International Journal of Modern Education IJMOE
EISSN: 2637-0905

Volume 7 Issue 26 (September 2025) PP. 32-41
DOI: 10.35631/IJMOE.726003

INTERNATIONAL JOURNAL OF MODERN EDUCATION (IJMOE)
www.ijmoe.com

GLOBAL ACADEMIC EXCELLENCE

STEM INTERVENTION: IGNITING MOTIVATION AND ASPIRATION TO ELEVATE MARGINALISED STUDENTS (ASNAF) THROUGH EXPERIENTIAL LEARNING

Hanis Hazwani Ahmad[1], Mohd Zaki Shahabuddin[2*], Wan Safizah Wan Salim[3], Nur Asmaliza Mohd Noor[4]

[1] Pusat Pengajian Ekonomi, Kewangan dan Perbankan, Universiti Utara Malaysia, Kedah, Malaysia
Email: h.hazwani@uum.edu.my
[2] Fakulti Perniagaan dan Sains Pengurusan, Universiti Islam Antarabangsa Tuanku Syed Sirajuddin, Perlis, Malaysia
Email: mzaki@unisiraj.edu.my
[3] Pengajian Kejuruteraan Awam, UiTM Cawangan Pulau Pinang, Pulau Pinang, Malaysia
Email: wansafizah@uitm.edu.my
[4] Fakulti Kejuruteraan Awam, UiTM Cawangan Pahang, Pahang, Malaysia
Email: nurasmaliza@uitm.edu.my
[*] Corresponding Author

Article Info:

Article history:
Received date: 30.06.2025
Revised date: 17.07.2025
Accepted date: 12.08.2025
Published date: 01.09.2025

To cite this document:

Ahmad, H. H., Shahabuddin, M. Z., Salim, W. A. W., Noor, N. A. M. (2025). STEM Intervention: Igniting Motivation And Aspiration To Elevate Marginalised Students (Asnaf) Through Experiential Learning. *International Journal of Modern Education, 7* (26), 32-41.

DOI: 10.35631/IJMOE.726003

Abstract:

This study explores the impact of a hands-on STEM intervention on the perceptions, attitudes, and aspirations of Form Three students, with a specific focus on those from *Asnaf* (low-income) backgrounds. The intervention conducted in a secondary school in Arau, Perlis, involved a tower-building challenge using satay sticks, designed to foster student engagement through experiential and collaborative learning. A quantitative pre-test and post-test design was employed, using structured questionnaires to assess four key constructs: interest, awareness, knowledge, and motivation toward STEM. Instrument's reliability, descriptive statistics, and construct-level analysis were used to examine changes in student responses. The results revealed a generally positive impact of the STEM activity, particularly in enhancing student motivation and aspiration, which showed the most significant improvement. Although the domain of interest exhibited a slight declines, the overall findings suggested that experiential learning can effectively encourage STEM- related aspirations, especially for underserved learners. This study affirms the value of accessible, practical STEM interventions in supporting equitable education outcomes and highlights the need for sustained, inclusive programs designed especially in STEM education.

International Journal of Modern Education IJMOE
EISSN: 2637-0905
Volume 7 Issue 26 (September 2025) PP. 32-41
DOI: 10.35631/IJMOE.726003

Keywords:

STEM Education, Asnaf, Experiential Learning, School Students, STEM Activity

Introduction

The Malaysian government has emphasised STEM (Science, Technology, Engineering, and Mathematics) education as a crucial pathway to becoming a developed nation. However, recent trends indicate a decline in student interest in the science stream at the secondary school level, impacting engineering courses in higher education institutions, which are struggling to attract new students. This decline raises concerns about the future availability of qualified graduates for STEM-related fields, particularly in engineering and technology, which is crucial for Malaysia's technological advancement and economic growth (Astro Awani, 2024).

