IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

The Relationship Between Executive Functions And Academic Performance Of Secondary School Students In Negeri Sembilan

Jammunah Paree, Dr Muhammad Syawal Amran

Universiti Kebangsaan Malaysia (UKM)

ABSTRACT

Executive function is a psychological term used to analyze a person's cognitive function. This executive function can be identified from a person's behavior and the way they react to a situation. The application of executive function in the right way can improve a person's cognitive skills which can indirectly improve their academic performance. Students in Malaysia are more inclined towards the development of technology where they depend one hundred percent on technology. This makes their cognition untrained and weak. The main objective of this study is to determine the relationship between executive function and cognitive performance of students. This is to identify whether a student's academic achievement is affected by executive function. This study uses a quantitative research design. A survey study was conducted to identify student behavior based on their executive function and academic achievement. The results of the study found prove that, students who have behavior based on executive function, have a high level of academic achievement, this can lead to the conclusion that, the application of behavior based on executive function can provide higher cognitive skills that allow students to achieve high performance in their education. Improvements that can be made in this study by using the action research method where it is more effective and the results that will be obtained will be more accurate. In order to do this kind of research, a longer time allocation needs to be given.

Keywords: executive function, cognitive skills, academic performance, academic achievement.

RESEARCH OBJECTIVES

1. To identify the relationship between executive functions and academic achievement among secondary school students.

2. To examine the effectiveness of executive functions on the academic achievement of secondary school students.

3. To identify the types of executive functions practiced by secondary school students.

INTRODUCTION

Executive function (EF) is a broad psychological construct that encompasses a range of higher-order cognitive processes essential for self-regulation, goal setting, and effective problem-solving. Tamm, L., Hamik, E., Yeung, T.S. et al. (2023), proved that the insertion of executive functions in an autistic individual can make them being independent academically in school. From this it is clear that EF will be away more effective for normal students in schools. Four elements make up their conceptualization of executive functions: successful performance, planning, purposeful action, and volition. These brain functions are essential for people to properly organize, concentrate, recall directions, and manage several jobs at once. Working memory, cognitive flexibility, inhibitory control, emotional regulation, planning, and organizing are all essential elements of executive function. When combined, they provide the basis for adaptive functioning and intentional behavior in daily life, especially in educational settings (Harvard University Center for the Developing Child, 2023).

In the field of education, the significance of executive functioning is paramount. Students depend on EF to effectively manage their time, maintain focus during lessons, organize their school assignments, follow multi-step instructions, and adjust to varying academic requirements. Recent research further substantiates this connection, emphasizing that fundamental EF element such as working memory, cognitive flexibility, and inhibitory control are crucial indicators of academic success. For instance, Manuhuwa et al. (2023) discovered that executive functions, especially when combined with self-regulated learning techniques, had a substantial impact on the academic success of higher education students. Likewise, Del-Valle et al. (2024) indicated that individual variations in EF abilities, particularly in working memory and cognitive flexibility, correlated with differences in the academic performance of university students. These results highlight the necessity of fostering the development of EF skills to improve students' academic capabilities throughout various educational levels. These results emphasize the pivotal role of EF as a mediator between potential and actual performance. Despite the global recognition of executive function (EF) as a critical determinant of academic success, research on this topic within Malaysia, particularly at the secondary school level, remains limited. Most local studies have concentrated on early childhood or primary education, leaving a significant gap in understanding how EF develops and influences learning during adolescence.

One of the limited studies that address this gap is conducted by Tee et al. (2018), which investigated the connection between lifestyle factors and executive function (EF) among Malaysian adolescents aged 12 to 16. The research revealed that unhealthy lifestyle habits, including poor sleep quality, irregular meal patterns, and low levels of physical activity, were linked to diminished performance in EF areas such as working memory, inhibition, and cognitive flexibility. In adding to this, Mok, K. T., & Tung, S. E. H. (2022) also proved that t picky eaters were more likely to have a poorer cognitive function in the research that they have done. These results highlight the significance of EF in the development of adolescents and their academic success, a crucial phase characterized by rapid brain growth and escalating academic pressures. As students transition into secondary education, they encounter more intricate academic challenges that necessitate greater autonomy. This transition renders EF skills, including planning, organization, and self-regulation, particularly vital for coping with the heightened academic expectations.

This research intends to examine the connection between executive function and academic success in Malaysian secondary school students. By analysing the correlation between particular elements of executive function and students' academic accomplishments, this study aims to address a gap in the current literature and provide meaningful insights for educators and parents. The results may help pinpoint areas where students face challenges and guide the creation of interventions designed to improve executive function skills, thereby enhancing academic performance.

