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The effects of parental autonomy on the creation of STEM career interests

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ABSTRACT

This research paper focuses on the effects of the parent autonomy factor that supports the needs of students in science, technology, engineering, and mathematics (STEM) learning and builds the interest of students in STEM careers. This was a quantitative research study that employed the parent authority questionnaire (PAQ). Based on the research objective, the questions in the PAQ were altered to evaluate the effects of parents on student interest in STEM careers and adapted to the purpose of the study. The PAQ comprises a scale of 1-10 ranging from strongly disagree to strongly agree. Research respondents included 419 upper secondary students from national schools in Malaysia, and the research used a proportionate stratified random sampling technique. The research determined parents' autonomy towards the development of students' STEM career interest and the data was analyzed using structural equation modelling (SEM). The results found that the autonomy of parents significantly affected upper secondary students in the development of STEM careers of students. The research question was answered by proving that the autonomy of parents is directly significant (p<001). Results showed that parents explicitly offer meaningful impacts and valuable values to motivate students of the science stream at the secondary level to ensure that their STEM career interests are well nurtured. The findings from this research provide useful insight into the learners, and lead to the value of autonomy of parents in promoting a curriculum design that suits the needs of students in the future.

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1. INTRODUCTION

The student in science, technology, engineering, and mathematics (STEM) field is a key source of employment. Accordingly, world economic policies have the agenda of producing more graduates from the professional and vocational sectors in the STEM field [1]. Next, the higher education institution (HEI) level is the continuity of the secondary school level. Therefore, past research has emphasized that the best time to channel information related to STEM careers among students begins from the secondary school level. During this period, students start to develop career aspirations more proactively and become increasingly aware of learning requirements [2], [3]. Early preparation must be carried out to guarantee student outcomes as a result of a planned curriculum. Therefore, students' awareness of the importance of science in relation to STEM career interests that begin from the secondary school level is early preparation for the students to be consistent in choosing STEM study fields in HEI.

The importance of the STEM education system has ignited concern from the Malaysian Ministry of Education (MOE) to further enhance students' understanding of STEM and parents can act as a significant influence. Thus, the Malaysia Education Blueprint (MEB) 2013-2025 was introduced and launched on September 6, 2013 by highlighting the development and awareness of STEM careers among all teachers, students, and parents. MEB 2013-2025 is a long-term education plan documented by MOE in the national education system transformation plan.

Parents play an important role in influencing students, especially with regards to academic development. Besides, parents' influence is the main domain in creating the basis for academic development on students' career development [4]. Previous researches [5]–[7] also found that parents' authoritativeness contains a balance of firmness and toleration in academic and career choice aside from influencing students in making a decision. Hence, it is important to identify parents' influence in line with students' learning requirements to support and develop students' interest in STEM.

Parental influence in students' academic development is able to influence students to master the knowledge of science and learn skills for the formation of STEM careers [4]. However, there are challenges if parental authority becomes limited, such as when parents misunderstand students' academic development and in turn lead to students maintaining good academic competence with career choice confusion [8]. Moreover, the high demand for certain career fields has led to extreme concern among parents as students could become depressed and give up on getting good achievements [9]. Thus, parental influences that are not appropriate to students' learning needs will directly influence students' STEM career formation [10]. Therefore, identifying parental authority in influencing the need for the formation of STEM career interests is necessary so that students have clarity about their own career interests.

Interest is always connected with the process that could contribute towards learning and academic achievement. Interest drives the students to elevate their desire to achieve their goals by being more aware of the learning environment needs [11]. As a result, students that tend to be interested in the STEM field will have a direct effect on the nation's growth. Boosting the students' interest especially towards the science stream must appropriately prioritized by all organizations to assist efforts to achieve the education system targets in shaping students' outcomes as the nation's domestic capital [12]. Therefore, to ensure students' success in the education system, it is vital to identify parental factors affecting students' needs in the learning process that could influence STEM career interests particularly in terms of learning outcomes.

Parents' autonomy has a huge influence on career aspiration among students, mainly in developing students' interest in choosing STEM careers [13], [14]. Parents' autonomy can be interpreted as the social relations that exist between parents and students that involve trust in terms of knowledge and skills in creating social capital that could lead to positive outcomes in the future [15], [16]. Parents' autonomy level towards career development differs for every student. Nonetheless, starting from the secondary school level, the inclusive involvement of parents with regards to STEM career development could have a significant and meaningful impact on students' outcomes in competing globally [12], [17].

