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Quick Response Code:

Website: www.jehp.net
DOI: 10.4103/jehp.jehp_266_22

Executive tasks and cognitive flexibility and their relationship to academic achievement among university students with attention deficit hyperactivity disorder

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Abstract:

BACKGROUND: The current study measured the executive tasks and cognitive flexibility and their relationship to the academic achievement of female students of the College of Education at Imam Abdulrahman Bin Faisal University in the Kingdom of Saudi Arabia.

MATERIALS AND METHODS: This research is a descriptive quantitative design. The study sample included 200 female students using purposive sampling. The study applied a test of executive tasks, cognitive flexibility, and a scale of attention deficit hyperactivity disorder for adults prepared by the researchers. Data were analyzed using several tests, namely descriptive statistics, Pearson correlation at the level of <0.05.

RESULTS: The results showed a statistically significant relationship between the scores of students with attention deficit and hyperactivity on the executive tasks scale and its dimensions (planning, organization, purposeful action, self-monitoring, and total score), cognitive flexibility, and academic achievement, which necessitates the need to design empirical research to reduce the severity of attention deficit hyperactivity disorder among undergraduate students because it will have a positive impact on their academic achievement.

CONCLUSION: The researchers highlight the necessity for conducting empirical research to improve the executive tasks of students as it will have a positive impact on their lives.

Keywords:

Academic achievement, attention deficit hyperactivity, disorder, executive tasks

Introduction

Recent studies have proven that attention deficit hyperactivity disorder (ADHD) not only affects schoolchildren, but also extends to include students in the stage of adulthood, where the number of students suffering from this disorder in adulthood represents a ratio of 1:30 adults.^[1] Adults with ADHD and impulsivity suffer from negative effects of this disorder, which reflects on executive tasks, social, academic,

and other aspects of their lives. Students who suffer from ADHD may also have some accompanying psychological problems such as anxiety and mood disorders. They also suffer from daily challenges in their studies, at work, and at home, such as difficulty obtaining a stable job, difficulty in social relationships, and a possible risk of engagement in some illegal behaviors.^[2] Within the limits of the researchers' knowledge, few studies in the Arab environment deal with attention deficit in adulthood as studies of ADHD in the

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How to cite this article: Almutairi JH, Ahmed AT. Executive tasks and cognitive flexibility and their relationship to academic achievement among university students with attention deficit hyperactivity disorder. J Edu Health Promot 2022;11:224.

region focus on measuring and diagnosing disorder in childhood and school time. Accordingly, the researchers studied the subject and examined the extent to which a group of female students at the College of Education show symptoms of this disorder and its relationship to executive tasks. Studying this disorder is important as it can affect the academic achievement of female students and their future career planning.

Executive functions trigger the execution of a series of cognitive tasks with conditioning and control of behavior. It also helps in boosting cognitive flexibility.^[3] Executive functions affect the academic achievement and efficiency of individuals with ADHD.^[4] Piaget postulated that cognitive flexibility is a cognitive ability possessed by each individual. It appears according to the expected change in thinking patterns due to the factors of maturity and growth. Therefore, cognitive flexibility and executive tasks may be affected in students with ADHD, and this in turn can affect their academic achievement, which the current study seeks to reveal.

Literature conducted on the cognitive flexibility showed several results. For instance, the study by Taconnat *et al.*^[5] aimed to know the effect of age on a sample of adults and the elderly, and the role of cognitive flexibility in the process of remembering. The study sample consisted of 62 young men whose ages ranged between 20 and 40 years. The results showed lower performance among the elderly in remembering words in addition to forgetting many of them, and the older individuals used cognitive flexibility to help memory performance, and the results showed that the most effective factor in remembering was cognitive flexibility. A study by Carney *et al.*^[6] concluded that executive tasks disorder among students with ADHD was the main reason behind the academic failure of these students. The study sample consisted of 250 secondary school students. The results of a study by Sheldon^[7] concluded that the most disruptive executive tasks for students with attention deficit hyperactivity disorder were planning and regulating behavior. In addition, Ran^[8] conducted a study that aimed to test the relationship between cognitive flexibility, adaptation, and achievement. The sample of the study consisted of 42 students from New York University. The results showed that students with high flexibility were more accomplished and more adaptable to new or emergency situations.

