statistical findings for Mathematics subjects in the SPM examination for the year 2022, as reported by Berita Harian in 2023. Based on the findings, the average performance trend shows a consistent decline over the years. Thus, it may be inferred that failure is a contributing factor that impacts students' academic performance when entering higher education.

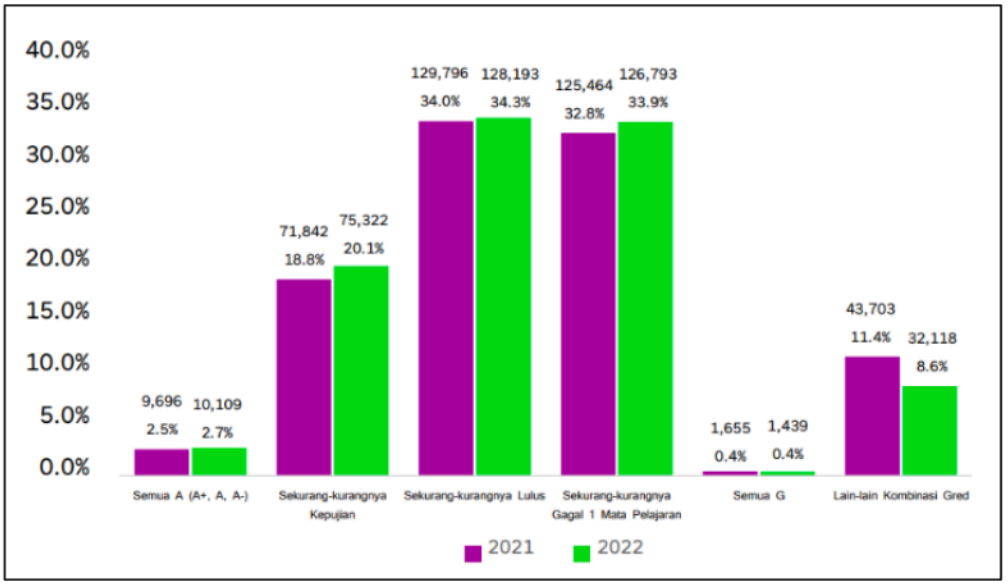

Fig. 1. SPM 2022 result analysis report

Source: relevan.com.my (Jun 8, 2023)

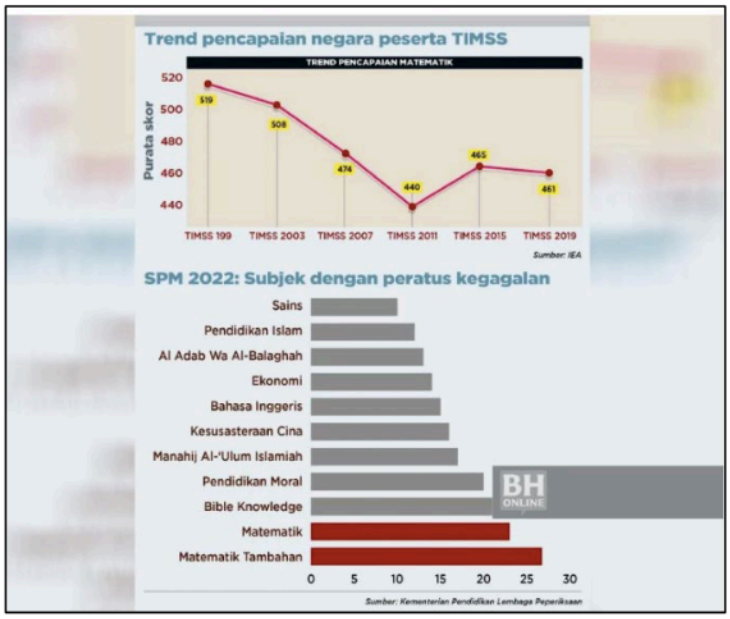

Fig. 2. Statistics on mathematics SPM 2022

Source: Berita Harian (Jun 21,2023)

Ultimately, the difficulties in mathematics education require a comprehensive strategy that tackles teaching techniques, curriculum development, and the wider educational framework. To ensure students' success in higher education and future jobs, it is imperative for educators and policymakers to prioritise the development of critical thinking and problem-solving abilities, along with the understanding of fundamental mathematical principles. Education institutions may empower students to succeed in a complex and interconnected world by cultivating a profound comprehension of mathematics and offering sufficient assistance and resources.

