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Original article

Multiple Intelligences and Their Relationship to Physical and Skill Achievement among Middle School Students

[1,*]Shukry Basem Jamal, [2]Qasim Yehya Zyad

[1]College of Physical Education and Sports Sciences, University of Mosul, Iraq
[2]Department of Sports Activities, Nineveh Governorate Education Directorate, Iraq

*Correspondence: jamal@uomosul.edu.iq

Abstract

Purpose: This study investigated the levels of multiple intelligences, physical fitness, and sport-specific technical skills among elementary school students and examined the relationships between these three constructs to identify key cognitive predictors of motor and athletic development in young learners. Methods: Ninety-two fifth-grade male Iraqi students participated. Physical fitness was assessed via medicine ball throw, vertical jump, 30-meter sprint, Barrow agility run, and sit-and-reach test. Technical skills included basketball free throws and dribbling, handball shooting, and soccer zigzag dribbling. Multiple intelligences were measured using McKenzie's inventory. Results: Results showed below-norm upper and lower limb strength (medicine ball throw: M = 4.5 m; vertical jump: M = 4.62 cm), moderate sprinting (M = 5.11 s), agility (M = 21.8 s), and flexibility (M = 17 cm). Technical skills were moderate (basketball free throws: M = 3; basketball dribbling: M = 11.32 s; handball shooting: M = 17; soccer dribbling: M = 14.2 s). Bodily-kinesthetic intelligence was dominant (M = 3.6). Correlations revealed bodily-kinesthetic intelligence predicted sprinting ($r = .209$, $p < .05$), basketball dribbling ($r = .221$, $p < .05$), and handball shooting ($r = .212$, $p < .05$); visual-spatial intelligence correlated with upper limb strength ($r = .247$, $p < .05$); logical-mathematical intelligence with handball shooting ($r = .245$, $p < .05$); and interpersonal intelligence with lower limb strength ($r = .299$, $p < .01$) and sprinting ($r = .209$, $p < .05$). Conclusion: Bodily-kinesthetic intelligence consistently predicted both physical fitness and technical skills, while other intelligences showed selective associations.

Keywords: psychomotor performance, physical performance testing, cognitive development, elementary students, educational measurement

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Introduction

Physical education (PE) is not only a setting for developing motor skills and physical fitness, but also a learning domain where perception, decision-making, problem solving, and social interaction influence performance. Within this context, multiple intelligences (MI) theory provides a framework that helps explain individual differences in movement learning and sport performance, especially because several intelligence types align directly with perceptual–motor and tactical demands in PE (Mitchell & Kernodle, 2004; Armstrong, 2009). Among these, bodily-kinesthetic, visual-spatial, logical-mathematical, and interpersonal intelligences are particularly relevant to coordination, spatial awareness, strategic reasoning, and team interaction in games and sport tasks (Mitchell & Kernodle, 2004; Demirel, 2000).

Recent studies support MI's potential as a predictor of sport performance. Visual-spatial intelligence has been associated with youth motor coordination and physical activity engagement (Jansen & Heil, 2010; Jansen, Lehmann, & Tafelmeier, 2018), while bodily-kinesthetic intelligence has been strongly linked to motor competence (Aguilar et al., 2021). Logical-mathematical intelligence contributes to anticipation and tactical decision-making in games (Armstrong, 2009), and interpersonal intelligence supports teamwork and cooperation (Mitchell & Kernodle, 2004). These findings suggest that MI profiles may help identify cognitive attributes that facilitate the acquisition of sport-specific skills such as dribbling, passing, shooting, or agility-based maneuvers.

Despite this potential, MI-based differentiation is still rarely applied in PE settings, especially in Arab educational systems where traditional PE instruction focuses heavily on repetitive drills and physical execution without acknowledging cognitive diversity (Al-Khayat & Al-Hayali, 2001). At the same time, elementary school years represent a critical phase for the development of physical fitness components such as strength, agility, flexibility, and speed, which are foundational for health and future sports participation (Bailey et al., 2009). Importantly, psychological and cognitive factors also contribute to motor proficiency and physical activity behaviors (Stodden et al., 2008), yet these dimensions remain under-examined in regional PE practice.

To measure MI profiles in applied school-based research, McKenzie's multiple intelligence inventory (MII) is among the most widely used tools and has been used consistently in academic research on education (McKenzie, 1999; Kutz et al., 2013). This survey's internal consistency, as reported by multiple researchers and utilized in earlier studies, ranges between 0.85 and 0.90 (Kutz et al., 2013; Razmjoo, 2008). The inventory contains 90 items covering nine distinct intelligence domains, with ten items representing each intelligence type.

However, in Iraq, there is still a lack of empirical research linking MI domains with children's sport-specific performance and physical fitness levels. This limits teachers' ability to design instruction that matches children's cognitive strengths and restricts the development of pedagogies that leverage MI theory to enhance motor learning.