The emphasis on parents' involvement in education system has been the focus of comprehensively producing a skilled workforce in the STEM field. Furthermore, parents who are more concerned about students' academic development, emotions, and skills impart direct influence on students' STEM career choice [3], [10], [18]. Parents act as inspiration for their children to stay focused on academics and be consistent in fulfilling career aspiration requirements. Students' consistency in exploring STEM as a career aspiration requirement leads to increased motivation among students. Additionally, motivation that is influenced by external factors such as parents' involvement is aligned with the theory of self-determination. It places attention on parents influence in target setting and students career that is two-way in nature [4].

Parents who have early awareness of the global importance and market value of STEM will view the importance of STEM not only from a mastery of knowledge perspective, but also from a different perspective of developing students' interest in STEM careers. Moreover, parents who are aware of students' learning and their targets are able to produce a positive impact on interest development in fulfilling students' career aspirations [19]. Parents are also important assets in students' academic development and readiness for the career world. Past research [4], [20]–[22] emphasized that parents are a significant factor influencing students' career development beginning from the secondary school level until the choice of study field in HEI. Thus, parents' awareness of STEM career market value in the future will provide direct positive influence towards the development of students' interest in STEM careers.

A report from the United States Bureau of Labor and Statistics [23] stated that the need for skilled labor in STEM is expected to increase to more than 11 million beyond the year of 2030 to strengthen the nation's economy. This is parallel with the Malaysia new economic model that highlights three main requirements to compete with developed countries starting from the year 2020 in Figure 1. The three main requirements include the need for a skilled workforce to achieve the public's yearly per capita income target in line with other developed countries which are USD 15,000 until USD 20,000. "The future of the nation's

economy depends on STEM because STEM careers will become a priority in the future" [23]. However, until the year 2008 Malaysia recorded a yearly income per capita of only USD 6,000 which is below the level of a developed country in Figure 1 [24]. Therefore, expanding the national economy is the public's responsibility. It must be shaped as early as possible at the schooling level so that Malaysia can provide skilled employment with the ability to compete on par with other countries that have high incomes.

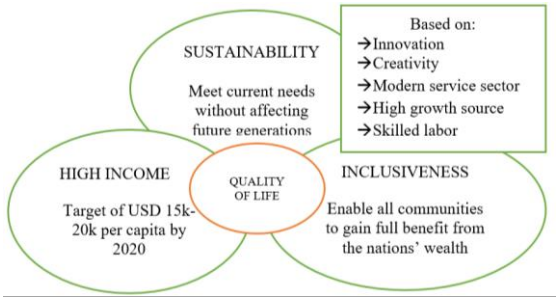

Figure 1. Malaysia new economic model

The demand for STEM has become the main issue in the global education system as there is a drastic increase in the demand for skilled labor in the STEM field. The importance of STEM awareness begins when the demands and the anticipated requirement of skilled workforce in the industry are not aligned with the students' participation enrolment at the secondary school level [25], [26]. Subsequently, this directly affects the graduates' participation in choosing STEM study fields at the HEI level [14], [27]. Furthermore, the STEM industry has a wide classification of sectors, and it comprises of a huge part of the national economy compared to non-STEM sectors [17].

According to the economic planning unit in the Prime Minister's Department [28], the shortage of graduates in the STEM field will affect the production of a skilled workforce for the industry. Therefore, it is a must to encourage awareness and interest in developing STEM careers as early as the secondary school level. Thus, the objective of this research paper is to determine whether parents' autonomy has a direct and significant effect on the development of students' STEM career interests.

2. RESEARCH METHOD

Research design is a correlation by studying the effects between the independent variable and the dependent variable. This research approach uses a survey method with the use of questionnaire forms parental authority questionnaire (PAQ) and interest in STEM careers (S-STEM). The research was executed at secondary schools that were chosen at random in Selangor, Malaysia. The schools were chosen randomly according to the zones in Selangor. The division of zones in Selangor was done by dividing Selangor into two zones, Zones 1 and 2. Zone 1 included six districts, namely, Gombak, Hulu Selangor, Rawang, Hulu Langat, Sepang, Petaling, while Zone 2 included the four districts of Sabak Bernam, Kuala Selangor, Klang, Kuala Langat which were randomly selected. The respondents in this research consisted of 419 upper secondary school science students from all 10 districts in Selangor, Malaysia. The samples were chosen using proportionate stratified random sampling.