3. METHODOLOGY

3.1 The survey data

The data acquired in this investigation was gathered using an online questionnaire that was disseminated over WhatsApp or Telegram. The population size for this study is 705. The respondents completed 329 online surveys using the purposive sampling approach. The sample size was determined using a sample size calculator, considering a 95% confidence interval, a 5% margin of error, and a population size of 705. Purposive sampling was used to select students with relevant experience in MAT133 and STA108 courses to investigate specific performance and correlation objectives. This method ensures efficiency, relevance, and the inclusion of participants who can provide meaningful insights into the factors affecting failure rates and the relationship between secondary and tertiary mathematics education. The questionnaire was divided into two distinct parts. The first component included the socio-demographic data of the user, along with other pertinent information required for analysing the respondents' profiles. The second component was the primary focus of the study.

Table 1 shows the variables included in the study. There are five variables which consists of gender, science stream, interest in Mathematics subject, SPM's Mathematics Grade and STA108 are categorical and having nominal scale while one variable categorical (MAT133) has ordinal scale of measurement.

Table 1. Variables included in the study

Variables	Category
Gender	Male Female
Science stream	Yes No
Interest in Mathematical Subject (Mathematics and Statistics)	Yes No Not sure
MAT133	A B C
SPM's Mathematics Grade	Pass Fail
STA108	Pass Fail

3.2 Testing Association Between Variables Using Chi-Square Test

A measure of the discrepancy existing between the observed and expected frequencies is supplied by the statistic χ^2 given by:

$$\chi^2 = \sum \frac{(o_j - e_j)^2}{e_j} \tag{4}$$

where χ^2 represents the chi-squared value, o_j represents the observed value, e_j represents the expected value and the symbol $\sum$ represents the summation of values for all j.

A Chi-Square test of independence uses the following null (H_0) and alternative hypotheses (H_1):

H_0: There is an association between gender and MAT133
H_1: There is no association between gender and MAT133
H_0: There is an association between MAT133 and Mathematics grade in SPM
H_1: There is no association between MAT133 and Mathematics grade in SPM
H_0: There is an association between STA108 and Mathematics grade in SPM
H_1: There is no association between STA108 and Mathematics grade in SPM

If the p-value that corresponds to the test statistic $\chi^2$with degrees of freedom is less than chosen significance level, then reject the null hypothesis.

https://dx.doi.org/10.24191/jcrinn.v9i2.443

4. RESULTS AND DISCUSSION

4.1 Profile of Students

Table 1 displays the demographic profile of the students. There are a total of 329 students involved in this study. Majority of students are female, accounting for 84.2%, while the remaining 15.8% are male. 72.6% of the students are from the science stream, while the remaining 27.4% are not. Around half of them (56.5%) have an interest in mathematics, while 32.5% are unsure and the remaining 10.9% are not interested in mathematics. Most students excelled in MAT133, with a pass rate of 99.1%, while the rate of failure was a mere 0.9%. In total, most students (79.3%) achieved an A grade, followed by 14.3% who received a B grade, and the remaining 6.4% who scored a C. Majority of the students achieve higher score for STA108 97.9% while the remaining are not with 1.8%. There are no missing values.

Table 2. Demographic profile of students

	Category	Frequency	Percentage (%)
Gender	Male	52	15.8
	Female	277	84.2
Science stream	Yes	239	72.6
	No	90	27.4
MAT133	Pass	326	99.1
	Fail	3	0.9
Interest in Mathematical Subject (Mathematics and Statistics)	Yes	186	56.5
	No	36	10.9
	Not sure	107	32.5
SPM's Mathematics Grade	A	261	79.3
	B	47	14.3
	C	21	6.4
STA108	Pass	322	97.9
	Fail	6	1.8

Based on the results, the data for all three variables significantly deviate from a normal distribution and are not normally distributed since the p-value is less than 0.05 (Table 3). Therefore, the objectives will involve running the analysis using non-parametric tests. These tests do not assume normality and will provide more accurate insights given the distribution characteristics of our data. So, will use the (Chi-square test, Mann-Whitney U test, Kruskal-Wallis test, or Spearman's rank correlation), as appropriate for our data and research questions.

