International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 25 (June 2025) PP. 133-142
DOI: 10.35631/IJMOE.725010

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

INFLUENTIAL FACTORS IMPACTING STUDENTS' ACADEMIC PERFORMANCE IN SMK SRI KURAU USING FUZZY DELPHI METHOD

Mohd Halimi Ab Hamid[1*], Anas Fathul Ariffin[2], Nurul Nadiya Abu Hassan[3], Muhammad Yassar Yusri[4]

[1] College of Computing, Informatics and Mathematics, Universiti Teknologi MARA, Cawangan Perlis Kampus Arau, Arau, Perlis, MALAYSIA.
Email: halimi@uitm.edu.my
[2] College of Computing, Informatics and Mathematics, Universiti Teknologi MARA, Cawangan Perlis Kampus Arau, Arau, Perlis, MALAYSIA.
Email: anasfathul@uitm.edu.my
[3] College of Computing, Informatics and Mathematics, Universiti Teknologi MARA, Cawangan Pahang Kampus Jengka, Bandar Tun Abd Razak Jengka, Pahang, MALAYSIA.
Email: nurulnadiya@uitm.edu.my
[4] College of Computing, Informatics and Mathematics, Universiti Teknologi MARA, Cawangan Johor Kampus Segamat, Segamat, Johor, MALAYSIA.
Email: muham449@uitm.edu.my
[*] Corresponding Author

Article Info:

Article history:
Received date: 27.03.2025
Revised date: 14.04.2025
Accepted date: 15.05.2025
Published date: 05.06.2025

To cite this document:

Ab Hamid, M. H., Ariffin, A. F., Hassan, N. N. A., & Yusri, M. Y. (2025). Influential Factors Impacting Students' Academic Performance In Smk Sri Kurau Using Fuzzy Delphi Method. *International Journal of Modern Education, 7* (25), 133-142.

Abstract:

Students' academic performance is influenced by various interrelated factors, necessitating a structured approach to identifying the most significant determinants. The 2022 and 2023 SPM results show worrying failure rates in key subjects like Mathematics, Sejarah, and Bahasa Melayu, though there was a slight improvement in 2023. These trends highlight the need for more targeted and evidence-based teaching strategies. This study aims to rank and evaluate the key subfactors affecting student achievement at SMK Sri Kurau, Bagan Serai, using the Fuzzy Delphi Method. A panel of 30 expert teachers participated in the study to assess student-related, school-related, and parental-related factors through expert consensus. The findings indicate that student attendance, attitude, and self-tuition are the most critical student-related factors, while teaching methods, class size, and school resources play a significant role in school-related influences. In contrast, financial status was the only parental factor accepted by expert consensus, while parental concern and education level were not considered significant. The results provide valuable insights for educators and policymakers to develop targeted interventions for improving student performance.

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 25 (June 2025) PP. 133-142
DOI: 10.35631/IJMOE.725010

DOI: 10.35631/IJMOE.725010.

Keywords:

Academic Performance, Fuzzy Delphi Method, Student-Related Factors, School-Related Factors, Parental-Related Factors

Introduction

Academic performance is a fundamental indicator of educational success and has long been a central theme in educational research. In the Malaysian education system, academic achievement is critically assessed through the Sijil Pelajaran Malaysia (SPM), a standardized national examination undertaken by secondary school students. The outcomes of this examination significantly influence students' opportunities for higher education and future career prospects. Despite ongoing initiatives by the Ministry of Education—such as curriculum reforms, teacher training, and school improvement programs—students' academic performance continues to be influenced by a complex web of interrelated factors. These include individual attributes like motivation, learning habits, and self-discipline; familial elements such as parental involvement, socio-economic status, and home environment; as well as institutional aspects, including school resources, classroom size, peer influence, and teaching methodologies. However, the dynamic interactions and relative significance of these factors remain insufficiently understood, limiting the effectiveness of interventions designed to boost student outcomes. The 2021,2022 and 2023 SPM results underscore this concern, with alarming failure rates in several key subjects: Mathematics 24.3%, 24.3% and 23.2%, respectively, Sejarah or History with 5.6%, 7.6% and 5.4%, respectively, and Bahasa Melayu with 2.5%, 2.6% and 2.4%, respectively. Figure 1 shows failure rate from 2021-2023 for Mathematics, Sejarah and Bahasa Melayu.

