

Cognitive Flexibility Among Middle School Students and Its Relationship with Participation in School Sports Activities: A Comparative Study

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Abstract:

This study aimed to examine the impact of school-based physical activity on the development of Cognitive Flexibility among middle school students. The researcher adopted a descriptive approach using a random sample of 300 students from oukid allal middle School in Laghouat Province." The results revealed statistically significant differences in favor of students who practiced physical activity, with team sports participants outperforming individual sports participants. The highest levels of Cognitive Flexibility were observed among students who engaged in physical activity four or more days per week and among those with longer sports experience.

KEY WORDS :

Cognitive Flexibility ; Sports Activities; Middle School Students.

المخلص: هدفت هذه الدراسة إلى التعرف على أثر ممارسة النشاط الرياضي المدرسي في تنمية المرونة العقلية لدى تلاميذ مرحلة التعليم المتوسط اعتمد الباحث المنهج الوصفي على عينة عشوائية مكوّنة من 300 تلميذ من متوسطة أوكيد علال بولاية الاغواط ، أظهرت النتائج وجود فروق ذات دلالة إحصائية لصالح التلاميذ الممارسين للنشاط الرياضي، كما تفوّق ممارسو الرياضات الجماعية على ممارسي الرياضات الفردية. وسُجّلت أعلى مستويات المرونة العقلية لدى التلاميذ الذين يمارسون النشاط الرياضي بمعدل اربعة أيام أسبوعياً فأكثر، ولدى ذوي الخبرة الطويلة.

الكلمات المفتاحية: المرونة العقلية ؛ النشاط الرياضي ؛ تلاميذ التعليم المتوسط.

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1-Introduction:

Physical Education and sports constitute a fundamental pillar within the system of athletic practice, given their profound impact on shaping the learner's personality and ensuring the integration of their physical, health, social, and psychological development (Rabaai & Rafik, 2022). The middle school years represent a critical developmental period during which students undergo substantial cognitive, emotional, and social changes that shape their learning abilities and overall adjustment. Academic performance at this stage is widely recognized as a key indicator of educational quality and of students' capacity to meet school demands. According to (Liem, 2019) adolescents' academic achievement is the net result of their cognitive and non-cognitive attributes, as well as the sociocultural context in which they grow. Similarly, Steinmayr et al. (2012) emphasize that academic success constitutes an essential prerequisite for personal development and contributes significantly to the prosperity of society as a whole.

Over the past decades, considerable attention in educational and psychological research has been devoted to identifying the factors that influence students' academic performance. Numerous studies have explored a range of determinants, including personality traits, cognitive abilities, peer relationships, family dynamics, school environment, and broader sociocultural influences (Castro-Sánchez et al , 2019). As contemporary learning environments become increasingly dynamic and cognitively demanding, researchers have highlighted the importance of specific cognitive skills that enable students to adjust to new learning conditions. Among these skills, cognitive flexibility has emerged as a central component of effective learning and adaptation.

Cognitive flexibility is commonly defined as the ability to shift between different strategies of thinking, consider alternative perspectives, and adopt new approaches when encountering novel or challenging situations (Scott, 1962; Diamond, 2013). As a core dimension of executive functions, cognitive flexibility plays a crucial role in enabling learners to solve problems, regulate their thinking processes, and respond adaptively to changes in classroom tasks and instructional methods. Empirical research indicates that students with higher levels of cognitive flexibility tend to demonstrate improved problem-solving abilities, enhanced creative thinking, greater learning

efficiency, and better adjustment to academic challenges (Cañas, 2003)

Furthermore, recent studies have positioned cognitive flexibility as an important explanatory factor for variations in academic outcomes among adolescents. Students in the middle-school stage who exhibit stronger cognitive flexibility are generally more capable of reorganizing their thinking when confronting difficulties, adapting to active learning environments, and engaging effectively with modern instructional approaches, including digital and interactive learning platforms (Zelazo, 2015). Additionally, cognitive flexibility has been linked to essential self-regulatory processes such as selective attention, inhibitory control, and emotional regulation, which in turn contribute to improved academic development (Blair & Raver, 2015).

Developing cognitive flexibility through sports participation is a pivotal step toward enhancing mental health and achieving educational excellence. Given the crucial role of executive functions in student adaptation, this study seeks to investigate the empirical impact of school sports on these mental capacities. Consequently, the central research question is formulated as follows: **To what extent does participation in school sports activities contribute to statistically significant differences in cognitive flexibility levels among middle school students**

As for the partial questions, they are as follows:

- Is there a statistically significant difference in the level of cognitive flexibility between middle school students who practice team sports and those who practice individual sports?
- Is there a statistically significant difference in the level of cognitive flexibility between middle school students who practice sports activities regularly and those who practice them irregularly?
- Is there a statistically significant difference in the level of cognitive flexibility between middle school students who have practiced sports for a long duration and those who have practiced for a short duration?