Therefore, this study investigates the multiple intelligence profiles of fifth-grade Iraqi students and examines their associations with key physical fitness indicators and sport-specific technical skills. It focuses particularly on whether bodily-kinesthetic, visual-spatial, logical-mathematical, and interpersonal intelligences demonstrate meaningful correlations with performance outcomes. By identifying the most influential intelligence domains, this study seeks to inform PE pedagogy and curriculum development in Iraq, offering evidence-based recommendations to support more effective, individualized, and cognitively informed physical education.

Methods

Research design and Sample

During the 2021–2022 school year, 92 male fifth-graders (mean age = 10–12 years) were selected from Abu Hanifa Elementary School in Nineveh, Iraq. Power factors for correlational analyses were taken into account when determining the sample size. A sample size of 92 offers enough power to identify medium-sized relationships ($r = 0.29–0.30$) between several intelligence characteristics and measures of technical ability or physical fitness, with α set at 0.05 and power ($1 - \beta$) at 0.80. The current sample is sufficient to investigate the intermediate predictive associations that are the focus of this investigation, even though lower correlations ($r = 0.20–0.25$) would be underpowered.

Those who were officially enrolled in the fifth grade, were within the normal age range for this grade (10–12 years), and had received medical clearance to engage in regular physical education classes at school were eligible to participate. Only students who completed the Multiple Intelligences Inventory and the physical and technical competence tests were included, and all participants had informed parental approval and child assent.

Measurements and Procedures

The research sample at Abu Hanifa Intermediate School underwent a battery of tests including several intelligences tests, motor skill performance, and physical fitness between March 4 and May 2, 2022. First, under the guidance of the study team and assigned helpers, physical fitness tests were conducted outdoors between March 4 and April 17, 2022. In order to maintain consistency in the testing environment, motor skill performance tests were carried out in the same outdoor yard from April 18 to May 2, 2022, after this phase. Simultaneously, on April 27, 2022, the Multiple Intelligences Test was given in a specific classroom within the school, which offers a more regulated and calmer indoor environment appropriate for cognitive assessment. These sequential and structured assessments ensured comprehensive data collection across physical, motor, and cognitive domains. The research protocol was recognized in the Declaration of Helsinki (World Medical Association, 2013).

Physical Fitness Tests

Upper-Body Explosive Strength: Participants threw a 3-kg medicine ball as far as they could from their chest while sitting with their back supported. Meters were used to measure the distance. An accurate indicator of upper-limb explosive strength is this test (Stockbrugger & Haennel, 2001).

Lower-Body Explosive Strength: Students began standing and executed a maximum vertical jump test; the height of the jump was recorded. According to Markovic et al. (2004), this test is a common field evaluation of lower-limb power and explosive strength.

Linear running speed: Students performed a 30-m maximal sprint. They started standing and ran 30 meters, with timing recorded to the closest 0.1 seconds. The test is frequently used to assess acceleration and short distance running skills (Little & Williams, 2005).

Barrow Zig-Zag Agility Test: Students had to run in a zigzag pattern past cones as fast as they could, and their time was recorded. The test evaluates agility and multidirectional speed and is a component of the Barrow Motor Ability Test battery (Barrow, 1954).

Sit and Reach Flexibility Test: Students sat with their legs outstretched and reached as far forward as they could along a measuring box. Centimeters were used to mark the best of three efforts. According to Zanevskyy & Zanevska, (2017). this is a standardized test of lower-back and hamstring flexibility.

Technical skills tests

Basketball Free-Throw Accuracy Test (BFAT): Ten free throws from the designated free-throw line were attempted by each participant. The quantity of successful baskets was noted. Basketball shooting accuracy is frequently assessed using this test (Apostolidis & Emmanouil, 2015).

Basketball Dribbling Test with Direction Change (BDTDC): Students had to dribble a basketball through a zigzag pattern of cones, and the time it took them to finish was noted. Ball handling speed and control under directional changes are measured by this test (Apostolidis & Emmanouil, 2015).

Handball Shooting Accuracy Test (HSAT): Each student attempted ten goal shots from a predetermined distance; the number of successful attempts was recorded. This is a methodical evaluation of handball shot accuracy (Hoff & Almasbakk, 1995).

Soccer Zig-Zag Dribbling Test (SZDT): the best time of two attempts was recorded when dents dribbled a ball through five posts in a zigzag pattern as part of the football zig-zag dribbling test. This exam assesses football players' dribbling agility and ball control (Reilly et al., 2000).