Idris and Bacotang (2023) reported that Malaysian school students generally exhibit a moderate level of interest and perception toward STEM education. This is a trend that is particularly evident among students from low socioeconomic backgrounds. In this context, Asnaf students, who belong to the zakat recipient group and represent low-income communities, often face various constraints in accessing high-quality learning experiences, including STEM fields. The digital-divide, lack of exposure to hands-on learning, and limited reference resources are among the factors contributing to low levels of engagement. This highlights the importance of understanding how STEM interventions impact Asnaf students, and ensuring that teaching strategies are appropriately designed and tailored to support their learning needs.

This study focused on the implementation of a tower building for a competition using satay skewers, which was carried out with Form 3 students including Asnaf students at a secondary school in Perlis, Malaysia. This activity was designed to introduce STEM elements in an interactive, easily accessible form, and is suitable for the students' backgrounds. It combines basic engineering elements, teamwork, and creativity in a fun and challenging atmosphere. The outcomes from this study are expected to provide an insightful understanding of how STEM activities impact groups of students who might lack access to direct experiential education.

Literature Review

STEM education has become a critical focus in global education reform due to its role in preparing students for a rapidly changing technology-driven world. A growing body of research have highlighted the potential of STEM to foster impartial access to quality education, especially for students from the low-income or underprivileged groups (Idris et al., 2023; Razali, 2021; Uludüz & Çalik, 2023)).

STEM education is recognised as a tool for reducing educational inequalities, particularly among socioeconomically disadvantaged students. STEM can help reduce education gaps among students who have limited access to resources. For example, in Malaysia, some students from the lower-income groups, such as those classified as Asnaf often lack opportunities to experience quality STEM learning. Idris, Govindasamy, and Nachiappan (2023) stated that creating STEM activities that are more inclusive and suitable for these students can improve

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 26 (September 2025) PP. 32-41
DOI: 10.35631/IJMOE.726003
their interest and be a motivational factor for them to participate in science and technology subjects at school.

Experiential learning has shown to be highly effective in enhancing STEM engagement. Kolb's (1984) foundational theory of experiential learning continues to inform modern pedagogy, stating that students learn more effectively through active participation. Building on this, Keshtkar, Tamborrell, and Kojima (2023) examined experiential STEM activities in educational settings and found that students reported better engagement, higher motivation, and improved confidence when involved in hands-on learning experiences. Such activities, comprising engineering challenges and collaborative tasks, were particularly impactful in helping students understand the STEM concepts.

Furthermore, the project-based learning (PBL) also gained prominence as a strategy that supports academic achievement while also nurturing transferable skills such as collaboration and critical thinking. Rehman et al. (2024), in their meta-analysis of PBL effectiveness, concluded that students exposed to STEM through projects consistently outperformed their peers in conventional learning environments. This reinforces the value of integrating problem-solving and real-world applications into the STEM curriculum, especially for students with limited access to enrichment programs.

Despite the proven benefits of STEM education, challenges remain in delivering it justifiably, particularly in rural or economically disadvantaged schools. Recsam (2022) conducted a comprehensive review of STEM implementation in Malaysia and found that while policies exist to promote STEM, many schools still face significant barriers, including insufficient resources, lack of teacher training, and limited community involvement. These factors often result in lower engagement levels among students from B40 households, including those classified as Asnaf.

Student self-efficacy plays a key role in STEM participation. Students who believe that they are capable of performing STEM-related tasks are more likely to pursue related studies or careers. Issa and Khataibeh (2021) demonstrated that project-based learning not only improved cognitive outcomes but also significantly boosted students' confidence in their abilities. Such confidence is especially critical for underrepresented groups, as early success experiences in STEM can positively shape long-term attitudes and career decisions.

Based on the reviewed literature, the main variables relevant to the study are summarised concisely in Table 1. The key findings highlighted the importance of specific factors namely the interest and engagement, career awareness, STEM knowledge, and motivation/aspiration in shaping students' perception and participation in STEM education. These insights collectively support the design and objectives of the STEM intervention explored in this study.