https://dx.doi.org/10.24191/jcrinn.v9i2.443

Table 3. Normality test

	Kolmogorov-Smirnov		
	Statistic	**df**	**p-Value**
Mathematics grade in SPM	0.475	329	<0.001
MAT133	0.529	329	<0.001
STA108	0.536	329	<0.001

4.2 Evaluation of Chi Square Test

The result on the association between Mathematical grade in SPM with MAT133 course and STA108 course and the relationship between gender and MAT133 and gender presented in Table 6, Table 5 and Table 4 respectively. Based on Table 4., the total of 329 students were included in the analysis. We found that out of 326 pass students in MAT133, 51 students (15.64%) were male, 275 students (84.36%) were female. Next, out of 3 fail students in MAT133, 1 student (33.33%) were male, 2 students (66.67%) were female. Furthermore, based on the Chi-Square analysis, the gender and MAT133 do not have statistically significant association. (χ^2(df) = 0.699 (1), p = 0.403 > α = 0.05)

Table 4. Tabulation of gender and MAT133

	MAT133		**Chi-Square (df)**	**p-Value**
Gender	**Pass (n (%))**	**Fail (n (%))**		
Male	51(15.64)	1(33.33)	0.699 (1)	0.403
Female	275(84.36)	2(66.67)		

While in Table 5., the total of 329 students were included in the analysis. We found that out of 326 pass students in MAT133, 260 students (79.75%) were having A, 45 students (13.80%) were having B while 21 students (6.45%) were having C in Mathematics grade in SPM. Next, out of 3 fail students, 1 student (33.33%) were scoring an A, 2 students (66.67%) were scoring B and none of them scoring C in Mathematics grade in SPM. Furthermore, based on the Chi-Square analysis, the MAT133 and Mathematics grade in SPM have statistically significant relationship. (χ^2(df) = 6.816 (2), p = 0.033 < α = 0.05)

Table 5. Tabulation for MAT133 and Mathematics grade in SPM

	MAT133		**Chi-Square (df)**	**p-Value**
Mathematics grade in SPM	**Pass (n (%))**	**Fail (n (%))**		
A	260 (79.75)	1 (33.33)	6.816 (2)	0.033
B	45 (13.80)	2 (66.67)		
C	21 (6.45)	0 (0.00)		

Lastly, Table 6 revealed total of 329 students were included in the analysis. We found that out of 326 pass students in STA108, 259 students (80.19%) were having A, 45 students (13.93%) were having B while 19 students (5.88%) were having C in Mathematics grade in SPM. Next, out of 3 fail students, 2 students

(33.33%) were scoring A, B and C in Mathematics grade in SPM. Furthermore, based on the Chi-Square analysis, STA108 and Mathematics grade in SPM have statistically significant association. (χ^2(df) = 10.136 (2), p = 0.006 < α = 0.05)

Table 6. Tabulation for STA108 and Mathematics grade in SPM

	STA108		Chi-Square (df)	p-Value
Mathematics grade in SPM	**Pass (n (%))**	**Fail (n (%))**		
A	259 (80.19)	2 (33.33)	10.136 (2)	0.006
B	45 (13.93)	2 (33.33)		
C	19 (5.88)	2 (33.34)		

5. CONCLUSION

This study aimed to explore the factors influencing academic performance in mathematics among tertiary-level students, focusing on gender differences and the predictive power of SPM Mathematics grades. Our findings indicate no significant association between gender and MAT133, highlighting the absence of gender disparities within this academic context. Furthermore, the test also revealed a significant relationship between students' achievements in MAT133 and their SPM Mathematics grades, suggesting that this variable might influence academic success at the tertiary level.

Interestingly, the test results indicated a significant association between STA108 results and SPM Mathematics grades, suggesting that performance in these courses is interconnected but not determinant of each other. This means that success in SPM Mathematics grades does not guarantee a similar outcome in STA108. This finding underscores the complexity of academic achievements in related mathematical subjects and highlights the potential for targeted educational interventions to improve outcomes across multiple courses.