The general hypothesis was: There are statistically significant differences in the levels of cognitive flexibility among middle school students attributable to school sports participation variables

The partial hypotheses are as follows

- There are statistically significant differences in the level of Cognitive Flexibility between intermediate school students who practice Team sports activities and those who practice individual sports activities.
- There are statistically significant differences in the level of Cognitive Flexibility between intermediate school students who practice sports activities regularly and those who practice them irregularly.
- There are statistically significant differences in the level of Cognitive Flexibility between intermediate school students who have practiced school sports activities for a long period and those who have practiced them for a short period.

2- General objective of the study:

- To determine whether team sports (which require social interaction and coordination) enhance cognitive flexibility more effectively than individual sports
- To measure the impact of "athletic discipline" and regular sports participation on executive cognitive functions
- To identify whether the cumulative duration of sports practice leads to greater improvements in neural and cognitive flexibility

3- Procedural definition of the concepts mentioned in the research:

- The first concept: Cognitive Flexibility

is defined as one of the core executive functions that enables an individual to change their perspectives or ways of thinking to adapt to new requirements. It is the ability to switch smoothly between different cognitive rules to deal with emerging situations (Diamond, 2013).

The researcher concludes :The learner's ability to abandon incorrect phonetic patterns and smoothly transition toward applying newly acquired scientific pronunciation rules, while demonstrating the capacity for immediate self-correction during verbal performance.

-The second concept: Sports Activities

sports activities are defined as structured physical practices that involve specific rules and physical exertion, which contribute not only to physical fitness but also to the enhancement of cognitive processes, social skills, and psychological well-being (Bailey, 2006).

The researcher concludes : A set of organized physical movements and exercises practiced by intermediate stage students, specifically designed to stimulate mental alertness and support the process of cognitive construction.

-The Concept Three: Middle School

The cognitive construction and thinking phase is a foundational stage aimed at preparing the learner and developing their linguistic and critical capabilities. The significance of this phase is manifested in the effort to enrich the learner's linguistic repertoire and to establish precise standards that ensure the instruction of correct pronunciation in accordance with the required scientific principles (souhila · 2023)

The researcher concludes: the intermediate stage is defined as the transitional educational period that follows primary school and precedes secondary school. It typically encompasses the age group between 12 and 15 years.

- Previous studies that dealt with the subject. Through a review of

4- The methodological procedures used in the study:

4-1 Method and tools: The researcher adopted the descriptive-comparative approach, as it is the most suitable method for the nature and objectives of this study. This approach enables the description and analysis of cognitive flexibility levels among middle school students, while identifying the statistically significant differences based on their sports participation variables

-The exploratory study: The researcher conducted a pilot study on a small sample of (08) middle school students selected from the same educational institution but outside the main research sample. This study aimed to verify the psychometric properties of the research tools, ensure the clarity of the linguistic phrasing and assess its suitability for the students' cognitive level. Additionally, it sought to determine the time required to complete the assessment and address

any technical difficulties that might arise before proceeding with the final field application.

-Sample and methods of selection: A simple random sampling technique was employed to select the study participants from the student population at 'Oukid Allal' Middle School in the Laghouat Province during the 2023-2024 academic year. To ensure objective representation, a sample of 300 students was selected out of a total population of 600 (representing 50%). The selection process ensured that every individual in the population had an equal opportunity to be included, without any prior bias regarding their participation in school sports activities, thereby ensuring the neutrality and statistical accuracy of the results

- fields of study.

Human Field : Middle school students at "Oukid Allal" Middle School.

Spatial Field : Oukid Allal Middle School, Laghouat Province.

Temporal Field: The academic year 2023–2024.

-Study Variables:

-The Independent Variable: School Sports Participation.

-The Dependent Variable: Level of Cognitive Flexibility.

- Research tools: The researcher utilized a questionnaire as the primary data collection tool, consisting of (15) items. Responses are measured using a three-point Likert scale: Agree (3 points), Neutral (2 points), and Disagree (1 point), where each response is assigned its corresponding score.