Table 1: Key Findings of the Reviewed Literature

Variable	Authors & Year	Key Findings
Interest and Engagement	Idris et al. (2023)	Inclusive STEM activities improve interest and motivation among students.
	Keshtkar et al. (2023)	Experiential STEM activities in educational settings proved students' better engagement.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 26 (September 2025) PP. 32-41
DOI: 10.35631/IJMOE.726003

STEM Career Awareness	Idris et al. (2023)	Rural students have low awareness of STEM careers due to lack of exposure.
	Recsam (2022)	Current educational systems do not properly incorporate STEM career streams.
STEM Knowledge and Understanding	Keshtkar et al. (2023)	Experiential STEM tasks improve understanding on subject matters.
	Rehman et al. (2024)	PBL enhances concept mastery and academic performance.
Motivation and Aspiration	Issa et al. (2021)	PBL increases students' self-confidence and belief in STEM abilities.
	Rehman et al. (2024)	Real-world, problem-based tasks strengthen motivation and STEM aspirations.

Methodology

This study employed a quantitative research design using a pre-test and post-test approach to evaluate changes in students' perceptions and attitudes toward STEM following a specific intervention. The participants were Form 3 students from a secondary school in Arau, Perlis. The participants also included students from *Asnaf* backgrounds.

The intervention consisted of a tower-building STEM activity using satay sticks, conducted in small groups. This hands-on task was designed to introduce core STEM elements such as basic engineering, group problem-solving, creativity, and scientific thinking. The activity was intended to foster engagement and encourage practical understanding, especially among students with limited access to experiential STEM education.

Two sets of questionnaires were administered: one before the activity and one after. The instrument measured student responses across several key areas, including:

- Interest and engagement in STEM
- Awareness of STEM professions
- Knowledge and understanding of STEM-related concepts
- Aspiration of STEM to their academic and career direction

Each construct included multiple items measured on a Likert-type scale. Items were grouped and analysed based on these construct categories to observe domain-specific changes.

In addition, the study explored correlational relationships between selected variables, as conceptualised in the framework (see Figure 1):

Volume 7 Issue 26 (September 2025) PP. 32-41
DOI: 10.35631/IJMOE.726003

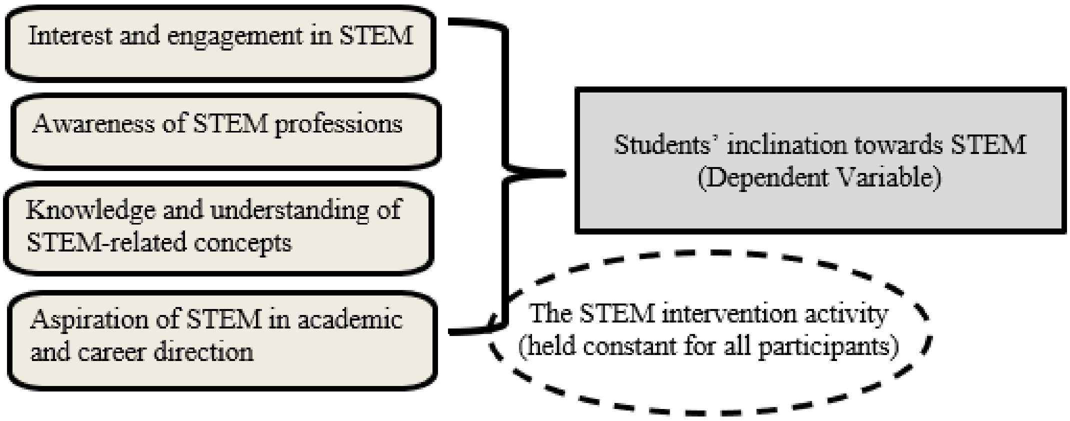

Figure 1: Conceptual Framework of Study

The data were analysed using the following techniques:

- **Instrument reliability** of variables relationship was explored, as per the conceptual framework in Figure 1, to evaluate associations between students' perceptions of the program and their STEM aspirations, while keeping the intervention constant across all participants.
- **Descriptive statistics** (mean and standard deviation) were used to compare item-level and construct-level scores before and after the program.
- A **construct-level analysis** was conducted to identify which areas showed the greatest improvements or declines, with particular emphasis on "Motivation/Aspiration" towards STEM.