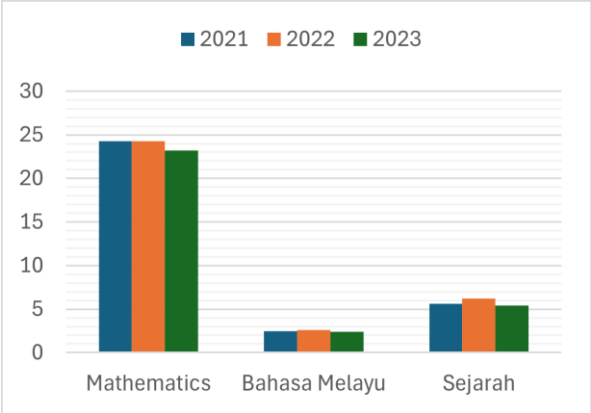

Figure 1: Failure Rate for SPM 2021, 2022 and 2023

While there was a modest decline in failure rates in the 2023 results, the figures still suggest the need for more targeted and evidence-based strategies. Compounding this issue, many students struggle with Higher Order Thinking Skills (HOTS) questions—an area emphasized under the Malaysian Education Blueprint 2013–2025 to foster critical and analytical thinking. These challenges highlight the urgency of identifying the underlying causes of academic underperformance.

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 25 (June 2025) PP. 133-142
DOI: 10.35631/IJMOE.725010

To address this need, the present study adopts the Fuzzy Delphi Method (FDM), a structured technique that integrates expert judgment using qualitative linguistic variables, making it particularly suitable for analysing complex and subjective issues. Unlike traditional statistical methods, FDM accommodates uncertainty and imprecision in human decision-making, making it ideal for educational contexts. This research focuses on SMK Sri Kurau in Bagan Serai, aiming to systematically identify and rank the most critical factors affecting students' academic achievement. The outcomes of this study are expected to offer valuable insights for stakeholders—including educators, school administrators, policymakers, and parents—to design more effective strategies that foster academic excellence and support holistic student development.

Literature Review – Heading 1 (TNR, 12, Bold, Align Left, Capitalize Each Word)

Multi-Criteria Decision Making (MCDM) is a decision-making tool that combines quantitative and qualitative factors to address complicated decisions (Afolayan, 2021). MCDM uses techniques like TOPSIS, Fuzzy Delphi, ELECTRE, and AHP to evaluate options with conflicting criteria (Saaty, 2008). These strategies help decision-makers identify the best alternative, especially in unclear situations (Zhang et al., 2019). This research utilises Fuzzy Delphi to analyse the expert's opinions on study matter.

Fuzzy Delphi Method

Fuzzy Delphi technique is used by researchers to create consensus among experts, according to Kamarulzaman et al. (2015). Fuzzy Delphi generates textual remarks together with a distribution of estimations on multiple future scenarios (Di Zio et al., 2021). The Fuzzy Delphi Method (FDM) was first presented by Kaufmann and Gupta in 1988 (Mosayebi et al., 2020). FDM's ability to reduce the amount of Delphi rounds allows it to shorten the research duration. The Delphi technique, which may analyse the agreement in a single round, incorporates the use of fuzzy elements (Kamarulzaman et al., 2015). Besides, Fuzzy Delphi approach takes into consideration fuzziness in the selection of criteria and the interpretation of results, in contrast to the conventional Delphi method. Less iteration is usually required during the data collection procedure. This approach has been found to be superior to the traditional Delphi method in certain investigations. In order to get expert consensus on the factors impacting students' academic performance in SMK Sri Kurau using Fuzzy Delphi method, this study employs the Fuzzy Delphi Method.

Factors and Subfactors

In this section, factors and subfactors impacting students' academic performance are discussed and listed in the following subsection. Students' academic performance is influenced by various factors, which can be categorized into student, school, and parental-related factors.