Multiple Intelligences Test

MII was used since it has been used consistently in academic research on education (McKenzie, 1999; Kutz et al., 2013). This survey's internal consistency, as reported by multiple researchers and utilized in earlier studies, was 0.85 to 0.90 (Kutz et al., 2013; Razmjoo, 2008). There are nine different categories of intelligence represented by the 90 items in this test, with ten items for each type. Every sentence is written positively, and the contents are presented in a random order. Five response options are available to respondents: "Applies to me completely," "Applies to me a lot," "Applies to me sometimes," "Applies to me a little," and "Does not apply to me completely." These responses are scored on a five-point Likert scale ranging from 5 to 1, respectively. Each type of intelligence is scored independently, allowing for separate analysis of each intelligence dimension. The nine distinct types of intelligence are shown in Table 1.

Table1: Subscales of the Multiple Intelligence Inventory (MII) and Their Descriptions.

Subscale (Intelligence Type)	Description / What It Includes
1. Verbal-Linguistic Intelligence	Enjoys reading, writing, storytelling, and verbal games; good at speaking, debating, and remembering information.
2. Logical-Mathematical Intelligence	Solves puzzles and problems, works well with numbers, likes experiments and logical patterns, enjoys strategy games.
3. Visual-Spatial Intelligence	Thinks in images and pictures, enjoys drawing and design, good at puzzles and maps, visualizing objects in space.
4. Bodily-Kinesthetic Intelligence	Uses the body effectively; enjoys physical activity, sports, role-play, crafts, and learning through movement and touch.
5. Musical-Rhythmic Intelligence	Sensitive to sound, rhythm, and melody; enjoys singing, playing instruments, composing, and recognizing musical patterns.
6. Interpersonal Intelligence	Works well with others, good at communication and empathy, enjoys group work and social interaction.
7. Intrapersonal Intelligence	Self-aware and reflective; prefers working alone, sets goals, understands personal strengths and weaknesses.
8. Naturalistic Intelligence	Interested in nature, animals, plants, and the environment; classifies natural objects and enjoys outdoor activities.
9. Existential Intelligence	Thinks deeply about life, existence, and purpose; interested in philosophical questions and abstract thinking.

Statistical analyses

All statistical analyses were performed using IBM SPSS Statistics software (version 20.0). Prior to conducting the main analyses, the normality of data distribution was assessed using the Shapiro–Wilk test. Descriptive statistics (means and standard deviations) were calculated for the three examined constructs: physical fitness, sport-specific technical skills, and multiple intelligences. Associations among these constructs were evaluated using Pearson's product–moment correlation analysis. Effect sizes for the correlation coefficients were interpreted according to Cohen's criteria, where values of approximately $r = 0.20$ indicate a small effect, $r = 0.50$ a medium effect, and $r \geq 0.80$ a large effect (Sullivan and Feinn, 2008). The level of statistical significance was set at $\alpha = 0.05$.

Results

Starting with the Physical Fitness tests, participants showed moderate performance in fitness components (Table 2). Mean scores were 4.5 m for upper limb strength, 4.62 cm for lower limb strength, 5.11 sec for sprinting, 21.8 sec for agility, and 17 cm for flexibility. Overall, the values reflect variability in motor capacities, with agility and flexibility showing relatively consistent results compared to explosive strength measures.

Table 2. Results of the Physical Fitness tests.

#	Physical Component	Test	Mean	SD (±)
1	Upper Limb Explosive Strength (m)	Medicine Ball Throw	4.5	3.21
2	Lower Limb Explosive Strength (cm)	Vertical Jump Test	4.62	2.92
3	Sprinting Speed (Sec.)	30-Meter Speed Test	5.11	2.84
4	Agility (Sec.)	Barrow Zig-Zag Agility Test	21.8	1.84
5	Flexibility (cm)	Sit and Reach Test	17	1.04

The participants' scores on sport-specific technical skill tests summarized in Table 3 indicated a moderate level of technical proficiency, with handball shooting showing the strongest relative performance and basketball free throws representing the most challenging skill.

Results of the Multiple Intelligences test were displayed in Table 4. These results showed that bodily-kinesthetic intelligence recorded the highest mean score (M = 3.6, SD = 1.62; total = 331.2), followed by existential (M = 3.1, SD = 2.11; total = 285.2) and naturalistic intelligence (M = 2.9, SD = 2.88; total = 266.8). These findings highlight bodily-kinesthetic intelligence as the most dominant domain among participants, aligning with their engagement in physical activities.

Table 3. Results of the sport-related technical skills tests.

#	Technical Skill	Test	Mean ($\bar{x}$)	SD (±)
1	Basketball Free Throw Shooting	Basketball Free-Throw Accuracy Test	3	1.02
2	Basketball Dribbling	Basketball Dribbling Test with Direction Change	11.32	1.83
3	Handball Shooting (#)	Handball Shooting Accuracy Test	17	1.60
4	Soccer Dribbling (Sec.)	Soccer Zig-Zag Dribbling Test	14.2	1.58

As for the relationships between Physical Fitness tests and Multiple Intelligences presented in Table 5, significant associations were found between visual-spatial intelligence and upper limb strength ($r = .247$, $p < .05$), bodily-kinesthetic intelligence and sprinting speed ($r = .209$, $p < .05$), and interpersonal intelligence with both lower limb strength ($r = .299$, $p < .01$) and sprinting speed ($r = .209$, $p < .05$).