Results and Discussion

Instrument Reliability

To evaluate the internal consistency of the instrument's reliability, Cronbach's alpha was calculated for both the pre- and post-intervention datasets as presented in Table 2. The analysis yielded an alpha value of 0.871 before the program and 0.837 after, both of which fall within the range of good reliability ($\alpha > 0.80$).

These results indicated that the instrument consistently measured the intended constructs across time points. The high reliability values enhanced the credibility of comparisons made between pre- and post-program responses, supporting the survey's used in assessing changes in student perceptions and competencies related to STEM.

Table 2: Summary of Cronbach's Alpha for Survey Instrument

Survey Phase	Cronbach's Alpha	Interpretation
Before STEM Program	0.871	Good reliability
After STEM Program	0.837	Good reliability

International Journal of Modern Education
EISSN: 2637-0905
Volume 7 Issue 26 (September 2025) PP. 32-41
DOI: 10.35631/IJMOE.726003

Descriptive Statistics

Descriptive statistical analysis was conducted to compare survey responses before and after the implementation of the STEM intervention. Table 3 presents the means and standard deviations for each item across both points. Overall, the results indicated notable shifts in student perceptions and attitudes towards the conducted STEM activity.

Table 3: Descriptive Statistics

Variable – Description	Mean (Before)	Std Dev (Before)	Mean (After)	Std Dev (After)
Ac1 - I want to be scientist	2.3	0.712	2.4	0.647
Ac2 - I want to be engineer	2.13	0.776	2.17	0.775
Ac3 - I want to be mathematician	2.19	0.793	2.17	0.845
Ba1 - English fluency	1.74	0.721	1.81	0.754
Ba2 - Science fluency	1.74	0.511	1.82	0.534
Ba3 - Math fluency	1.63	0.639	1.78	0.687
Bb1 - STEM interest	2.62	0.818	2.63	0.797
Bb2 - Enjoy science subject	2.89	0.683	2.87	0.727
Bb3 - Enjoy experimental activities	2.38	0.709	2.38	0.718
Bb4 - Understand STEM	2.79	1.064	2.85	0.917
Bb5 - Like new invention	2.83	0.75	2.76	0.826
Bb6 - Like to improvise tool	2.7	0.774	2.65	0.741
Bb7 - Know to repair machine	2.71	0.867	2.56	0.791
Bb8 - Eager to know machine works	2.94	0.814	2.84	0.833
Bb9 - Looking for STEM career	2.61	0.885	2.62	0.87
Bb10 - Interest in STEM subjects	2.63	0.867	2.63	0.891
Bb11 - To become innovator	2.63	0.79	2.73	0.798
Bb12 - Know electronics	2.95	0.808	2.79	0.882
Bb13 - To apply creativity and innovation in future job	2.98	0.747	2.73	0.842
Bb14 - I can be engineer	2.63	0.88	2.62	0.818

Table 3 shows a consistent sample and supports the validity of pre- and post-intervention comparisons. Items Ac1 to Ac3 assessed students' aspirations to pursue STEM-related careers. The item "I want to be a scientist" (Ac1) showed a slight increase in the mean score from 2.30 to 2.40, indicating a positive shift in students' interest toward science careers. However, aspirations to become an engineer (Ac2) and mathematician (Ac3) remained relatively stable, with minimal changes in mean scores. This suggests that while the activity may have enhanced interest in scientific roles, it had a more limited effect on aspirations in engineering and mathematics.

Items Ba1 to Ba3, which measured students' confidence in their fluency in English, science, and mathematics, all demonstrated modest improvements in post-intervention. For example, science fluency increased from 1.74 to 1.82, and math fluency from 1.63 to 1.78. These results after engaging in the hands-on activity, indicate a positive shift in the students' self-perceived academic ability in the core STEM areas.

