



(RESEARCH ARTICLE)



Exploring generational differences in attitudes barriers and motivations toward science education among generation x, y and z

NOOR ANIS AZIRA ZAINUDDIN and SITI MADHIHAH ABD MALIK *

Faculty of Computer Science and Mathematics, University Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia.

International Journal of Science and Research Archive, 2025, 17(01), 110-115

Publication history: Received on 21 August 2025; revised on 01 October 2025; accepted on 03 October 2025

Article DOI: <https://doi.org/10.30574/ijrsra.2025.17.1.2749>

Abstract

Choosing a career in science is shaped by a mix of motivations, challenges, and personal circumstances that vary across generations. Scientific fields are vital in tackling global issues, yet disparities persist among generational groups. However, much of the existing research tends to look at isolated factors or doesn't fully explore how generational differences impact students' views on science education. This study aims to fill that gap by examining how attitudes toward science differ across three generational groups: Generation X (1965-1980), Generation Y or Generation Y (1981-1996), and Generation Z (1997-2012). Using a structured survey and a statistical approach called Analysis of Variance (ANOVA), the study analyzes responses from 80 respondents. This study identified key influences on their decision to pursue science education. The results reveal significant generational differences, particularly in attitudes toward science and the barriers students face. Generation Y show the most positive attitudes but also report the highest barriers, while Generation Z faces fewer challenges. Generation X, however, demonstrates the least favorable views toward science education. Interestingly, there were no significant differences in how the generations perceive the factors that influence science education, their career motivations, or the improvements needed in the field. By understanding and addressing the specific barriers that the new generation faces, we can foster a greater interest in science and build a more engaging educational framework across generations.

Keywords: Generational Differences; ANOVA; Science Education; Attitudes Toward Science; Barriers To STEM; Career Motivation

1. Introduction

Generational differences extend beyond age, as social, economic, environmental, political and technological factors influence how each generation views science education. These differences shape the attitude, motivations and barriers that each generation faces when deciding to pursue science education, impacting their overall engagement with the field. As generation experiences unique societal changes, their perceptions of science and its relevance evolve accordingly.

As these perceptions shift, the demand for skilled professionals in science, technology, engineering and mathematics (STEM) continues to grow. However, in Malaysia the number of students pursuing science education, especially after secondary school has been declining. This trend poses a significant risk to the country's technological and economic future.

Several factors contribute to this decline, including motivation, family support and academic performance. Yet, generational differences in attitudes toward science are often overlooked. Each generation has unique experiences that shape their decision to pursue science education. This study aims to explore how generational differences affect students' attitudes towards science, the barriers they face and their motivations. The goal is to provide actionable insights to enhance science education and increase participation.

* Corresponding author: SITI MADHIHAH ABD MALIK

Several studies have highlighted the factors contributing to the decline in students' interest in pursuing science education. Wambungu [1] identified significant differences in students' attitudes toward science, with gender and school environment playing key roles. Using MANOVA, the study found that a supportive school environment positively influenced students' perceptions of science. However, gender differences also influenced how science was valued, with male and female students showing different levels of interest, suggesting that further exploration is needed to understand these trends in more detail.

Similarly, Demirkol et al. [2] focused on attitudes toward STEM education, examining variables like gender, subject specialty, and teaching experience. Their use of MANOVA showed that while teachers generally held positive views of STEM, they lacked confidence in lesson planning. Gender played a significant role in shaping teachers' attitudes, with male teachers showing a preference for lesson planning, while female teachers engaged more with STEM activities, especially in mathematics. This finding suggests that gender not only influences student attitudes but also affects the way educators approach STEM teaching.

May et al. [3] examined the relationship between science education standards, particularly the Next Generation Science Standards (NGSS), and students' interest in STEM. The study found that students in NGSS-implementing schools had a higher interest in science and technology, although interest in engineering and mathematics was less pronounced. Gender differences were minimal, challenging earlier studies that suggested greater disparities in STEM interest between male and female students. The study underscores the importance of authentic, cross-curricular learning experiences in increasing student engagement with STEM.

Iwuanyanwu [4] focused on gender differences in attitudes toward science among Grade 9 students. The findings indicated that students in single-sex schools had more positive attitudes toward science compared to their peers in co-ed schools, with boys showing greater interest and confidence in science. Notably, girls in single-sex schools demonstrated attitudes comparable to boys in co-ed schools. This research also highlighted that hands-on projects and teacher influence were crucial in increasing student engagement, particularly in single-sex schools where peer and family support were stronger.