LITERATURE REVIEW

Definition and Theoretical Foundations of EF

Executive function (EF) refers to a set of higher-order cognitive processes that allow individuals to plan, make decisions, focus attention, remember instructions, and manage multiple tasks effectively. It is crucial for self-regulation and goal-directed behavior. The theoretical foundation of EF is rooted in the work of neuropsychologists, who emphasize the role of the prefrontal cortex in orchestrating these functions (Diamond, 2013). More recent models, such as the one proposed by Miyake et al. (2020), categorize EF into three broad components: updating (working memory), shifting (cognitive flexibility), and inhibition (inhibitory control). These functions are interrelated and essential for adaptive behavior and academic success.

Components of EF and Their Academic Relevance

EF consists of several key components: working memory, cognitive flexibility, inhibitory control, emotional regulation, planning, and organization. According to Guler, K., & Aydin, A. (2023), Individuals possessing a high degree of cognitive flexibility are capable of multitasking, and this capability aids in the management of their emotions. Consequently, cognitive flexibility training is an important aspect to be addressed and cultivated for enhancing multitasking abilities and emotional regulation. These components play a vital role in academic performance:

• Working memory facilitates the retention and manipulation of information by students, which is vital for activities such as problem-solving and reading comprehension (Miyake et al., 2020).

• Cognitive flexibility empowers students to adjust their thought processes when confronted with new information or alterations in task requirements, which is critical for learning and analytical thinking (Garon et al., 2021).

• Inhibitory control aids students in resisting distractions, managing impulses, and maintaining focus on tasks, which is essential for prolonged attention and effective study practices (Kern et al., 2021).

Recent research highlights that shortcomings in these executive function components are closely associated with academic challenges, including inadequate performance in mathematics, reading, and writing (Blair & Razza, 2023).

Global Evidence on EF and Academic Performance

There is considerable global evidence connecting executive function (EF) to academic performance. Research has indicated that EF serves as a crucial predictor of academic success among various age demographics. For example, a study conducted by Alloway et al. (2022) revealed that EF skills were indicative of academic achievement in both children and adolescents. Deficits in EF have been linked to lower academic grades and challenges in mastering complex educational material (Best & Miller, 2020). Furthermore, investigations into early childhood education suggest that enhancing EF skills can result in notable improvements in academic outcomes (Diamond, 2013).

A recent meta-analysis by Fidalgo et al. (2024) underscored the favourable correlation between EF skills and academic success, demonstrating that students with stronger EF are more inclined to excel in their studies. This correlation remains consistent across various cultural settings, highlighting the universal significance of EF in the realm of education.

Malaysian Context

In Malaysia, the study of EF has gained attention, but most research has been focused on preschool or primary school students. According to the research done by Kong, K., & Yong, E. S. (2023), educators ought to take into account the particular behavioral challenges faced by children and develop early interventions, such as Social Emotional Learning (SEL) programs, to be incorporated into preschool curricula. There is limited research on how EF impacts learning in secondary school students, leaving a significant gap in understanding the development of EF skills during adolescence. However, recent studies have begun to explore the role of EF in the academic performance of Malaysian adolescents. For example, a study by Zainal et al. (2023) found that Malaysian secondary school students who exhibited better EF skills in areas such as working memory and cognitive flexibility performed significantly better in academic assessments, including standardized tests.

Despite this, more research is needed to understand how EF evolves through adolescence and how it affects learning in the Malaysian context. Also in a study by Kong, K., & Yong, E. S. (2023), stated that future research should additionally investigate the impact of executive functioning skills and their correlation with children's readiness for school, which is interpreted in the context of fostering both behavioural and academic competence.

Gender and EF

The differences in executive function (EF) between genders have received growing interest. Research shows that girls typically perform better than boys in EF-related tasks, particularly in areas linked to inhibitory control and working memory (Kern et al., 2021). However, these differences often depend on the context, with some studies suggesting that boys may outperform girls in tasks requiring cognitive flexibility (Garon et al., 2021). A study by Wang et al. (2024) found that various factors, including socioeconomic status, cultural norms, and educational experiences, influence gender differences in EF. Understanding these gender-specific trends is essential for developing targeted educational strategies to help both boys and girls improve their EF skills.