Volume 7 Issue 26 (September 2025) PP. 32-41
DOI: 10.35631/IJMOE.726003

The majority of items under the Bb category, which explored the students' general interest, engagement, and attitudes toward STEM, showed stable or slightly positive trends. Notably, "I understand STEM" (Bb4) increased from 2.79 to 2.85, and "I want to become an innovator" (Bb11) from 2.63 to 2.73, reflecting improved comprehension and aspiration related to innovation.

However, a number of items recorded minor declines, particularly those involving technical or hands-on dimensions. These include "I like new inventions" (Bb5), "I know how to repair machines" (Bb7), and "I know electronics" (Bb12). The declines, while not drastic, may indicate increased awareness of the complexity involved in such tasks following direct exposure, a phenomenon sometimes referred to as the "awareness effect."

In summary, the STEM intervention had a modestly positive impact, particularly in enhancing students' motivation, perceived fluency, and understanding of STEM. While the activity succeeded in maintaining general interest, some practical and technical aspects showed slight decreases, suggesting the need for continued support and scaffolding in those areas. These findings highlight the value of experiential STEM programs in promoting early interest, while also underscoring the importance of sustained and targeted follow-up activities to strengthen competencies in more complex STEM domains. This is consistent with the findings of Ali et al. (2018), which reported that students involved in STEM competitions developed a deeper interest in STEM careers, notably due to the mentoring and hands-on experiences provided throughout the activity. Similarly, Kairi et al. (2024) reported that most of secondary school students who participated in a competition-based learning chose to pursue studies in STEM.

Analysis of Pre- and Post STEM Program

Figure 2 presents the variables with the most notable changes in mean scores following the implementation of the STEM program. For example, students showed that elements in the program encouraged them in terms of cooperation within a team, problem solving and innovation and creativity. Creativity showed the most substantial positive shift with a mean increase of +0.26. This suggests that a strong impact of the program on specific aspects, are related to the students' motivation, confidence, or sustained interest in STEM-related areas. This is also similar with the, experience in the STEM subject of mathematics and students showing interest in the STEM subject specifically in veterinary fields. This result also shows a moderate increase in mean scores, indicating that the program may have effectively enhanced understanding or appreciation in those domains. These positive trends imply that the intervention successfully addressed key learning or attitudinal goals for several constructs measured in the study.

In contrast, some variables exhibited a decline or minimal change. The result suggests that students are interested in how a machine works and have a modest decrease of −0.10, which may reflect reduced engagement or possible confusion regarding that specific component of the program. Students who prefer to be as scientists also show a decline (−0.10), warranting further review to determine whether the instructional strategies used were adequately aligned with participants' needs or expectations. Despite these minor regressions, the general pattern reveals a net positive impact of the STEM intervention, reinforcing the value of targeted programming in promoting STEM education outcomes. These results provide important insights into refining future program content and delivery to maximise overall effectiveness.

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 26 (September 2025) PP. 32-41
DOI: 10.35631/IJMOE.726003