Data collection was conducted using the instruments PAQ adapted from the instrument developed by Buri [15] and interest in STEM careers (S-STEM) [29]. The PAQ instrument was used to determine the influence of parental authority on the formation of students' STEM career interests by using only items from the most dominant categories among students. The influence of authoritative parents had more effects on students compared to authoritarian and permissive parents [5], [6]. The influence from the authoritative parent category was also the most dominant influence among secondary school students in Malaysia [30]. Therefore, the study aimed to determine the influence of authoritative parenting on the formation of STEM career interests among science stream students in Selangor, Malaysia.

The questionnaires were analyzed using structural equation modelling (SEM) to predict the results obtained based on the research objective. The measurement software utilized in this research was structural equation modelling analysis of moment structure (SEM-AMOS). In general, the SEM-AMOS software uses a graphic illustration model. Therefore, it can analyze the influence between latent variables more effectively, accurately, and efficiently. Moreover, its usability and flexibility are recognized based on the technique in the SEM software that includes simultaneous evaluations for the research variables [31].

3. RESULTS AND DISCUSSION

3.1. Measurement model

Confirmatory factor analysis (CFA) is a statistical method to determine the relationship between constructs or latent variables and indicators that are involved in the study [30]. In this study, CFA functioned as the determinant for model fit index using the results from the research in Table 1. However, there was no agreement between researchers regarding fit indexes that must be used more specifically [31]. As a result, Hair *et al*. [32] recommended the use of the index for at least one fit index for every model fit index category, which included an absolute fit, incremental fit, and parsimonious fit. The study determined the value of the index according to every category as bolded in Table 1. CFA analysis between parents' autonomy and the development of students' STEM career interests achieved the model fit index to represent each category as shown in Figure 2.

Table 1. Model fit index [32]

Category	Index name	Index full name	Accepted index
Absolute fit	Chisq	Discrepancy chi-square	>0.05
	RMSEA	Root mean square of error approximation	<0.08
	GFI	Goodness of fit index	>0.90
Incremental fit	AGFI	Adjusted goodness of fit	>0.90
	CFI	Comparative fit index	>0.90
	TLI	Tucker-Lewis index	>0.90
	NFI	Normed fit index	>0.90
Parsimonious fit	Chisq/df	Chi-square/degrees of freedom	<5.0

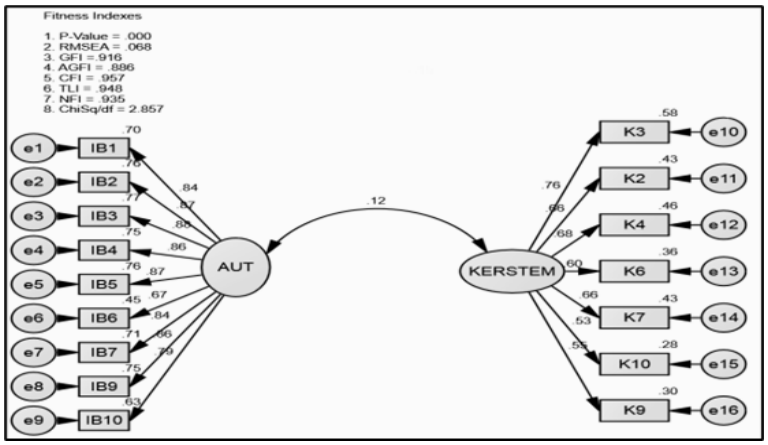

Figure 2. Measurement model analysis for latent construct

Generally, the measurement model that fulfills the majority of model fit index values for every category is considered good and acceptable [32]. Also, some of the index values that are important to evaluate fit index for measurement model in CFA are root mean square error of approximation (RMSEA), comparative fit index (CFI) and Chisq/df for continuous data [33], [34]. Hence, this research achieved a majority of the index values at least for one index to fulfill every index category that had been set, which were index values for P-value, Chisq, RMSEA, CFI, Tucker–Lewis index (TLI), and Chisq/df based on continuous research data in Table 2.