Student Related Factors

Student related factors refer to the various elements that are specific to students and have the potential to significantly influence their academic performance. Giving student a strong education is crucial to a quality education process, and school and student-related elements play a major role in this regard (Waters & Marzano, 2006). It's crucial to remember that each student's experience with these factors will differ, and they frequently combine in intricate ways Student-related factors include attendance, attitude towards school, and self-driven tuition. Regular class attendance is crucial for academic success, as students who frequently miss classes tend to have lower performance (Abou Naaj et al., 2023). Additionally, a student's

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 25 (June 2025) PP. 133-142
DOI: 10.35631/IJMOE.725010

motivation, engagement, and attitude toward learning play a significant role in shaping their academic outcomes. According to Aris & Ahmad (2023), students that take the initiative to attend extra tuition classes outside school hours, can enhance their understanding and improve their grades.

School Related Factors

The teaching and learning strategies used in the classroom are examples of elements associated with the school. Segkulu (2022) asserts that a number of school-related variables, such as the availability of instructional materials, the standard of the physical facilities, class size, student-teacher ratios, and teacher qualifications, affect academic performance School-related factors involve the teaching environment and resources available to students. Teaching methods significantly impact students' engagement and comprehension, as the lack of effective teaching strategies and learning materials can hinder academic performance. Another crucial aspect is class size, as smaller classes allow for better teacher-student interaction and personalized learning, whereas larger class sizes may limit individual attention and feedback, affecting students' overall academic outcomes. Aside from the school learning dynamic, school resources, such as material given to students, are also an important aspect of which the school needs to care (Hanushek & Woessmann, 2017). Most schools in Malaysia do have a textbook for each subject given to each student. But not many of them have other materials like practical books, activity books, and exercise books for students.

Parental Related Factors

While parental education level is often overlooked as a factor influencing a child's academic performance, research has demonstrated its significance. According to Bakar et al. (2017), parents who attained a particular degree of education were able to help their kids with their homework and knew what books, models, and maps their kids needed. Similarly, children whose parents have little, or no education also tend to have high rates of absenteeism and even dropout (Lara & Saracostti, 2019). Parental-related factors highlight the importance of family support in education. Financial stability plays a crucial role, as parents with better financial resources can provide additional learning materials and afford private tuition, giving their children an academic advantage. Moreover, according to Petit Early Learning Journey (2023), parental involvement and concern for their child's education contribute to academic success. Students with engaged and supportive parents are more likely to be motivated, disciplined, and perform better in school.

Figure 2 presents all the factors and subfactors considered in this study based on the previous research that have been done on the related topic.

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 25 (June 2025) PP. 133-142
DOI: 10.35631/IJMOE.725010

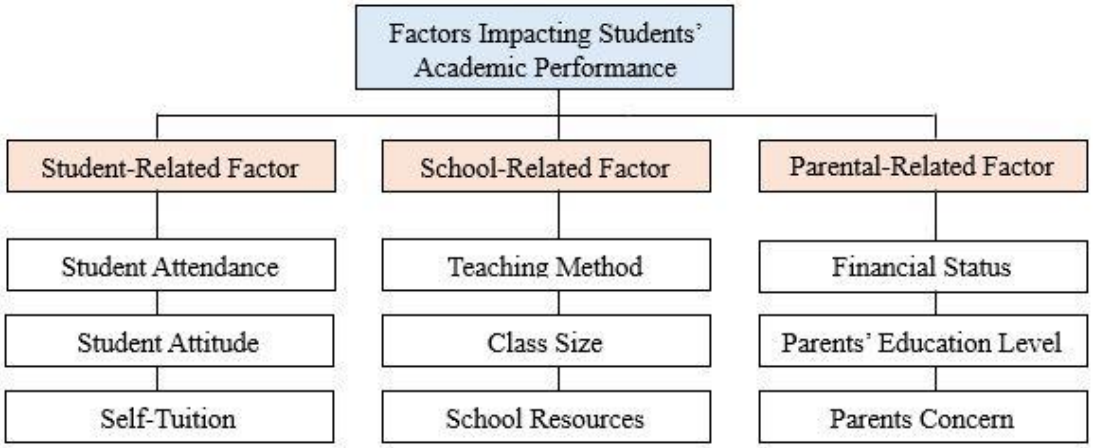

Figure 2: List of Factors and Subfactors

Methodology

Research design of this study can be summarized into five steps which are data collection, triangular fuzzy number, determination of threshold value, determination of item acceptability and defuzzification process. Figure 3 presents the research framework implemented in this paper.