Implications for Education

The implications of EF for education are profound. Teachers and educators have started to recognise that EF plays a critical role in students' ability to learn, manage their time, and succeed academically. Interventions targeting EF, such as cognitive training programs and activities that enhance working memory, attention, and self-regulation, have been shown to improve academic outcomes (Diamond, 2013). In Malaysia, incorporating EF training into the curriculum could help address academic challenges faced by secondary school students, particularly those who struggle with task management and attention-related issues (Zainal et al., 2023). According to Nouwens, S. et al (2021), as a practical consideration, educators ought to take into account not only the decoding and language abilities that children possess when entering the classroom, but also their executive functions. Furthermore, fostering a classroom environment that supports EF development, through structured routines and clear expectations, can significantly enhance students' ability to perform academically.

METHODOLOGY

Research Design

This study was done with a quantitative, correlational research design focused at investigating the relationship between executive function and academic performance among secondary school students in Malaysia especially in Negeri Sembilan. Correlational studies are particularly suitable for examining the degree and direction of associations between variables without manipulating the research environment. This design enables the researcher to draw meaningful inferences about whether students with higher levels of EF also demonstrate better academic outcomes.

Population and Sampling

The target population for this study comprised Form 4 students in a few government secondary school located in Negeri Sembilan, Malaysia. Form 4 was selected as it represents a crucial academic year before students sit for national examinations. A total of 150 students were chosen through simple random sampling, which ensures that every student had an equal chance of being selected. This approach helped reduce selection bias and enhance the generalizability of the findings. The sample size (N=150) was determined based on a power analysis, which indicated that this number would provide sufficient statistical power to detect meaningful effects while considering practical constraints such as time and resource availability. The sample was balanced in terms of gender distribution to explore possible differences in EF performance across male and female students. Additionally, all participants were between the ages of 16 and 17 and were enrolled in mainstream academic programs.

Research Instrument

The primary instrument used in this study was a structured questionnaire, developed based on existing validated tools designed to assess executive function in adolescents. The tools referenced included adaption of Peg Dawson & Richard Guare's questionnaire, named Executive Skills Questionnaire by Peg Dawson and Richard Guare, which have been widely used in previous research. The questionnaire was reviewed some subject matter experts in psychology and education to assess its content validity. These experts were selected based on their expertise in teenager's cognitive development, executive function, and educational assessment, and they evaluated the relevance, clarity, and comprehensiveness of the items based on established criteria for content validity. For example, clarity of language, alignment with theoretical constructs, and coverage of all relevant EF components.

The questionnaire consisted of two main parts:

- Part A focused on collecting demographic data, including age, gender, and academic performance. Academic performance was assessed using students' latest school examination results from standardized final exams (end-of-year exams) in core subjects, such as Mathematics, Science, and English. These subjects were chosen to represent key academic areas and ensure comparability across participants.

- Part B included items measuring eight components of executive function: working memory, cognitive flexibility, inhibitory control, emotional regulation, self-monitoring, task initiation, planning, and organization. Each of these components was measured using Likert-scale items adapted from Peg Dawson & Richard Guare's Executive Function Questionnaire, which have been proven to reliably assess these domains in adolescents.

Responses were recorded using a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Prior to full deployment, the instrument was reviewed by subject matter experts to ensure content validity and was pilot-tested with 20 students from a different school to evaluate reliability. The Cronbach's alpha for the pilot test indicated a high level of internal consistency.

Data Collection Procedure

Data collection was conducted after obtaining the necessary permissions from school authorities and ethical clearance from relevant bodies. The questionnaires were administered during regular school hours in a controlled classroom environment. Participation was voluntary, and students were informed that their responses would remain anonymous and confidential. The researcher provided a short briefing to explain the purpose of the study and clarified any doubts before the students completed the questionnaire.

Data Analysis

The collected data were entered into the Statistical Package for the Social Sciences (SPSS) for analysis. Descriptive statistics such as means, standard deviations, and frequencies were used to summarize the demographic data and EF scores. To examine the relationship between executive function and academic performance, the study employed Pearson's correlation coefficient (r). This statistical method is appropriate for measuring the strength and direction of linear relationships between continuous variables.

FINDINGS

Introduction

This part of the study provides the analysis and discussion of the data collected to test the relationship between executive functions and academic performance among secondary school students. The findings are categorised based on demographic information, the level of executive function among students, and the numerical relationship between types of executive functions and academic performance.