A study conducted by Tan^[9] aimed at studying the relationship between cognitive flexibility and achievement motivation among secondary school students in Singapore schools. Results indicated a positive significant correlation between cognitive flexibility and motivation to achieve. Although cognitive

flexibility and ADHD received considerable attention in the literature, empirical research conducted separately and in general, and attention deficit hyperactivity disorder among university students were limited. The current study deals with an under-researched topic as it focuses on the study of ADHD among university students because of its influence on their academic life. The study also focused on addressing the relationship between executive tasks and cognitive flexibility and studying the extent to which students with ADHD are affected.

The current study aimed at determining the relationship between executive tasks, cognitive flexibility and academic achievement among female students with ADHD at the College of Education, as well as identifying female students who had ADHD that persisted with them from childhood until adulthood, according to the diagnostic indications listed in the Fifth Diagnostic Statistical Manual, and whose academic achievement may be affected as a result of the presence of this disorder.

Therefore, the following questions were formulated:

- 1 Is it possible to achieve a causal model that shows a relationship of influencing and being influenced (both directly and indirectly) among the study variables (cognitive flexibility, executive tasks, and academic achievement)?
- 2 Is there a relationship between the average scores of students with ADHD on the executive tasks scale, the dimensions of their cognitive flexibility (planning, organization, purposeful action, self-monitoring, and the total score) and academic achievement?
- 3 Are there differences between the mean scores of students with ADHD on each of the dimensions of executive tasks scale (planning, purposeful action, organization, self-monitoring), their total score and academic achievement?

Materials and Methods

Study design and setting

This study was a cross-sectional one, with the survey method used to determine the study variables among 260 university students in the eastern region of Saudi Arabia.

Study participants and sampling

260 female students enrolled in the BA level at the College of Sciences and Human Studies at Imam Abdul Rahman Bin Faisal University for the academic year (2020/2021) participated in the study. Their ages ranged between 18 and 22 years.

Data collection tool and technique

To achieve the objectives of the study, answer its questions and verify its hypotheses, the researchers

prepared several measurement tools. The researchers designed the study tools for data collection: The first scale for cognitive flexibility, and the second scale for executive tasks, and third scale ADHD test. The scales were developed and modified from the relevant literature. After collecting the initial items for the study, scales were given to a group of experts to examine the face validity of the items, and suggestion were given and corrected accordingly. Each scale measured by several items that were scaled on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Cronbach's alpha was used to examine the internal reliability of the cognitive flexibility scale with $\alpha = 0.761$ and executive tasks with $\alpha = 0.77$, and attention deficit hyperactivity disorder test ($\alpha = 0.77$).

Ethical consideration

The researchers conducting the necessary agreements ethics committee from the Scientific Council at the Imam Abdulrahman Bin Faisal University, and then the researchers informed the participants that the responses will be used for the research purpose only.

Results

First hypothesis: It is possible to achieve a causal model that shows the relationship (both direct and indirect) of influencing and being influenced among the study variables (cognitive flexibility, executive tasks and academic achievement). To achieve a causal model that shows the relationship of influencing and being influenced within the framework of the existing relationships among the study variables, the structural equation modeling method was used in the Amos24 program. The model generating position was used to reach the best causal model that determines mutual influence relationships among the study variables for the study sample. First, the structural equation model for the indirect effects among the variables of the study, flexibility, and executive tasks on achievement. Figure 1 illustrates the structural equation model among the study variables.

The variables of the current study shown in Figure 1 are divided into three types:

1. Independent variables: These are the variables of cognitive flexibility and executive tasks.
2. Dependent variable: It is the variable affected by the independent variables and the intermediate variables, and it is the academic achievement variable.
3. Dimensions and items represents the measurement error at each of the dimensions to which it belongs.