Table 2. Fit index measurement model [32]

Category	Index name	Accepted index	Index measurement model
Absolute fit	Chisq	>0.05	285.708
	RMSEA	<0.08	.068
	GFI	>0.90	.916
Incremental fit	AGFI	>0.90	.886
	CFI	>0.90	.957
	TLI	>0.90	.948
	NFI	>0.90	.935
Parsimonious fit	Chisq/df	<5.0	2.857

Once the CFA procedure for every measurement model was carried out, the validity and reliability of the constructs were measured. Next, evaluation of the unidimensional, validity, and reliability of the measurement model was required before the production of a structural model. Unidimensional is a process to eliminate items that have low factor loading. The new model is operated, and the process of item elimination is continued until fit indexes achieve the required level. To ensure the validity, a procedure was conducted to make sure: i) Convergent validity: Average variance extracted (AVE)≥0.50 as refer to Table 3; ii) Construct validity: All constructs fulfill the fit index model to meet the required index level; iii) Discriminant validity: No overlap, eliminated, or has a "free parameter" characteristic item for all research constructs as presented in Table 4; iv) Reliability requirement is achieved through these processes: internal reliability with Alpha Cronbach≥.70, and Composite reliability (CR)≥0.6 as shown in Table 3.

Table 3 shows the validity values that give the AVE value for convergent validity≥0.50 and construct validity also shows all constructs meet the appropriate index model to meet the required index level. However, items with a loading factor value <0.6 were dropped. Thus, as many as one item (IB8) is discarded because it has a low loading factor to construct parent`s authority from PAQ. Meanwhile, there are five items (K1, K5, K8, K11, and K12) that were removed from the STEM career interest construct because they had a low loading factor and could not measure the construct well. For items that can already measure constructs well, the loading factor for each item must be 0.6 or higher [35].

Table 4 shows the diagonal values referring to the square root of the AVE values for each construct. The correlation for each construct also showed a positive correlation. The model achieved discriminant validity by recording high diagonal values as well as representing the correlation values for each construct based on the measurement model [31].

Table 3. Summary of CFA for latent construct

Construct	Eliminated item	Cronbach Alpha (>0.7)	CR (≥0.6)	AVE (≥0.5)
Parents authority	IB8	.953	.95	.70
STEM career interest	K1			
	K5	.807	.89	.50
	K8			
	K11			
	K12			

Table 4. Results of the correlation between construct measurement model

Construct	Parents' authority
Parents' authority	*.836
STEM career interest	**.102

3.2. Structural model

The structural model functions as a model that connects free variables and dependent variables [33]. It represents the magnitude and correlation direction between a set of visible variables or latent variables by enabling researchers to evaluate the relationship between variables based on the influence that was hypothesized in the model. Furthermore, the structural model involves all structural lines between latent variables in the model and overall fit for the structural model. The testing of a structural model using AMOS could generate information regarding the overall influence and direct influence of the variables in the model, whereas the calculation of estimation standard of regression could provide input on the validity of indicator for every variable.

According to Awang [31], the first step for the researcher is to test the model fit index based on the statistical index. If all the indices meet the recommended guidelines, then the model is acceptable for structural model testing. In this study, researchers used SEM to examine the influence of attitudes toward STEM and parental authority on the formation of students' STEM career interests.

3.3. Direct influence between parental authority and stem career interests

Figure 3 shows a model of the direct influence of parental authority (AUT) on the formation of students' STEM (KERSTEM) career interests. The direct influence between parental authority and the formation of STEM career interests was significant (β=.494, p=.001) in Table 5. Therefore, it is clear that the influence of parents plays an important role in shaping the future careers of students, especially in the field of STEM which is a need of the industry today. Based on Table 5, the value of the beta coefficient (estimated) is 494. Results have maintained a significant p-value of <0.001 between parental authority and students' STEM career interests.