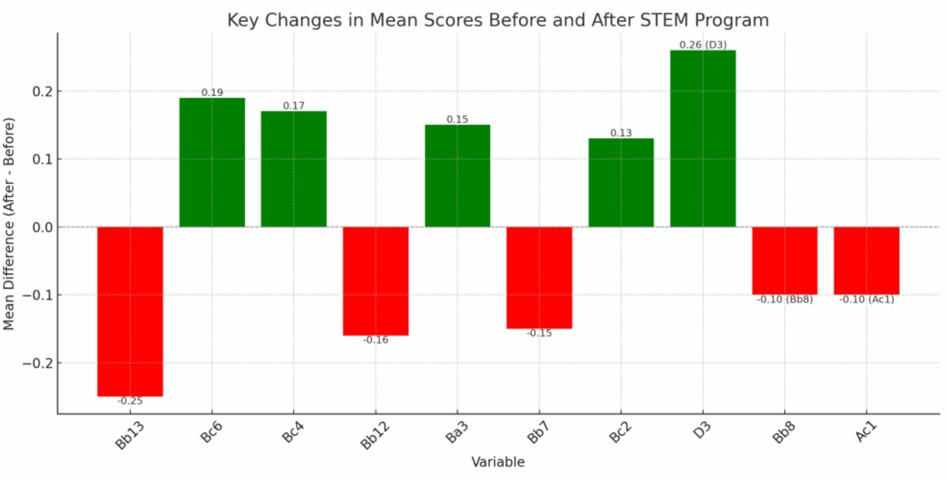

Figure 2: Analysis of Pre- and Post STEM Program

Construct-Level Analysis: Pre- and Post-STEM Program

A comparative analysis of pre- and post-program descriptive statistics revealed notable trends across key constructs related to STEM education. The most substantial improvement was observed in the 'Motivation/Aspiration' construct, which recorded an increase in average mean from 0.50 before the program to 2.34 after the program. This significant gain (+1.84) suggests that the STEM intervention had a pronounced positive impact on students' intrinsic motivation, career interest, or future aspirations in STEM fields. Such an increase underscores the program's effectiveness in fostering long-term engagement and vision among participants.

Conversely, constructs such as 'Interest in STEM', and 'Awareness', exhibited modest declines in average scores, with reductions ranging from -0.16 to -0.27. These changes, although relatively small, may indicate that the program either shifted focus away from these foundational aspects or that measurement inconsistencies were present in the pre-program phase, as reflected in the notably higher standard deviations prior to the intervention. Interestingly, 'Knowledge/Understanding' remained relatively stable across both phases, suggesting the program successfully maintained baseline comprehension. Overall, the descriptive trends highlight both the strengths and potential areas for enhancement within the STEM curriculum.

Table 4: Construct-Level Analysis: Pre- and Post-STEM Program

No	Construct	Average Mean (Before)	Average Std Dev (Before)	Average Mean (After)	Average Std Dev (After)	Mean Difference
1	Interest in STEM	2.41	1.81	2.19	0.79	-0.22
2	Awareness	2.07	3.66	1.8	0.66	-0.27
3	Knowledge/Understanding	2.78	0.99	2.74	0.81	-0.04
4	Motivation/Aspiration	0.5	0.53	2.34	1.07	1.84

Conclusion and Recommendation

This study evaluated the impact of a hands-on STEM activity, the tower-building challenge, on the perceptions, understanding, and aspirations of Form Three students, particularly those from *Asnaf* backgrounds. The pre- and post-intervention analysis demonstrated that the program had a generally positive influence on students' engagement with STEM.

Among the four constructs assessed, motivation and aspiration showed the most substantial improvement, indicating that the activity effectively sparked interest in STEM-related careers and fostered forward-looking attitudes. While some domains such as knowledge/understanding remained stable, others including interest, and awareness, showed modest declines or minimal change. These findings suggest that while the activity was successful in promoting ambition and enjoyment, certain foundational STEM elements may require additional reinforcement or targeted instructional strategies.

To strengthen the impact of future STEM interventions, it is recommended that programs incorporate a series of related activities that gradually increase in complexity. This tiered approach would allow students, particularly studenrs from *Asnaf* backgrounds, to reinforce foundational knowledge while steadily building their confidence and problem-solving skills. Given the modest declines observed in areas such as awareness and interest, supplemental instruction focused on conceptual clarity and real-world STEM applications may help sustain student engagement. Embedding reflective components, such as guided discussions or learning diaries can further enhance students' ability to connect STEM activities to their personal goals and future aspirations.

Acknowledgement

The authors would like to acknowledge and extend their special gratitude to the Faizuddin Centre of Educational Excellence (FCoEE), who granted the Short-Term Grant Scheme 2024 for this project.