The structural equation model shown in Figure 1 had good conformance quality indicators as shown in Table 1, where the values of the conformance quality indicators fell

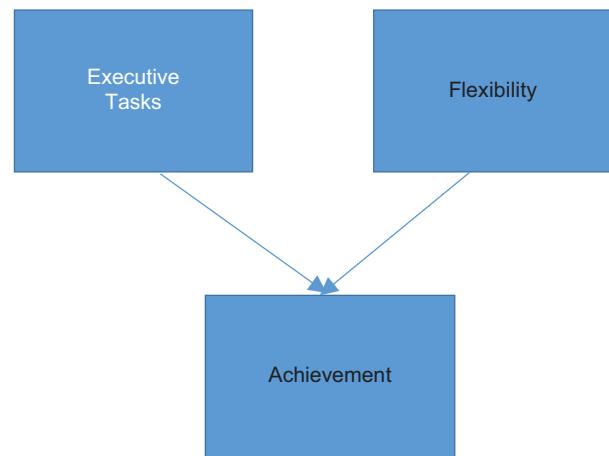


Figure 1: Measurement model

within the ideal range for each indicator. This indicates the good conformity of the model to the data.

Table 1 shows that the structural equation model had good and statistically acceptable matching quality indicators. It is clear from Figure 1 that there are direct and indirect effects between cognitive flexibility and academic achievement at a significance level of 0.01, and the value of the direct relationship between executive tasks and academic achievement is significant at a significance level of 0.001. Second, the direct effects model between the study variables, and Figure 2 shows the structural equation model between them. The variables of the current study shown in Figure 2 are divided into three types:

1. Independent variable: It is the variable of cognitive flexibility.
2. Intermediate variables: They are the influencing and being influenced variables, and the executive tasks variable.
3. Dependent variable: It is the variable affected by the independent variables, and it is the academic achievement variable.
4. Dimensions and items represents the measurement error at each of the dimensions to which it belongs.

The structural equation analysis model shown in Figure 2 had good conformity quality indicators, as shown in Table 2, where the values of the conformity quality indicators fell within the ideal range for each indicator. This indicates the good conformity of the model to the test data. Table 2 shows conformance quality indicators values to the current structural model.

Table 2 shows that the structural equation model had good and statistically acceptable matching quality indicators. It is clear from Figure 3 that there are direct and indirect effects and that the value of the direct effect between cognitive flexibility and executive tasks

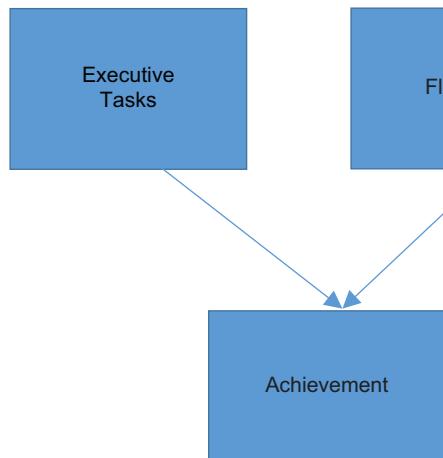


Figure 2: Structural model

amounted to 0.04 at a significance level of 0.001, which means flexibility has an indirect effect on academic achievement in the presence of a mediator variable of executive tasks.

Third, the direct effects model among the study variables, and Figure 3 shows the structural equation model between them. Figure 3 shows the structural equation model between the variables of cognitive beliefs and motivational beliefs in the psychosocial context.

Variables included in the model Figure 3 were the following:

1. Independent variable: It is the influencing variable, and it is the variable of executive tasks.
2. Dependent variables: It is the variable affected by the independent variable, and it is the cognitive flexibility variable.
3. Dimensions and items represents the measurement error at each of the dimensions to which it belongs.

The structural equation model shown in Figure 3 had good conformity quality indicators, as shown in Table 3, as the values of the conformity quality indicators fell within the ideal range for each indicator, which indicates the good conformity of the model to the data.

It is clear from Table 3 that the structural equation model has good and statistically acceptable matching quality indicators. Figure 3 shows that the value of the direct effect between cognitive flexibility and academic achievement is significant at a significance level of 0.001, and that the value of the direct effect between executive tasks and cognitive flexibility is significant at a significance level of 0.001, which means that there are indirect effects of executive tasks on academic achievement through an intermediate variable, cognitive flexibility.