The questionnaire was designed based on the study's theoretical framework, covering four main axes. The items were formulated in clear and simple language appropriate for the students' age group to ensure conceptual clarity and avoid ambiguity. Notably, the questionnaire was administered electronically via an online platform. The questionnaire consists of (15) items categorized into four main axes:

The First Axis: Focuses on "School Sports Participation and Cognitive Flexibility," including (4) items (Items 01 to 04).

The Second Axis: Examines The Type of Sports Activity and Cognitive Flexibility comprising (4) items (Items 05 to 08).

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The Third Axis: Concerns "Regularity of Sports Practice and Cognitive Flexibility containing (2) items (Items 09 and 10).

The Fourth Axis: Investigates The Duration of Sports Practice and Cognitive Flexibility consisting of (5) items (Items 11 to 15)

The total score is calculated by summing the responses for all 15 items. Based on the 3-point Likert scale, the total score ranges from a minimum of 15 to a maximum of 45 Higher scores indicate a higher level of cognitive flexibility among students.

To interpret the levels of cognitive flexibility, the scores are categorized into three levels:

Low Level: (15 – 25) points.

Moderate Level: (26 – 35) points.

High Level: (36 – 45) points.

- The scientific foundations of the tool:

Validity :The researcher verified **Face Validity** through (05) expert referees. Given that the **Martin & Rubin (1995)** Cognitive Flexibility Scale is globally established, **Cooper's Equation** was applied to confirm consistency. Agreement rates ranged from **90% to 100%**, validating the tool for field use

Reliability: The "Test-Retest" results yielded a high correlation coefficient of **(0.937)** for the overall scale, with axis values ranging from **(0.802 to 0.918)**, confirming the tool's high stability.

Statistical Methods: SPSS v.25 was utilized to calculate:

Cooper's Formula: For face validity.

Pearson Coefficient: For reliability.

Descriptive Statistics: (Means, SD, Frequencies).

Steven Thompson's Equation: For sample size.

4-2 Presentation and Analysis of Results:
-Sample Responses According to Study Variables

Table (01): Results of the Study Sample’s Responses According to Study Variables

Variable	Alternatives	Frequency	Percentage	Arithmetic
Practicing Physical Activity	No	101	33.66%	1.568
	Yes	199	66.33%	
Type of Activity	Individual Sport	113	37.66%	1.565
	Team Sport	187	62.33%	
Number of Times Practiced per Month	Less than 4 times	110	36.66%	1.45
	times or more	190	63.33%	
Number of Years Practice	Less than a year	91	30.33%	1.658
	More than a year	209	69.66%	

The results of The table (01): shows the distribution of the study sample in terms of practicing physical activity and mental flexibility. The results indicated that the majority of participants engage in physical activity (66.33%), compared to 33.66% who do not. The types of sports were distributed between team sports (62.33%) and individual sports (37.66%). Regarding the frequency of practice, 63.33% of participants exercise four times or more per month, compared to 36.66% who exercise less than four times. The data also showed that 69.66% of participants have more than one year of experience in practicing sports, while 30.33% have less than a year of experience.

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The mean score for Cognitive Flexibility was 1.658, indicating a convergence in Cognitive Flexibility levels among the participants, meaning that most of them exhibit a relatively balanced ability to adapt and think flexibly in various situations.

-Study Sample Responses to the Questionnaire Items

Table (02): Results of the Study Sample's Responses to the Questionnaire Items

Statements	Answers						Weighted Mean	
	Disagree		Neutral		Agree		Arithmet ic Mean	Sample Trend
	F	P %	F	P %	F	P %		
1	40	13.33%	85	40%	175	58.33%	2.38	Agree
2	43	14.33%	85	28.33%	172	57.33%	2.41	Agree
3	40	13.33%	91	30.33%	169	56.33%	2.423	Agree
4	70	23.33%	30	10%	200	66.66%	2.399	Agree
5	85	28.33%	43	14.33%	172	57.33%	2.23	Agree
6	43	14.33%	97	32.33%	160	53.33%	2.55	Agree
7	30	10%	200	66.66%	70	23.33%	2.42	Neutral

The results of The table (02): The results of the table indicate a generally positive tendency among the participants toward the statements under study, as reflected in the mean scores, which ranged between 2.23 and 2.55 on a three-point scale. Statement 1 achieved a mean of 2.38, with a high agreement percentage of 58.33%, compared to only 13.33% disagreement showing a strong consensus among respondents. Similarly, Statement 2 recorded a mean of 2.41, with agreement reaching 57.33%, while disagreement remained low at 14.33%. Statement 3 obtained a mean of 2.423, with 56.33% agreement, which reflects a stable positive tendency.