References

Ali, M., Talib, C. A., Surif, J., Ibrahim, N. H. & Abdullah, A. H. (2018). Effect of STEM competition on STEM career interest. *2018 IEEE 10th International Conference on Engineering Education (ICEED), pp. 111-116.*

Astro Awani. (2024, August 26). *Columnist: Rethinking STEM education for Malaysia's future*. https://international.astroawani.com/malaysia-news/columnist-rethinking-stem-education-malaysia-s-future-485131

Fairhurst, N., Koul, R. & Sheffield, R. (2023). Students' perceptions of their STEM learning environment. *Learning Environ Res 26, 977–998.* https://doi.org/10.1007/s10984-023-09463-z

Idris, R., Govindasamy, P., Nachiappan, S., & Bacotang, J. (2023). Examining Moderator Factors Influencing Students' Interest in STEM Careers: The Role of Demographic, Family, and Gender. *International Journal of Academic Research in Progressive Education and Development, 12(2), 2148–2161.* http://dx.doi.org/10.6007/IJARPED/v12-i2/17609

Idris, R., Govindasamy, P., & Nachiappan, S. (2023). Challenge and Obstacles of STEM Education in Malaysia. *International Journal of Academic Research in Business and Social Sciences, 13(4), 773– 780*. http://dx.doi.org/10.6007/IJARBSS/v13-i4/16676

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 26 (September 2025) PP. 32-41
DOI: 10.35631/IJMOE.726003
Idris, R., Govindasamy, P., Nachiappan, S. (2023). Trends and Considerations of Self- Efficacy of STEM Education in Malaysia. *International Journal of Advanced Research in Education and Society, [S.l.], v. 5, n. 1, p. 208-215, mar. 2023. ISSN 2682-8138*. https://myjms.mohe.gov.my/index.php/ijares/article/view/21829

Issa HB, Khataibeh A (2021). The Effect of Using Project Based Learning on Improving the Critical Thinking among Upper Basic Students from Teachers' Perspectives. *Pegem Journal of Education and Instruction, Vol. 11, No. 2, 2021,52-57.*https://files.eric.ed.gov/fulltext/EJ1302127.pdf

Keshtkar, S., Tamborrell, P., & Kojima, H. (2023). Learning perceptions of STEM students partaking in an international experiential learning. *Int J Interact Des Manuf 17, 3279–3303*. https://doi.org/10.1007/s12008-023-01380-y

Kairi, N. I., Jamaludin, N., & Mohd Ridzuan, N. D. (2024). Competition-based learning in science camp to stimulate upper secondary school students' motivation in learning STEM. *Sains Humanika*, *16*(2), 53–63. https://doi.org/10.11113/sh.v16n2.2137

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.

Ministry of Education. (2022). *Annual Report of the Malaysian Education Development Plan.* Putrajaya: Ministry of Education Malaysia.

Razali, F., Abdul Manaf, U., & Ayub, M. A. F. (2020). STEM Education in Malaysia towards Developing a Human Capital through Motivating Science Subject. *International Journal of Learning, Teaching and Educational Research, 19(5). doi.org/10.26803/ijlter.19.5.25.* https://doi.org/10.26803/ijlter.19.5.25

Razali, F. (2021). Exploring Crucial Factors of an Interest in STEM Career Model among Secondary School Students. *International Journal of Instruction, 14(2), 385-404.* https://doi.org/10.29333/iji.2021.14222a

RECSAM. (2022). STEM education in Malaysia: A review. *Learning Science and Mathematics Online Journal, 9, 1–10.* https://www.recsam.edu.my/sub_LSMJournal/images/docs/2022/2022_9_ASPIN_125139.pdf

Rehman, N., Huang, X., Batool, S., & Andleeb, I. (2024). Assessing the effectiveness of project-based learning: A comprehensive meta-analysis of student achievement between 2010 and 2023. *CMU Journal of Social Sciences and Humanities, 11(2), e2024015.* https://doi.org/10.12982/CMUJASR.2024.015

Uludüz, Şule & Çalik, Muammer. (2023). A Thematic Review of STEM Education for Disadvantaged Students. *Canadian Journal of Science, Mathematics and Technology Education. 1-21.* 10.1007/s42330-022-00247-w.