Figure 3: Research Framework

Data Collection

The major research instrument for this study was primary data from a questionnaire survey. The experts' opinions from previous studies served as the basis for designing the questionnaire. Thirty teachers from SMK Sri Kurau, Bagan Serai, are included in the study as respondents to the dataset in this proposal. Literature review is carried out to develop the research questionnaire. The minimum sample of experts in the Fuzzy Delphi studies is 10 to obtain high uniformity among experts (Adler & Ziglio, 1996; Jones & Twiss, 1978 dari food). Hence, 30 experts were chosen in this research using purposive sampling technique

Triangular Fuzzy Number

The triangular fuzzy number (TFN) was calculated by recording each response provided by an expert in the Likert scale scoring system. Table 1 shows the comparison between Likert scale scoring and Fuzzy scoring.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 25 (June 2025) PP. 133-142
DOI: 10.35631/IJMOE.725010

Table 1: Comparison Between Likert Scale Scoring And Fuzzy Scoring

Likert Scoring Scale	Linguistic variable	Fuzzy Scoring
5	Strongly Agree	(0.6, 0.8, 1.0)
4	Agree	(0.4, 0.6, 0.8)
3	Moderate	(0.2, 0.4, 0.6)
2	Disagree	(0.0, 0.2, 0.4)
1	Strongly Disagree	(0.0, 0.0, 0.2)

Three values were considered for each recorded response: the least value ($n1$), the most plausible value ($n2$), and the greatest value ($n3$). The average of each item's fuzzy scores, represented by the values $m1$, $m2$, and $m3$, for the purpose of continuing the defuzzification process.

Determination of Threshold Value

By utilizing the following formula to compute the difference between each expert fuzzy number and the average fuzzy number, the threshold value (d) for each item will be determined.

$$d(\bar{m}, \bar{n}) = \sqrt{\frac{1}{3}[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]}$$

Meanwhile, percentage of expert group consensus will be computed based on the frequency of item with threshold value less than or equal to 0.2 per number of experts.

Determination of Item Acceptability

A construct was deemed acceptable if its threshold value (d-construct) was less than or equal to 0.2. This determination of the construct's acceptability was based on its value. The threshold value (d) for each evaluated item, where (d) ≤ 0.2 is accepted, was another basis for expert agreement on each evaluated item. A percentage will be used to show the frequency of acceptable values. Less than 75% of the expert consensus on the items was rejected. The procedure of calculating the fuzzy score value based on an a-cut value of 0.5 is known as defuzzification. The measured item is approved if the fuzzy score value is equal to or more than 0.5 and rejected if it is less than 0.5. After defuzzification, an item's rank inside a comparable construct was ascertained (Manakandan, Sujith, et al., 2017 Hakim).

Defuzzification Process

To determine the relative relevance of each item, the defuzzification process ($Amax$) can be used to rank each of the items. The order of the greatest to lowest value is the basis for the rating. This rating method uses the following formula to assist in deciding which objects to keep and which to reject.

$$A_{max} = \frac{1}{3}(m_1 + m_2 + m_3)$$

Where m_1 is the average fuzzy number of all experts considered for the minimum value ($n1$), m_2 is the average fuzzy number of all experts considered for the most reasonable value ($n2$), and m_3 is the average fuzzy number of all experts considered for the maximum value ($n3$).

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 25 (June 2025) PP. 133-142
DOI: 10.35631/IJMOE.725010

Result and Discussion

In this section, the numerical results obtained in data analysis regarding influential factors impacting students' academic performance are presented.