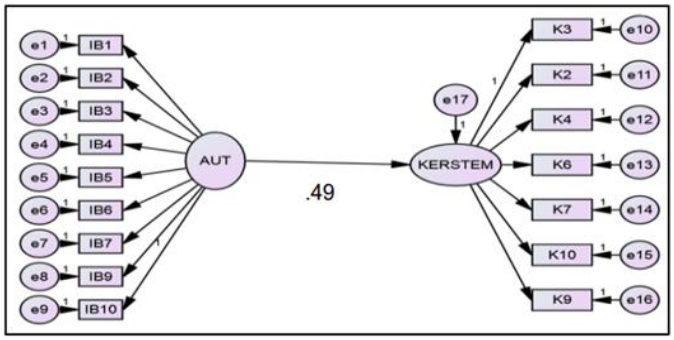

Figure 3. Direct influence analysis between parents' authority and creation of STEM career

Table 5. Output from direct influence analysis between parents' authority and creation of STEM career

Construct	Estimation	Standard estimation	P-value	Result
AUT→KERSTEM	.494	.407	.001	Significant

3.4. Discussion

Based on the findings, there was a direct influence between parents' autonomy towards the development of students' STEM career interest. Not only that, but the analysis also executed on the structural model found that the research objective was achieved and accepted, thus implying that there was a significant direct influence between parents' autonomy and development of STEM career interest ($p<.001$). The results from the testing are also supported by Murcia *et al.* [36] who stressed the importance of parental influence inclusively in the academic progress of learners as it can affect the learners' career aspirations positively and is relevant towards the value of a career in the STEM industry. Parents can also have a positive impact and significantly encourage the mastery of science and math subjects by science stream students at the secondary level to ensure that their STEM career interests are well nurtured [26], [37]. Additionally, the findings are also supported by Vanmeter-Adams *et al.* [38] stated that 65.5% of direct parental influence towards learners' academic progress and parents is the main significant component to increase learners' interest in STEM careers over the long-term. Therefore, parental influence is an important significant asset for learners' learning needs towards the formation of STEM career interest to ensure more comprehensive learning.

4. CONCLUSION

One of the methods to identify students' interest tendencies toward STEM careers is by statistically testing the influence of parents' autonomy on STEM career development. Researchers did not only manage to determine the variables that could influence the development of students' STEM career interests, but they also identified the significance of parents' autonomy towards students' needs in supporting STEM curriculum innovation. The findings of the research support the education system blueprints stating that parents act as a school society and are a good influence on students, especially to develop students' interest in STEM careers.

Therefore, to ensure that the need for science learning is always driven by STEM and can be sustained among students, every section of the school community needs to emphasize student involvement, particularly among parents. Next, comprehensive parental involvement is needed in introducing STEM concepts from a variety of clear channels to students such as engaging students with STEM programs outside of school hours and guiding students in the process of exploring STEM. This study has proven that the needs of parents are seen as the dominant factor in influencing the career formation of students starting from the secondary school level.

Additionally, the findings of this research have led to a positive impact on science education by providing a significant contribution towards producing students that can compete in the STEM industry. This was achieved because the research combined accurate variables to interpret secondary school standard curriculum (SSSC) targets to channel the importance of STEM. Therefore, it suits the students' requirements in learning, especially among students at the secondary school level and in the school community roles more comprehensively.

REFERENCES

[1] M. Kitada and J. Harada, "Progress or regress on gender equality: The case study of selected transport STEM careers and their vocational education and training in Japan," *Transportation Research Interdisciplinary Perspectives*, vol. 1, p. 100009, Jun. 2019, doi: 10.1016/j.trip.2019.100009.

[2] S. Chachashvili-Bolotin, M. Milner-Bolotin, and S. Lissitsa, "Examination of factors predicting secondary students' interest in tertiary STEM education," *International Journal of Science Education*, vol. 38, no. 3, pp. 366–390, Feb. 2016, doi: 10.1080/09500693.2016.1143137.

[3] F. Razali, "Exploring crucial factors of an interest in STEM career model among secondary school students," *International Journal of Instruction*, vol. 14, no. 2, pp. 385–404, Apr. 2021, doi: 10.29333/iji.2021.14222a.

[4] S. Barnes, J. Bimrose, A. Brown, and J. Gough, "The role of parents and careers in providing careers guidance and how they can be better supported evidence report," *Warwick Institute for Employment Research*, pp. 1–78, 2020.

[5] H. Alkharusi, S. Aldhafri, A. Kazem, A. Alzubiadi, and M. Al-Bahrani, "Development and validation of a short version of the parental authority questionnaire," *Social Behavior and Personality*, vol. 39, no. 9, pp. 1193–1208, 2011, doi: 10.2224/sbp.2011.39.9.1193.