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Regarding Statement 4, it showed a relatively high agreement rate of 66.66% and a mean of 2.399, despite the comparatively higher disagreement rate (23.33%). Nonetheless, the overall direction remained positive. Statement 5 showed the lowest mean (2.23), yet still maintained an agreement rate of 57.33%, indicating that the lower mean primarily resulted from an increased disagreement rate (28.33%) compared to the other statements.

Statement 6 recorded the highest mean in the table (2.55), consistent with an agreement rate of 53.33% and a notably high percentage of neutral responses (32.33%), indicating strong agreement alongside some hesitancy. Statement 7 was the only one classified as *neutral*, with a mean of 2.42. It received the highest neutrality rate (66.66%), compared to 23.33% agreement and 10% disagreement, suggesting that respondents were uncertain about this particular statement more than the others.

Overall, the results confirm that the participants expressed generally positive attitudes toward most statements, with varying degrees of agreement and a noticeable level of uncertainty specifically associated with Statement 7.

Study Sample Responses to the Cognitive FlexibilityScale Items
Table (03): Results of the study sample's responses to the Cognitive FlexibilityScale items

Statements	Answers						Weighted Mean	
	Disagree		Neutral		Agree		Arith metic Mean	Sample Trend
	F	P	F	P	F	P		
1	40	13.33%	85	40%	175	%85.33	2.38	Agree
2	43	14.33%	85	28.33%	172	57.33%	2.41	Agree
3	40	13.33%	91	30.33%	169	56.33%	2.423	Agree

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4	70	23.33%	30	10%	200	66.66%	2.399	Agree
5	85	28.33%	43	14.33%	172	57.33%	2.23	Agree
6	43	14.33%	97	32.33%	160	53.33%	2.55	Agree
7	30	10%	200	66.66%	70	23.33%	2.42	Neutral

The results of Table 3 indicate that the study sample possesses a good level of mental flexibility, as all items achieved mean scores ranging from 3.58 to 3.86, reflecting a clear tendency among most participants to agree with the presented statements. It is noteworthy that items 02 and 05 recorded the highest percentages of full agreement, at 52.7% and 48.7%, respectively, indicating that the aspects reflected in these items are more positively perceived and accepted by the participants.

In contrast, items 06 and 07 recorded the lowest mean scores (3.58 and 3.67) alongside a relatively higher proportion of "disagree" and "strongly disagree" responses, which may suggest some challenges or reservations among the participants regarding these specific aspects. The distribution of responses shows that most participants tend to think flexibly and adapt to different changes, although some items indicate a need to strengthen certain dimensions of mental flexibility, particularly in situations requiring rapid changes or acceptance of diverse viewpoints.

Overall, it can be concluded that the study sample demonstrates a good level of mental flexibility, with certain areas that can be further developed to enhance cognitive performance and improve adaptability to various challenges.

- Results of the T-Test for the Effect of Physical Activity on Mental Flexibility:
Table (04) shows the results of the T-Test conducted to examine the effect of practicing physical activity on the Cognitive Flexibilityof the study sample

Pr-Physi cal - Activ	N	Arithmetic Mean	Standard Deviation	Calculated t	Sig	Statistica Sign
Yes	191	46.25	2.97	-48.26	0.000	Significa nt
No	109	24.23	3.42			

From Tabl (04) According to the results in Table (04), the T-test reveals a statistically significant difference in cognitive flexibility between students who engage in physical activities and those who do not. The practicing group (N=191) achieved a significantly higher mean score (46.25) compared to the non-practicing group (24.23). With a T-value of -48.26 and a p-value of 0.000, these findings confirm that regular physical activity substantially enhances the cognitive flexibility of middle school students.

- Results of the T-Test for the Type of Physical Activity on Mental Flexibility:
Table (05) shows the results of the T-Test conducted to examine the effect of the type of physical activity on mental flexibility

Type of activity	N	Arithmetic Mean	Standard Deviation	Calculated t	Sig	Statistica Sign
Team sport	230	46.25	2.86	24.23-	0.000	Significant
Individ ual sport	70	25.30	9.12			

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The results in **Table (05)** indicate statistically significant differences in cognitive flexibility based on the type of sports practiced. Students engaged in Team Sports (N=230) achieved a markedly higher mean score of 46.25 (SD=2.86), whereas those in Individual Sports (N=70) recorded a mean of 25.30 (SD=9.12). The calculated T-value of -24.23 with a significance level of 0.000 confirms that these differences are statistically significant. These findings suggest that team sports, which require constant social interaction and rapid tactical adjustments, have a greater impact on enhancing Cognitive Flexibility compared to individual sports.