Further studies by Aschbacher et al. [5], Priulla et al. [6], and Potvin et al. [7] also contribute to this discussion. Aschbacher's research indicated that students in schools implementing NGSS exhibited higher interest in science, with no statistically significant gender differences. Priulla's study examined gender differences in STEM degree performance, noting that males outperformed females in technical fields like mathematics and physics, while females excelled in biology and biotechnology. Potvin et al. [7] found that student interest in science declined steadily from grades 5 through 11, despite continued interest in out-of-school STEM activities.

The role of teaching practices in shaping students' interest in science is another key area of focus. Similarly, Anderhag et al. [8] showed that primary school students enjoyed science more when lessons were connected to everyday experiences, but secondary school content, being more abstract, led to decreased engagement. These findings suggest that improving teaching methods and aligning the curriculum to students' existing interests may help reverse the decline in science engagement.

The decline in student interest and participation in science education has become a pressing issue, particularly in Malaysia, where fewer students are opting to pursue science education after secondary school. This trend threatens the country's future technological and economic development, as science, technology, engineering, and mathematics (STEM) fields are essential for innovation and national competitiveness. While factors such as motivation, family support, and academic performance have been widely studied, generational differences in attitudes toward science education remain underexplored. Each generation is shaped by distinct social, economic, and technological changes, influencing their views on the relevance and importance of science education. As these generational variations are not fully understood, educational policies and strategies may not effectively address the unique challenges each generation faces in pursuing science education. This study seeks to explore how generational differences affect students' attitudes, motivations, and barriers to science education, with the goal of providing insights that can enhance participation in STEM fields.

2. Methodology

This study adopted a quantitative research design to examine generational differences in perspectives on pursuing science education. Data were gathered through a self-developed online questionnaire distributed via Google Forms, comprising 25 items across five key constructs: General Attitudes Toward Science, Influences on Science Education, Barriers to Pursuing Science Education, Career Interests and Motivation, and Improvements in Science Education. Responses were recorded on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The questionnaire was administered to 80 Malaysian respondents, consisting of 11 from Generation X (13.75%), 8 from Generation Y (10%), and 61 from Generation Z (76.25%), selected through stratified random sampling to ensure generational representation.

Prior to analysis, reliability was tested using Cronbach's alpha in Excel, yielding a value of 0.719 for the 25 items, indicating acceptable internal consistency according to standard guidelines ($\alpha \geq 0.7$). Data analysis was conducted using SPSS. Assumption testing was performed to verify the suitability of parametric tests, including normality (via Kolmogorov-Smirnov and Shapiro-Wilk tests, supplemented by Q-Q plots), homogeneity of variances (Levene's Test), equality of covariance matrices (Box's M Test), and correlations to check for multicollinearity (all values < 0.80). Most assumptions were met, with minor deviations in normality for some variables in Generations Y and Z, but the analyses proceeded due to the robustness of ANOVA in moderate violations.

One-way Analysis of Variance (ANOVA) was employed to determine significant differences among the generational groups for each dependent variable, followed by Tukey HSD post-hoc tests for pairwise comparisons where omnibus significance was found. The analytical process followed a rigorous, step-by-step approach, from survey design and distribution to statistical testing, ensuring both ethical compliance and methodological validity throughout the research.

3. Results

There were 80 individuals who participated in this study, selected using a random sampling method. Of these, 11 were from Generation X (13.75%), 8 were from Generation Y (10%), and 61 were from Generation Z (76.25%). Data was collected through a self-developed online questionnaire distributed via Google Forms. The key area of focus in the questionnaire included (1) General attitudes towards science, (2) Influences on science education, (3) Barriers to pursuing science education, (4) Career interests and motivation and (5) Improvements in science education. Responses were collected on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Reliability testing of the survey items showed acceptable internal consistency with Cronbach's alpha of 0.719, suggesting that the questionnaire is reliable for assessing generational perspectives on science education.

Normality tests (Kolmogorov-Smirnov and Shapiro-Wilk) were conducted to check if the data were normally distributed. The results indicated that for most variables, the data were normally distributed across the generations. However, Generation Z showed significant deviations from normality in Career Interests and Motivation ($p=0.028$) and Improvements in Science Education ($p=0.002$). Despite these deviations, ANOVA was conducted as the other assumptions were met. We conducted one-way ANOVA analyses for each of the dependent variables. This allowed us to examine how the different generations varied in their perceptions and experiences related to science education across the area.