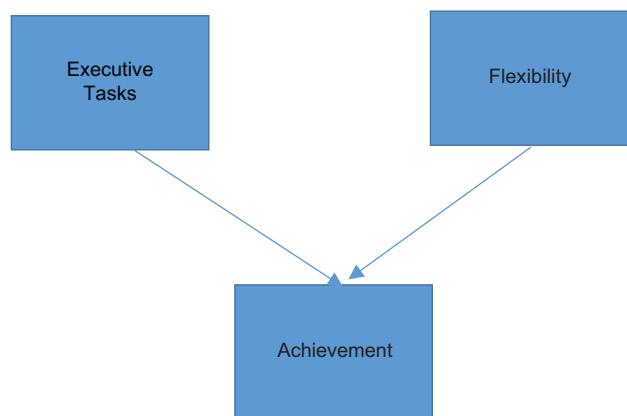


Figure 3: Hypotheses model

Table 1: Values of quality indicators of the model conformity

Category	Index	Notes
Absolute fit	RMSEA	RMSEA 0.000 <0.08 more better
Incremental fit	CFI	CFI 1.00 >0.85 acceptable
	TLI	TLI 0.99 >0.85 acceptable
Parsimonious fit	Chisq/df	Chisq/df 0.327 <3.0 more ideal

Table 2: Values of quality indicators of the model conformity

Category	Index	Notes
Absolute fit	RMSEA	RMSEA 0.000 <0.08 more better
Incremental fit	CFI	CFI 1.00 >0.85 acceptable
	TLI	TLI 1.00 >0.85 acceptable
Parsimonious fit	Chisq/df	Chisq/df 0.404 <3.0 more ideal

Table 3: Values of quality indicators of the model conformity

Category	Index	Notes
Absolute fit	RMSEA	RMSEA 0.000 <0.08 more better
Incremental fit	CFI	CFI 0.90 >0.85 acceptable
	TLI	TLI 0.98 >0.85 acceptable
Parsimonious fit	Chisq/df	Chisq/df 1.653 <3.0 more ideal

Discussion

The study seeks to identify the relationship between executive tasks and cognitive flexibility, and to study the extent to which students with ADHD are affected and their achievement. The results of the study showed that the three models achieved good quality indicators and all the relationships are significant. The reciprocal interactive relationship between cognitive flexibility and executive tasks and their direct impact on academic achievement are significant. The results agree with the study of Jansen *et al.*^[10] that aimed to study the level of executive tasks among students with ADHD in the secondary stage. The results concluded that students with ADHD suffer from executive tasks disorder. It also agrees

with the study by Carney *et al.*^[6] which concluded that executive function disorder among students with ADHD is the main reason behind the academic failure of these students. It also agrees with the validity of studies that emphasize the importance of attention as a cognitive process in academic achievement, as in the study by Watson *et al.*^[11] indicated the existence of a significant relationship between executive tasks disorder, attention deficit and hyperactivity. Likewise, a study by Schwebach^[12] indicated that pupils with attention deficit hyperactivity disorder suffer from executive functions disorder. The study is different from previous studies, as no study before tested the relationship between executive tasks and cognitive flexibility and their impact on a student's academic achievement based in university settings.

Limitations and Recommendations

This study, like other studies, has some limitations in terms of sample size, settings, and data collection. First, the study was limited to students who participated in this study; therefore, future studies should maximize the study sample by including more individuals. Second, the study was conducted in one city; therefore, future studies should be conducted in some other locations which has not been covered in this study. Finally, mixed methods and quantitative methods should be implemented in future studies as this study was limited to survey method.

Conclusion

Studying the reasons for the low academic achievement of students at the undergraduate level is important. Thus, the researchers draw attention to the necessity of addressing research in this field, especially since the university stage is one of the important stages that prepares students for professional life later on. A student reaching the university level is considered a national treasure that can have a significant role in boosting the well-being of his/her society. Studies have indicated that ADHD has gone beyond childhood and extended to include adulthood. The researchers point out the necessity of designing experimental research to reduce the severity of the disorder among students at the university level because it will have a positive impact on their academic achievement. Executive tasks are important to students in academic achievement and affect their professional life later in terms of the ability to plan and organize their life.^[13] Recently, the pandemic has affected people's lives in general and university students in particular.^[14] Therefore, the researchers highlight the necessity of improving students psychological and social factors as it will have a positive impact on their lives.^[15]

Acknowledgements

The study would like to thank the study participants for their participation.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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