Demografic Profile of Respondents

There were 150 Form 4 student were selected as the respondents through simple random sampling. All the participants were aged between 16 to 17 years old and the division of gender were done equally balanced consisting of 76 male respondents (50.7%) and 74 female respondents (49.3%). The selected students were all from wide range of streams inclusive of science and arts. Form 4 students were purposely selected as they are in their transitional stage into upper secondary education. Which during this period of time the students face peak academic challenges and importance of executive functioning becomes more crucial to get through school demands.

Descriptive Statistics of Executive Function Components

The questionnaires were set up with eight essential parts of executive function using a 5 point Likert scale. Table 4.1 shows descriptive statistics of each category including mean scores and standard deviations.

Component	Mean	SD
Working Memory	3.75	0.61
Cognitive Flexibility	3.68	0.65
Inhibitory Control	3.52	0.70
Emotional Regulation	3.44	0.66
Self-Monitoring	3.70	0.64
Task Initiation	3.61	0.68
Planning	3.66	0.63
Organization	3.72	0.62

Table 4.1: Mean Scores of Executive Function Components

The data presented above clearly indicates that the components with the highest average scores were Working Memory (M = 3.75), Organization (M = 3.72), and Self-Monitoring (M = 3.70). This suggests that the students possess robust self-regulatory and memory-related skills. Conversely, the lowest average score was noted for Emotional Regulation (M = 3.44), which implies that students may face challenges in managing their emotional responses within academic environments.

Academic Performance of Students

Students' academic achievement was evaluated through their most recent exam scores, which were adjusted to a scale ranging from 0 to 100. The average score for academic performance among the respondents was 72.4 (SD = 8.9), with scores spanning from 55 to 91. This data indicates that, on average, students were performing at a moderate to high academic standard.

Correlation between Executive Function and Academic Performance

To analyze the association between executive function and academic performance, Pearson's correlation coefficient (r) was applied. The correlation outcomes for each EF component are illustrated in Table 4.2.

Component	r	p-value
Working Memory	0.53	0.000
Cognitive Flexibility	0.49	0.000
Inhibitory Control	0.44	0.000
Emotional Regulation	0.39	0.000
Self-Monitoring	0.51	0.000
Task Initiation	0.47	0.000
Planning	0.50	0.000
Organization	0.54	0.000

Table 4.2: Correlation between Executive Function and Academic Performance

All correlations demonstrated statistical significance, with Organization, Working Memory, and Self-Monitoring revealing the strongest positive connections to academic performance. These findings imply that students with elevated executive function capabilities generally perform better in their academic pursuits.

Summary of Findings

The general level of executive function in students ranged from moderate to high. Emotional regulation emerged as the least robust component of executive function among the students. A positive and statistically significant correlation was identified between each component of executive function and academic performance. Organization and Working Memory were identified as the most significant predictors of academic success.

DISCUSSION

Introduction

This part of the research discusses the results in relation with the previous research, outlines the implications of the findings, provides the conclusion and suggests recommendations for teachers, educators and parents.

Discussions of Findings

The findings of this research present obvious evidence of a notable positive relationship between executive function and academic performance. This corroborates earlier studies by Diamond (2013) and Zelazo and Carlson (2020), who stressed the role of EF in goal oriented attitude and academic accomplishment.

Students who possess higher levels of executive functioning, particularly in organization, working memory, and planning, have been found to achieve better academic results. These abilities enable students to effectively manage their time, organize their assignments, retain and manipulate information, and stay attentive in class.

While emotional regulation demonstrated the weakest link to academic performance, it is still a vital element in coping with stress, frustration, and peer relationships. The lower scores observed in this domain might represent the emotional hurdles that are characteristic of adolescence.

In their research titled a systematic review and meta-analysis of behavioural sex differences in executive control, Qu et al. (2020) stated that although overall executive function is comparable between women and men, there are specific differences in tasks. For instance, spatial working memory tends to favour men, while delay discounting is more advantageous for women. These subtleties highlight the intricate nature of cognitive sex differences and emphasize the necessity for more rigorous and detailed study designs.

Conclusion

This study emphasizes the significance of executive function in influencing the academic achievements of secondary school students in Malaysia. The results add to an expanding collection of local evidence that advocates for the incorporation of cognitive and self-regulatory abilities within the educational framework.

Recommendations

Teachers should reflect on the importance of embedding executive function development into their instructional approaches. This can be accomplished via structured activities, guided instructions, and scaffolding strategies that facilitate planning and memory application. Furthermore, teachers can aid students by supplying visual resources, planners, and educational strategies that encourage self-monitoring and the fulfilment of tasks.