Table 1 Descriptive results

Factor	Generation X (n=11)		Generation Y (n=8)		Generation Z (n=61)	
	Mean	SD	Mean	SD	Mean	SD
General Attitudes Toward Science	3.77	0.44	4.23	0.22	4.08	0.41
Barriers to Pursue education in STEM	3.50	0.50	3.85	0.30	3.60	0.40
Career Interests and Motivation	3.90	0.38	4.10	0.35	3.95	0.32
Improvements in STEM	3.95	0.39	4.05	0.34	4.00	0.37
Influence on STEM	3.80	0.45	3.95	0.40	3.85	0.38

Table 1 offers valuable insights into the perceptions of different generations towards STEM field. The mean value for all the variables shows a clear generational trend. Generation Y have the highest mean value for all the variables and are followed by generation Z. This suggests that younger generations generally have more positive attitudes toward STEM field compared to generation X. The mean value for Generations X is lower indicating a more sceptical or neutral attitude towards STEM. This trend follows for SD value as well. Generation X shows a greater variability in all the variables. This suggests that some individuals in generation X may hold very negative views of pursuing studies in STEM field. In contrast to Generation Y and generation Z, suggesting more positive attitudes toward STEM field. Despite these differences, all three generations share similar views on the need for improvement in pursuing studies in STEM field.

Table 2 One-Way ANOVA and Tukey HSD Post-Hoc Comparisons results

Factor	p-value	Post-Hoc Comparisons (Tukey HSD)			Significance
		Generation X vs Y	Generation X vs. Z	Generation Y vs Z	
General Attitudes Toward STEM	0.029	0.041	0.0049	0.600	Significant
Barriers to Pursue education in STEM	0.021	0.088	0.973	0.016	Significant
Career Interests and Motivation	0.969	0.896	0.947	0.922	Not Significant
Improvements in STEM	0.157	0.748	0.973	0.937	Not Significant
Influence on STEM	0.653	0.45	0.890	0.375	Not Significant

The table 2 above focusing specifically on the p-values from the One-Way ANOVA, the Tukey HSD post-hoc results and their significance levels. The p-values indicate whether overall generational difference exists for each factor, while the Tukey HSD tests which control for multiple comparisons at $\alpha = 0.05$, pinpoint specific pairwise significances.

3.1. General Attitudes Toward STEM

The results from the pairwise comparisons indicate significant differences between generation X and both generation Y and generation Z ($p=0.041$ and $p=0.049$, respectively). However, there is no significant difference between generation Y and generation Z ($p=0.600$). These findings suggest that generation X, on average, holds a significantly lower attitude toward STEM fields compared to the younger generations, particularly generation Y and generation Z. This aligns with the descriptive means from Table 1, where older cohorts may perceive science as more rigid due to traditional curricula experienced in their youth. Culp-Roche et al. [9] reported that Baby Boomers and Generations X shows lower comfort with modern tech-integrated learning compared to younger groups, potentially dampening attitudes. Grimalt-Álvaro et al. [10] found clustered negative stereotypes more prevalent in older demographics, influenced by historical educational barriers. Similarly, trend from 2020-2024 show shifting positive attitudes in younger generations due to interdisciplinary STEAM approaches as reported by Liu [11].

3.2. Barriers to Pursuing Science Education

The barriers to pursuing science education factor yielded a significant p-value of 0.021, denoting generational variances. Tukey HSD results showed a significant difference between Generation Y and Generation Z ($p=0.016$), with Generation Y reporting higher barriers, while comparisons involving Generation X were non-significant (X vs. Y: $p=0.088$; X vs. Z: $p=0.973$). This pattern may reflect Generation Y's experiences during economic transitions and early career uncertainties, amplifying perceived obstacles like resource access or curriculum demands as discussed by Merayo [12].

3.3. Career Interests and Motivation

In contrast, the p-value was 0.969, far exceeding 0.05 and thus non-significant, with Tukey HSD confirming no pairwise difference. This indicates consistent motivation levels across generations, likely due to science's enduring appeal in innovation driven economies. Research by Landicho [13] also suggest that motivation remains stable despite external barriers.

3.4. Improvement in Science Education

For improvement in science education, the p-value was 0.157, with Tukey HSD showing no pairwise significance. This consensus implies intergenerational agreement on needs like curriculum updates. In 2024, a professional development study by Kirtman et al. [14] found that multidisciplinary training fosters unified views on educational improvement across generations.

3.5. Influences on Science Education

Finally, for influences on science education, the p-value was 0.315, which is not significant, indicating no overall generational differences. The Tukey HSD post-hoc tests confirmed this with all pairwise comparisons non-significant. This suggests that factors like family, media or teachers exert uniform influence across cohorts, possibly due to shared cultural exposures in a globalized era. Galiç and Arkün Kocadere [15] discussed that recent challenges in STEM education, such as pandemic-induced shifts to online learning, have created common influencers regardless of age. Additional context from Landicho [13] stated that external influences like policy and resources are perceived similarly across generations in educational contexts.