[6] H. Doron and A. Sharbani, "Parental authority styles of parents with attention deficit disorders (ADD) attention deficit disorder and gender differences among adults," *Open Journal of Social Sciences*, vol. 1, no. 6, pp. 43–49, 2013.

[7] D. David, B. Situmorang, R. Mini, and A. Salim, "The effects of authoritative paternal-maternal parenting styles on career decision self-efficacy of gen Z adolescents: Thinking styles as mediators," *International Journal of Innovation, Creativity and Change*, vol. 13, no. 10, pp. 148–160, 2020.

[8] D. Reilly, D. L. Neumann, and G. Andrews, "Gender differences in spatial ability: Implications for STEM education and approaches to reducing the gender gap for parents and educators," in *Visual-spatial Ability in STEM Education*, Cham: Springer International Publishing, 2017, pp. 195–224, doi: 10.1007/978-3-319-44385-0_10.

[9] A. E. Du Plessis, "The lived experience of out-of-field STEM teachers: A quandary for strategising quality teaching in STEM?" *Research in Science Education*, vol. 50, no. 4, pp. 1465–1499, Aug. 2020, doi: 10.1007/s11165-018-9740-9.

[10] C. S. Rozek, R. C. Svoboda, J. M. Harackiewicz, C. S. Hulleman, and J. S. Hyde, "Utility-value intervention with parents increases students' STEM preparation and career pursuit," *Proceedings of the National Academy of Sciences*, vol. 114, no. 5, pp. 909–914, Jan. 2017, doi: 10.1073/pnas.1607386114.

[11] J. O. Otundo and A. C. Garn, "Student interest and engagement in middle school physical education: Examining the role of needs supportive teaching," *International Journal of Educational Psychology*, vol. 8, no. 2, p. 137, Jun. 2019, doi: 10.17583/ijep.2019.3356.

[12] Curriculum Development Division Ministry of Education Malaysia, *Description of the medium school standard curriculum (KSSM)*. Putrajaya, Malaysia, 2016.

[13] M. Ing, "Gender differences in the influence of early perceived parental support on student mathematics and science achievement and stem career attainment," *International Journal of Science and Mathematics Education*, vol. 12, no. 5, pp. 1221–1239, Oct. 2014, doi: 10.1007/s10763-013-9447-3.

[14] C. van Tuijl and J. H. W. van der Molen, "Study choice and career development in STEM fields: an overview and integration of the research," *International Journal of Technology and Design Education*, vol. 26, no. 2, pp. 159–183, May 2016, doi: 10.1007/s10798-015-9308-1.

[15] J. Buri, "An instrument for the measurement of parental authority prototypes," *Journal of Physics A: Mathematical and Theoretical*, vol. 44, no. 8, pp. 1689–1699, 2011.

[16] B. Ralph and J. McNeal, "Parent involvement, academic achievement and the role of student attitudes and behaviors as mediators," *Universal Journal of Educational Research*, vol. 2, no. 8, pp. 564–576, 2014.

[17] T. Kennedy and M. R. L. Odell, "Engaging students in STEM education," *Science Education International*, vol. 25, no. 3, pp. 246–258, 2014.

[18] M. Guan, A. Capezio, S. L. D. Restubog, S. Read, J. A. L. Lajom, and M. Li, "The role of traditionality in the relationships among parental support, career decision-making self-efficacy and career adaptability," *Journal of Vocational Behavior*, vol. 94, pp. 114–123, 2016, doi: 10.1016/j.jvb.2016.02.018.

[19] E. Eisner, "The three curricula that all schools teach," *The educational imagination: On the design and evaluation of school programs*, Merill Pretince Hall, 1985, pp. 87–107.

[20] P. E. Davis-Kean, "The influence of parent education and family income on child achievement: the indirect role of parental expectations and the home environment," *Journal of Family Psychology.*, vol. 19, no. 2, p. 294, 2005.

[21] K. Murayama, R. Pekrun, M. Suzuki, H. W. Marsh, and S. Lichtenfeld, "Don't aim too high for your kids: Parental over aspiration undermines students' learning in mathematics," *Journal of Personality and Social Psychology*, vol. 111, no. 5, pp. 766–779, 2016, doi: 10.1037/pspp0000079.