Additionally, our research significantly contributes to the ongoing discussion regarding the relationship between secondary and tertiary mathematics education. By examining the links and the lack there of between SPM Mathematics grades and tertiary academic performance, as well as the interdependencies of course outcomes within tertiary education, this study highlights the complex transition students undergo in mathematical understanding and application from high school to university. Understanding these dynamics can aid educational policymakers and curriculum developers in crafting strategies that are finely tuned to address the specific needs and challenges of tertiary-level students. Furthermore, these insights encourage the development of targeted support systems and learning interventions that can bridge the gaps identified in secondary education preparation. This study also sets the stage for further research into specific pedagogical approaches that could enhance the effectiveness of mathematics education at the tertiary level, potentially influencing curriculum reforms and teaching methodologies.

6. CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

https://dx.doi.org/10.24191/jcrinn.v9i2.443

7. ACKNOWLEDGEMENTS/FUNDING

The authors gratefully acknowledge Universiti Teknologi MARA for the support of this research.

8. AUTHORS' CONTRIBUTIONS

Ilya Zulaikha Zulkifli : Design the research work, data analysis and interpreting the results. **Nor Faezah Mohamad Razi :** Design data analysis, interpretation, and conclusion. **Nor Hazlina Mohammad** : Data collection and design methodology. **Nor Aslily Sarkam :** Writing literature reviews and references.

9. REFERENCES

Amirah, F., Shukri, A., & Fikriah, N. (2023). A relationship between secondary and tertiary mathematics grades : A case study for foundation students (Hubungan antara gred Matematik menengah dan tertiari : Satu kajian kes untuk..). *Jurnal Personalia Pelajar*, *25*(January), 111–118.

Andersen, I. G., & Smith, E. (2023). Gender differences in Math and Science academic self-concepts and the association with female climate in 8th grade classrooms. *The Journal of Early Adolescence*, *44*(5), 545–578. https://doi.org/10.1177/02724316231188682

Balart, P., & Oosterveen, M. (2019). Females show more sustained performance during test-taking than males. *Nature Communications*, *10*(1), 1–11. https://doi.org/10.1038/s41467-019-11691-y

Bertoletti, A., Cannistrà, M., Diaz Lema, M., Masci, C., Mergoni, A., Rossi, L., & Soncin, M. (2023). The determinants of Mathematics achievement: A gender perspective using multilevel random forest. *Economies*, *11*(2), 1–20. https://doi.org/10.3390/economies11020032

Dersch, A. S., Heyder, A., & Eitel, A. (2022). Exploring the nature of teachers' Math-Gender stereotypes: The Math-Gender misconception questionnaire. *Frontiers in Psychology*, *13*(April), 1–14. https://doi.org/10.3389/fpsyg.2022.820254

Diekman, A. B., Steinberg, M., Brown, E. R., Belanger, A. L., & Clark, E. K. (2016). A goal congruity model of role entry, engagement, and exit: Understanding communal goal processes in STEM gender gaps. *Personality and Social Psychology Review*, *21*(2), 142–175. https://doi.org/10.1177/1088868316642141

Good, C., Aronson, J., & Inzlicht, M. (2003). Improving adolescents' standardized test performance: An intervention to reduce the effects of stereotype threat. *Journal of Applied Developmental Psychology*, *24*(6), 645–662. https://doi.org/10.1016/j.appdev.2003.09.002

Grassini, S. (2023). Shaping the Future of Education: Exploring the Potential and Consequences of AI and ChatGPT in Educational Settings. *Education Sciences*, *13*(7). https://doi.org/10.3390/educsci13070692

Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, *102*(November 2019), 101586. https://doi.org/10.1016/j.ijer.2020.101586

Hyde, J. S., & Mertz, J. E. (2009). Gender, culture, and mathematics performance. *Proceedings of the National Academy of Sciences of the United States of America*, *106*(22), 8801–8807. https://doi.org/10.1073/pnas.0901265106

Lee, J., Lee, H. J., Song, J., & Bong, M. (2021). Enhancing children's math motivation with a joint

intervention on mindset and gender stereotypes. *Learning and Instruction*, *73*(February 2023), 101416. https://doi.org/10.1016/j.learninstruc.2020.101416