Table 2: Student-Related Factor

Factors	Threshold value $d \leq 0.2$	Percentage of Expert's Consensus	Average of Fuzzy Number	Ranking	Verdict
Students Attendance	0.06	100%	0.7600	1	Accepted
Students Attitude	0.12	87%	0.7200	2	Accepted
Self-Tuition	0.10	90%	0.5533	3	Accepted

Table 2 shows that the threshold value for student's attendance, students' attitude, and self's tuition is 0.06, 0.12, and 0.10 respectively, making them all have met the first prerequisite. Hence, the Percentage of Expert's Consensus for student's attendance, students' attitude, and self's tuition are 100%, 87%, and 90% respectively, making them all obey the second prerequisite not to be lower than 75%. The average of fuzzy number for students' attendance, students' attitude and self's tuition are 0.7600, 0.7200, and 0.5533 respectively. This indicates that student's attendance can be ranked first, student's attendance is ranked second, and self's tuition is the third among them.

Table 3: School-Related Factor

Factors	Threshold value $d \leq 0.2$	Percentage of Expert's Consensus	Average of Fuzzy Number	Ranking	Verdict
Teaching Method	0.13	87%	0.6933	1	Accepted
Class Size	0.12	87%	0.6667	2	Accepted
School Resources	0.11	83%	0.6200	3	Accepted

Table 3 shows that the threshold value for teaching method, class size and school resources are 0.13, 0.12 and 0.11 respectively, making them all have met the first prerequisite. Hence, the Percentage of Expert's Consensus for teaching method, class size and school resources are 87%, 87% and 83% respectively, make them all obey the second prerequisite to not be lower than 75%. The average of fuzzy number for teaching method, class size and school resources are 0.6933, 0.6667 and 0.6200 respectively. This indicates that teaching method can be ranked first, class size is ranked second, and school resources is the third among them.

Table 4: Parental-Related Factor

Factors	Threshold value $d \leq 0.2$	Percentage of Expert's Consensus	Average of Fuzzy Number	Ranking	Verdict
Parental Education Level	0.13	70%	0.5867	2	Rejected
Financial Status	0.17	67%	0.5200	3	Rejected
Parent's Concern	0.11	97%	0.7067	1	Accepted

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 25 (June 2025) PP. 133-142
DOI: 10.35631/IJMOE.725010

Table 4 shows that the threshold value for parental education level, financial status, and parent's concern is 0.13, 0.17, and 0.11 respectively, making them all meet the first prerequisite. Hence, the Percentage of Expert's Consensus for parental education level, financial status, and parent concern are 70%, 67%, and 97% respectively, making two of them not obey the second prerequisite not to be lower than 75%. Therefore, the influential factors impacting students' academic performance for parental-related factors which is the sub-factor for parental education level and financial status can be considered rejected. The average of fuzzy number for parental education level, financial status, and parent concern are 0.5867, 0.5200, and 0.7067 respectively. This indicates that student's attendance can be ranked first, student's attendance is ranked second, and self's tuition is the third among them. Table 5 simplifies the results and shows the ranking and their acceptability item for each subfactors.

Table 5: Parental-Related Factor

Factors	Ranking	Verdict
Student-Related		
Students Attendance	1	Accepted
Students Attitude	2	Accepted
Self's Tuition	3	Accepted
School-Related		
Teaching Method	1	Accepted
Class Size	2	Accepted
School Resources	3	Accepted
Parental-Related		
Parents Education Level	2	Rejected
Financial Status	3	Rejected
Parents' Concern	1	Accepted

Conclusion

This study employed the Fuzzy Delphi Method (FDM) to identify and rank factors influencing students' academic performance at SMK Sri Kurau. It began by highlighting the need to understand key influences on academic achievement, categorizing them into student, school, and parental factors. A literature review supported the use of FDM to address uncertainty in such analyses. Data was collected from 30 teachers using structured questionnaires, and the responses were processed through a rigorous fuzzy analysis framework. The results revealed that student-related factors—especially attendance and attitude—had the greatest impact, followed by school-related aspects like class size and teaching methods, and finally, parental involvement. The study affirmed FDM's effectiveness in educational research and provided actionable insights for educators, parents, and policymakers. Based on the outcomes, the research has achieved their objectives but can be further studied with some recommendations. It recommended expanding future research to other schools, incorporating additional variables, improving the FDM application process, and conducting longitudinal studies to assess long-term effects. These steps aim to enhance educational practices and student outcomes through a deeper, more dynamic understanding of influencing factors.