4. Conclusion

This study investigates the perspectives of different generations towards pursuing education in science field. From the results, there are some differences between generations, especially in general attitude towards science and barriers to pursuing science education. Generation X shows lower attitudes compared to Generation Y and Generation Z, which may be because of their experiences with old education systems. On the other hand, Generation Y report higher barriers than Generation Z, perhaps due to economic problems during their time. However, for influences on science education, career interests and motivation and improvements in science education, no significant differences found across generations. This means that some aspects of science education are similar for all groups.

Overall, the findings suggest that younger generations like Generation Z have more positive views and fewer barrier, which can help in increasing interest in STEM fields. This is important for policy makers to focus on making science education better for older generations too. As supported by recent research, generational differences in STEM attitudes can affect career choices and addressing barriers is key for motivation. A study by Mulvey et al. [16] highlight that Generation Z show high interest in STEM but need better school support to overcome challenges. Therefore, this research contributes to understanding how generations perceive science education and provides a basis for future improvements.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflict of interest regarding the publication of this article.

References

- [1] Wambungu RM. Assessment of students' attitudes in sciences in secondary schools using MANOVA [MSc. Thesis]. University of Nairobi. 2014.
- [2] Demirkol K, Büşra Kartal B, Taşdemir A. The investigation of mathematics and science Teachers' attitudes towards STEM education regarding multiple variables. *Türk Akademik Yayınlar Dergisi*. 2022; 6(1): 77-98.
- [3] May BK, Wendt JL, Barthlow MJ. A comparison of students' interest in STEM across science standard types. *Social Sciences & Humanities Open*. 2022; 6(1): 100287.
- [4] Iwuanyanwu PN. Is science really for me? Gender differences in student attitudes toward science. *School Science and Mathematics*. 2022; 122(5): 259-270.
- [5] Aschbacher PR, Li E, Roth EJ. Is science me? High school students' identities, participation and aspirations in science, engineering, and medicine. *Journal of Research in Science Teaching*. 2009; 47(5): 564-582.
- [6] Priulla A, D'Angelo N, Attanasio M. An analysis of Italian university students' performance through segmented regression models: gender differences in STEM courses. *Genus*. 2021: 77(1).

- [7] Potvin P, & Hasni A. Analysis of the Decline in Interest Towards School Science and Technology from Grades 5 Through 11. *Journal of Science Education and Technology*. 2014; 23(6): 784–802.
- [8] Anderhag P, Wickman P, Bergqvist K, Jakobson B, Hamza KM, Säljö R. Why Do Secondary School Students Lose Their Interest in Science? Or Does it Never Emerge? A Possible and Overlooked Explanation. *Science Education*. 2016; 100(5): 791– 813.
- [9] Culp-Roche A, Hampton D, Hensley A, Wilson J, Thaxton-Wiggins A, Otts JA, Fruh S, Moser DK. Generational Differences in Faculty and Student Comfort With Technology Use. *SAGE Open Nurs*. 2020 Jul 15;6:2377960820941394.
- [10] Grimalt-Álvaro C, Valls C, Cebrián G, Marqués-Molíás L. An Exploration of Students' Attitudes Towards STEM and Climate Change: A Cluster Analysis Study with a Gender Perspective. *European Journal of STEM Education*. 2025; 10(1): 02.
- [11] Liu TY. Exploring Evolving Perspectives: Research Trends in Attitudes Toward STEAM Education. *Journal of Research in STEM Education*. 2024; 10(1-2): 47–59.
- [12] Merayo N, Ayuso A. Analysis of barriers, supports and gender gap in the choice of STEM studies in secondary education. *Int J Technol Des Educ*. 2022 Nov; 2:1-28.
- [13] Landicho CJB. Research attitudes, motivations, and challenges of STEM education researchers. *International Journal of Technology in Education (IJTE)*. 2020; 3(1): 49-61.
- [14] Kirtman N, Smith C, Demeritte T, Divinity D, Amouzandeh V, Fordham J A, Fadavi M. Strategic and Steady Can Win the Race: Incremental Exposure to Novel Multidisciplinary Pedagogies in STEM Fields Can Help Change Faculty "Teaching and Learning" Attitudes and Practices. *Journal of College Science Teaching*. 2024; 53(6): 573–583.
- [15] Galiç S, Arkün Kocadere S. Current trends and challenges in STEM education. *STEAM-BOX*. Linz, Austria: Linz School of Education – Johannes Kepler University Linz; 2023.
- [16] Mulvey KL, Cerda-Smith J, Joy A, Ozturk E. A Latent Class Analysis Predicting STEM Career Interest and Perceptions of Barriers. *Social Development*. 2025; 34: e12792.