Malespina, A., Schunn, C. D., & Singh, C. (2022). Whose ability and growth matter? Gender, mindset and performance in physics. *International Journal of STEM Education*, *9*(1). https://doi.org/10.1186/s40594-022-00342-2

Mian, L., Hussin, R., Slaninová, M. G., & Shahzadi, Y. (2022). The impact of E-education and innovation on unemployment reduction among graduates: A way forward for higher educational institutes. *Frontiers in Psychology*, *13*(December), 1–9. https://doi.org/10.3389/fpsyg.2022.914104

Michaelowa, K. (2007). The impact of primary and secondary education on higher education quality. *Quality Assurance in Education*, *15*(2), 215–236. https://doi.org/10.1108/09684880710748956

Mokhtar, M., Ghazali, N. A., Yusop, H., & Nordin, N. (2019). Factors contributing to Mathematics performance of UiTM Johor students. *Insight Journal (IJ)*, *4*, 175–193. https://insightjournal.my/

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Math = male, me = female, therefore math ≠ me. *Journal of Personality and Social Psychology*, *83*(1), 44–59. https://doi.org/10.1037/0022-3514.83.1.44

Rashid, R. A., & Karim, Z. A. (2021). The influence of gender and SPM's Mathematics grade towards the students ' achievement in Mathematics at UiTM Terengganu. *Creative Practices in Language Learning and Teaching (CPLT)*, *9*(1), 1–9.

Rodríguez, S., Regueiro, B., Piñeiro, I., Estévez, I., & Valle, A. (2020). Gender differences in Mathematics motivation: Differential effects on performance in primary education. *Frontiers in Psychology*, *10*(May 2015), 1–8. https://doi.org/10.3389/fpsyg.2019.03050

Saha, M., Islam, S., Akhi, A. A., & Saha, G. (2024). Factors affecting success and failure in higher education Mathematics: Students' and teachers' perspectives. *Heliyon*, *10*(7), e29173. https://doi.org/10.1016/j.heliyon.2024.e29173

Shaari, M. S., Chau, D. N., Majekodunmi, T. B., & Esquivias, M. A. (2023). Understanding the role of child abuse in divorce: A socioeconomic analysis using the ARDL approach. *Social Sciences and Humanities Open*, *8*(1), 100762. https://doi.org/10.1016/j.ssaho.2023.100762

Song, S. (2022). Growth mindset training and the effect of math-gender stereotype threat on girl students. *Best Evidence in Chinese Education*, *12*(2), 1629–1634. https://doi.org/10.15354/bece.22.ab012

Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype Threat and women's math performance. *Journal of Experimental Social Psychology*, *35*(1), 4–28. https://doi.org/https://doi.org/10.1006/jesp.1998.1373

van Hoeve, M., Doorman, M., & Veldhuis, M. (2023). Fostering a growth mindset in secondary mathematics classrooms in the Netherlands. *Research in Mathematics Education*, *0*(0), 1–22. https://doi.org/10.1080/14794802.2023.2241433

Xie, G., & Liu, X. (2023). Gender in mathematics: How gender role perception influences mathematical capability in junior high school. *Journal of Chinese Sociology*, *10*(1). https://doi.org/10.1186/s40711-023-00188-3

Yeh, C. Y. C., Cheng, H. N. H., Chen, Z. H., Liao, C. C. Y., & Chan, T. W. (2019). Enhancing achievement and interest in mathematics learning through Math-Island. *Research and Practice in Technology Enhanced Learning*, *14*(1). https://doi.org/10.1186/s41039-019-0100-9

Zakariya, Y. F. (2022). Improving students' mathematics self-efficacy: A systematic review of intervention studies. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.986622

Zhang, Z., & Peng, P. (2023). Co-development among reading, math, science, and verbal working memory in the elementary stage. *Child Development*, *94*(6), e328–e343. https://doi.org/10.1111/cdev.13962

Zilka, A., Nussbaum, S., & Bogler, R. (2023). The relationships among growth mindset, flow, critically reflective behavior and teacher burnout. *International Journal of School and Educational Psychology*, *11*(4), 367–379. https://doi.org/10.1080/21683603.2023.2245372