Results of the T-Test for the Frequency of Practicing Physical Activity on Mental Flexibility:

Table (06) shows the results of the T-Test for the frequency of practicing physical activity on mental flexibility

Number of times practiced per month	N	Arith metic Mean	Stand ard Devia tion	Calculated t	Sig	Statistica Sign
Less than 4 times	101	24.99	5.90	-29.12	0.000	Significa nt
4 times or more	199	45.12	2.99			

The results of Table (06) showed statistically significant differences between the two groups. The mean score for the group practicing physical activity less than 4 times per month was 24.99 with a standard deviation of 5.90, while the mean score for the group practicing physical activity 4 times or more per month was 45.12 with a standard deviation of 2.99. The calculated T-value was -29.12 at a significance level of 0.000, indicating statistically significant differences between the two groups. These results reflect a positive effect of frequent physical activity on mental flexibility, as individuals who practice sports 3 times or more per month demonstrate higher

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levels of Cognitive Flexibility compared to those who practice less frequently.

Results of the T-Test for the Number of Years of Practicing Physical Activity on Mental Flexibility:

Table (07) shows the results of the T-Test for the number of years of practicing physical activity on mental flexibility.

Number of years of practice	N	Arithmetic Mean	Standard Deviation	Calculated t	Sig.	Statistical Significance
Less than one year	91	23.77	3.40	-29.12	0.000	Significant
More than one year	209	35.48	6.60			

The results of Table (07) showed statistically significant differences between the two groups. The mean score for the group that had practiced sports for less than one year was 23.77 with a standard deviation of 3.40, while the group that had practiced sports for more than one year recorded a higher mean of 35.48 with a standard deviation of 6.60. The calculated T-value was -29.12 at a significance level of 0.000, confirming substantial differences in favor of those with longer experience in practicing sports. These results indicate that continuity in practicing physical activity significantly contributes to enhancing mental flexibility, as individuals who engage in sports for longer periods demonstrate higher levels of Cognitive Flexibility compared to beginners, reflecting the positive impact of sustained sporting experience

4-3 Discussion and interpretation of the results:

Analysis and Interpretation: The results in Tables (01) and (02) support this hypothesis. The superiority of Team sportspractitioners is attributed to the nature of these activities, which demand continuous

social interaction and high cognitive effort to respond to changing game strategies, thereby enhancing mental agility and adaptability. This finding is consistent with the study of (Aslan, 2018), which confirmed that team sports athletes possess higher levels of mental flexibility. On the other hand, the flexibility observed in individual sports practitioners can be interpreted as being oriented towards "independent problem-solving," a type of flexibility linked to strong self-motivation and internal locus of control, as opposed to the adaptive flexibility resulting from collective motivation.

Analysis and Interpretation: Based on the statistical findings, it is evident that consistency and regularity in sports practice constitute a fundamental difference in improving mental performance. Regular physical activity contributes to building flexible thinking patterns capable of coping with pressures. This is supported by the study of (Ahmed, 2019), which linked regular training to a significant improvement in mental flexibility. However, the results suggest that the impact of regularity may be influenced by mediating variables such as "training quality" and "psychological support." Regular practice without a stimulating environment may not yield maximum cognitive benefits; furthermore, some individuals may develop their flexibility through other cognitive resources such as reading and continuous self-learning.

Analysis and Interpretation: The results support the premise that cumulative experience (long-term practice) plays a decisive role in deepening cognitive abilities. Students who engage in sports for extended periods acquire a higher capacity to adapt to complex mental challenges compared to those with short-term practice, aligning with the findings of (Ahmed, 2019). This can be explained by the fact that long-term practice leads to the **internalization** of adaptation skills, making them part of daily behavior. Nevertheless, it should be noted that individual differences in "mental readiness" and "personal motivation" may act as moderating factors, where a highly predisposed student might achieve a leap in Cognitive Flexibility even within relatively shorter practice periods.

Conclusion:

The current study concludes that school sports activity serves as a primary driver in developing students' mental flexibility. However, this impact is not uniform but varies according to the characteristics of the sports practice. The findings demonstrated that collective activities provide a significant advantage in mental and social adaptation compared to individual activities. Furthermore, "regularity" and "cumulative experience" (long-term practice) were identified as the two essential pillars for transforming transient cognitive skills into stable personality traits. Consequently, the study concludes that the highest levels of Cognitive Flexibility are achieved when sports practice combines social interaction, consistency, and long-term commitment, thereby preparing students to better navigate academic and life challenges. The conclusion should contain the finding recommendation and the prospect of this research if it is available

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