Acknowledgement

The authors express their gratitude to the department of Academic Affairs of UiTM Perlis Branch and the department of Research and Industrial Linkage of UiTM Perlis Branch for their

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 25 (June 2025) PP. 133-142
DOI: 10.35631/IJMOE.725010
valuable support and guidance throughout the completion of this study. Appreciation is also extended to SMK Sri Kurau for their assistance in managing the questionnaire distribution and coordinating with the participants.

References

Abou Naaj, M., Mehdi, R., Mohamed, E. A., & Nachouki, M. (2023). Analysis of the Factors Affecting Student Performance Using a Neuro-Fuzzy Approach. *Education Sciences*, *13*(3). https://doi.org/10.3390/educsci13030313

Adler, M., & Ziglio, E. (1996). Gazing into the Oracle: The Delphi Method and its Application to Social Policy and Public Health. London: Jessica Kingsley Publication.

Aris, A., & Ahmad, S. (2003). Hubungkait antara pencapaian matematik pelajar aliran sains UiTM pahang dengan pencapaian matematik peringkat SPM dan faktor peribadi.

Bakar, N. A., Mamat, I., & Ibrahim, M. (2017). Influence of Parental Education on Academic Performance of Secondary School Students in Kuala Terengganu. *International Journal of Academic Research in Business and Social Sciences*, *7*(8). https://doi.org/10.6007/ijarbss/v7-i8/3230

Di Zio, S., Bolzan, M., & Marozzi, M. (2021). Classification of Delphi outputs through robust ranking and fuzzy clustering for Delphi-based scenarios. *Technological Forecasting and Social Change*, *173*, 121140. https://doi.org/10.1016/j.techfore.2021.121140

Hanushek, E. A., & Woessmann, L. (2017). School Resources and Student Achievement: A Review of Cross-Country Economic Research. In *Methodology of Educational Measurement and Assessment* (pp. 149–171). Springer Nature. https://doi.org/10.1007/978-3-319-43473-5_8

Jones, H., & Twiss, B. L. (1978). Forecasting Technology for Planning Decisions. New York: Macmillan.

Kamarulzaman, N., Jomhari, N., Raus, M. N., & Yusoff, Z. M. M. (2015). Applying the Fuzzy Delphi Method to Analyse the user Requirement for user Centred Design Process in Order to Create Learning Applications. *Indian Journal of Science and Technology*, *8*(32). https://doi.org/10.17485/ijst/2015/v8i32/92146

Lara, L., & Saracostti, M. (2019). Effect of Parental Involvement on Children's Academic Achievement in Chile. *Frontiers in Psychology*, *10*(JUN). 45 https://doi.org/10.3389/fpsyg.2019.01464

Manakandan, Sujith, K., Ismail, & Rosnah. (2017). Pesticide Applicators Questionnaire Content Validation: A Fuzzy Delphi Method. In *Med J Malaysia* (Vol. 72). https://www.researchgate.net/publication/319928305

Mosayebi, A., Ghorbani, S., & Masoomi, B. (2020). Applying fuzzy delphi and best-worst method for identifying and prioritising key factors affecting on university-industry collaboration. *Decision Science Letters*, *9*(1), 107–118. https://doi.org/10.5267/j.dsl.2019.7.001

Petit Early Learning Journey (2023). The importance of early childhood educators. Petit Early Learning Journey. https://www.petitjourney.com.au/the-importance-of-early-childhood-educators/.

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International Journal of Services Sciences*, *1*(1), 83-98.

Segkulu, L. (2022). Factors Affecting Students' Academic Performance in Social Studies Subject - the Case of Selected Senior High Schools in Sangnarigu District and Tamale Metropolis of Northern Ghana. *Asian Journal of Education and Social Studies*, 57–65. https://doi.org/10.9734/ajess/2022/v34i2748

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 25 (June 2025) PP. 133-142
DOI: 10.35631/IJMOE.725010
Waters, J. T., & Marzano, R. J. (2006). *School district leadership that works: The Effect of Superintendent Leadership on Student Achievement* (pp. 2006-2008). Denver, CO: Mid-continent Research for Education and Learning (McREL).

Zhang, X., Huang, J., Yu, D., & Li, Q. (2019). A hybrid multi-criteria decision-making approach for energy management in commercial buildings. *Energies*, *12*(13), 2560.