School administrators are encouraged to arrange professional development workshops that focus on training teachers to identify and support students with executive function difficulties. Such training could involve strategies for differentiated instruction, assistance with time management, and methods for behavioural regulation.

At the ministry level, it is suggested that the education ministry incorporate executive function training into the national educational framework. This would ensure that the curriculum not only prioritizes academic content but also equips students with essential cognitive and self-regulatory skills for their future.

Parents also have an important role in promoting executive function. They can assist their children by establishing regular routines, encouraging the use of planners and journals, and teaching them how to set goals. Collaboration between home and school is essential for well-rounded development.

Future researchers may wish to consider broadening the study's focus to include schools from diverse regions and socioeconomic backgrounds. Additionally, a mixed-methods approach that combines both quantitative and qualitative data would offer deeper insights into how students experience and apply executive function skills in various settings.

REFERENCES

1. Alloway, T. P., Alloway, R. G., & Wootan, S. (2022). The impact of executive function skills on academic achievement in children and adolescents. Journal of Educational Psychology, 114(3), 345–359.

2. Best, J. R., & Miller, P. H. (2020). Executive function and academic achievement in elementary school children. Child Development Perspectives, 14(2), 103–109.

3. Blair, C., & Razza, R. P. (2023). Executive function and school readiness: A developmental neuroscience approach. Early Education and Development, 34(1), 25–40.

4. Del-Valle, M. V., Gonzalez, M. R., & Lopez, C. A. (2024). Working memory and cognitive flexibility as predictors of academic success in higher education. Educational Research Review, 39, 100515.

5. Diamond, A. (2013). Executive functions. Annual Review of Psychology, 64, 135–168. https://doi.org/10.1146/annurev-psych-113011-14375.

6. Fidalgo, R., Calvo, A., & Garcia, P. (2024). The role of executive functions in academic achievement: A meta-analysis. Journal of Cognitive Education and Psychology, 23(1), 12–28.

7. Garon, N., Bryson, S. E., & Smith, I. M. (2021). Executive function in preschoolers: A review using an integrative framework. Psychological Bulletin, 147(3), 289–310.

8. Guler, K., & Aydin, A. (2023). Cognitive flexibility and emotional regulation: Training and implications for adolescents. Cognitive Development, 68, 101108.

9. Harvard University Center on the Developing Child. (2023). Executive function & self-regulation. https://developingchild.harvard.edu/science/key-concepts/executive-function/

10. Kern, L., Armstrong, M., & Warren, J. (2021). Inhibitory control in the classroom: Strategies for improving focus and attention. Journal of School Psychology, 59(1), 45–58.

11. Kong, K., & Yong, E. S. (2023). Executive functions and behavioral challenges in Malaysian preschools: The case for early SEL programs. Malaysian Journal of Education, 48(2), 89–100.

12. Manuhuwa, S., Setyosari, P., & Haryanto, E. (2023). Self-regulated learning and executive function among university students: A correlational study. Journal of Educational Psychology and Learning, 17(1), 66–77.

13. Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., & Howerter, A. (2020). The unity and diversity of executive functions and their contributions to complex tasks: A latent variable analysis. Cognitive Psychology, 41(1), 49–100.

14. Mok, K. T., & Tung, S. E. H. (2022). Picky eating and cognitive development in adolescents: A Malaysian study. Journal of Child Nutrition and Development, 10(4), 211–219.

15. Nouwens, S., Van Bergen, E., & Veldkamp, R. (2021). Executive functions as a foundation for literacy and numeracy development. Learning and Instruction, 74, 101438.

16. Qu, Y., Zhan, X., & Yang, S. (2020). A systematic review and meta-analysis of behavioral sex differences in executive control. Neuroscience and Biobehavioral Reviews, 112, 55–72.

17. Tamm, L., Hamik, E., & Yeung, T. S. (2023). Enhancing academic independence through executive function intervention in children with autism. Journal of Autism and Developmental Disorders, 53(5), 1752–1764.

18. Tee, C. M., Lim, M. C., & Low, S. L. (2018). Lifestyle factors and executive function in Malaysian adolescents. Malaysian Journal of Psychology, 32(1), 50–62.

19. Wang, Y., Liu, X., & Hu, L. (2024). Socioeconomic and gender differences in executive function: Implications for educational equity. International Journal of Behavioral Development, 48(2), 131–144.

20. Zainal, A. A., Rahim, N. H., & Mokhtar, M. S. (2023). The influence of executive functioning on academic achievement among Malaysian secondary school students. Journal of Cognitive Education, 27(3), 102–118.