[22] A. Soni and S. Kumari, "The role of parental math anxiety and math attitude in their children's math achievement," *International Journal of Science and Mathematics Education*, vol. 15, no. 2, pp. 331–347, Feb. 2017, doi: 10.1007/s10763-015-9687-5.

[23] United States Bureau of Labor and Statistics, *Employment in STEM occupations*. Washington DC, 2021.

[24] National Economic Advisory Council, *New economic model for Malaysia*. Percetakan Nasional Malaysia Berhad, Kuala Lumpur, 2010.

[25] E. Baran, S. Canbazoglu Bilici, C. Mesutoglu, and C. Ocak, "The impact of an out-of-school STEM education program on students' attitudes toward STEM and STEM careers," *School Science and Mathematics*, vol. 119, no. 4, pp. 223–235, Apr. 2019, doi: 10.1111/ssm.12330.

[26] F. Razali, U. K. A. Manaf, O. Talib, and S. A. Hassan, "Motivation to learn science as a mediator between attitude towards STEM and the development of STEM career aspiration among secondary school students," *Universal Journal of Educational Research*, vol. 8, no. 1A, pp. 138–146, Jan. 2020, doi: 10.13189/ujer.2020.081318.

[27] M. Badri, A. Alnuaimi, J. Mohaidat, A. Al Rashedi, G. Yang, and K. Al Mazroui, "My science class and expected career choices—a structural equation model of determinants involving Abu Dhabi high school students," *International Journal of STEM Education*, vol. 3, no. 1, p. 12, Dec. 2016, doi: 10.1186/s40594-016-0045-0.

[28] Department Economic Planning Unit Prime Minister's, *The eleventh Malaysia plan: Transforms the education system*. Putrajaya, Malaysia, 2015.

[29] N. Othman and S. Khairollah, "Exploration of the relationship between Islamic personality and motherhood," *International Journal of Islamic Thought*, vol. 4, no. 1, pp. 48–57, Dec. 2013, doi: 10.24035/ijit.04.2013.006.

[30] B. Byrne, *Structural Equation Modeling with AMOS: basic concepts, applications, and programming*, 2nd Ed. New York: Taylor & Francis Group, 2010.

[31] Z. Awang, *Structural Equation Modeling Using AMOS*. MPWS Rich Publication, 2015.
[32] J. Hair, W. C. Black, B. J. Babin, and R. E. Anderson, *Multivariate data analysis*, 7th ed. Pearson Prentice Hall, 2010.
[33] J. B. Schreiber, A. Nora, F. K. Stage, E. A. Barlow, and J. King, "Modeling and Confirmatory Factor Analysis Results: A Review," *The Journal of Education Research*, vol. 99, no. 6, pp. 323–338, 2006, doi: 10.3200/JOER.99.6.323-338.
[34] D. Hooper, J. Coughlan, and M. R. Mullen, "Structural Equation Modelling: Guidelines for Determining Model Fit," *The Electronic Journal of Business Research Methods*, vol. 6, no. 1, pp. 53–60, 2008, doi: 10.21427/D7CF7R.
[35] L. Hu and P. M. Bentler, "Fit Indices in Covariance Structure Modeling: Sensitivity to Underparameterized Model Misspecification," *Psychological Methods*, vol. 3, no. 4, pp. 424–453, 1998, doi: 10.1037/1082-989X.3.4.424.
[36] K. Murcia, C. Pepper, and J. Williams, "Youth STEM career choices: What's influencing secondary students' decision making," *Issues in Educational Research*, vol. 30, no. 2, pp. 593-611, 2020.
[37] F. Tentama and M. Z. Nur, "The correlation between self-efficacy and peer interaction towards students' employability in vocational high school," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 10, no. 1, pp. 8-15, 2021, doi: 10.11591/ijere.v10i1.20573.
[38] A. VanMeter-Adams, C. L. Frankenfeld, J. Bases, V. Espina, and L. A. Liotta, "Students Who Demonstrate Strong Talent and Interest in STEM Are Initially Attracted to STEM through Extracurricular Experiences," *CBE Life Sciences Education*, vol. 13, no. 4, pp. 687–697, 2014, doi: 10.1187/cbe.13-11-0213.

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