Table 4. Results of the Multiple Intelligences test (MIT).

#	Multiple Intelligences Tests	Mean (x̄)	SD (±)
1	Verbal-Linguistic Intelligence	2.7	2.62
2	Logical-Mathematical Intelligence	2.5	2.32
3	Visual-Spatial Intelligence	2.8	2.93
4	Bodily-Kinesthetic Intelligence	3.6	1.62
5	Musical-Rhythmic Intelligence	1.9	2.53
6	Interpersonal Intelligence	2.1	1.93
7	Intrapersonal Intelligence	2.8	1.67
8	Naturalistic Intelligence	2.9	2.88
9	Existential Intelligence	3.1	2.11

Table 5. Relationships between Physical Fitness Components and Multiple Intelligences.

#	Multiple Intelligences Tests	Upper Limb Explosive Strength	Lower Limb Explosive Strength	Sprinting Speed	Agility	Flexibility
1	Verbal-Linguistic Intelligence	-0.010	0.144	0.140	-0.015	0.164
2	Logical-Mathematical Intelligence	-0.017	0.024	0.060	-0.011	0.082
3	Visual-Spatial Intelligence	**.247***	-0.119	0.173	0.097	-0.121
4	Bodily-Kinesthetic Intelligence	0.116	-0.111	**.209***	-0.159	-0.048
5	Musical-Rhythmic Intelligence	0.083	0.191	-0.007	-0.043	-0.085
6	Interpersonal Intelligence	-0.088	**.299****	**.209***	-0.097	0.096
7	Intrapersonal Intelligence	0.109	-0.111	0.071	-0.090	0.143
8	Naturalistic Intelligence	0.107	-0.082	-0.078	0.093	-0.190
9	Existential Intelligence	-0.005	-0.096	-0.026	0.074	0.097

Note: *Correlation is significant at the 0.05 level; **Correlation is significant at the 0.01 level.

Finally, the relationships between technical skills and Multiple Intelligences presented in Table 6 indicated that bodily-kinesthetic intelligence was positively related to basketball dribbling ($r = .221$, $p < .05$) and handball shooting ($r = .212$, $p < .05$), while logical-mathematical intelligence correlated with handball shooting ($r = .245$, $p < .05$).

Table 6. Relationships between technical skills tests and multiple intelligences.

#	Multiple Intelligences Tests	*Free-Throw*	*Basketball Dribbling Test*	*Handball Shooting*	*Soccer Zig-Zag Dribbling*
1	Verbal-Linguistic Intelligence	-0.177	0.048	0.096	-0.045
2	Logical-Mathematical Intelligence	-0.140	-0.052	**.245***	-0.001
3	Visual-Spatial Intelligence	-0.104	-0.104	-0.171	0.027
4	Bodily-Kinesthetic Intelligence	0.094	**.221***	**.212***	-0.020
5	Musical-Rhythmic Intelligence	-0.043	0.075	-0.028	0.010
6	Interpersonal Intelligence	-0.087	0.010	-0.182	-0.053
7	Intrapersonal Intelligence	-0.067	0.049	0.060	0.051
8	Naturalistic Intelligence	0.040	-0.067	-0.049	-0.105
9	Existential Intelligence	0.011	0.090	0.120	0.051

Note: *Correlation is significant at the 0.05 level; **Correlation is significant at the 0.01 level.

Discussion

This study investigated the levels of multiple intelligence profiles, physical fitness, and sport-specific technical skills among elementary school students and examined the relationships between these three constructs to identify key cognitive predictors of motor and athletic development in young learners.

Results from the assessment of upper limb explosive strength showed lower values than the normative range of 6–7.5 meters for this age group (Faigenbaum et al., 2009; González-Devesa et al., 2025), Similarly this, the vertical jump revealed low lower limb explosive strength compared to anticipated 20–30 cm range (Milanese et al., 2010; Castro-Piñero et al., 2010). This suggests that programs targeted at explosiveness are necessary. On the other hand, children between the ages of 10 and 12 had moderate sprinting speed and agility (Ceylan, Saygin, & Irez, 2014; Sporiš et al., 2010). A healthy range of flexibility indicated sufficient joint mobility and a lower risk of injury (Nourbakhsh & Arab, 2002). These findings demonstrated the necessity of giving lower limb power development top priority in physical education programs.

Pupils who demonstrated a moderate level of proficiency in technical skills unique to their sport indicated that they could improve in particular areas. In line with similar earlier studies (Gallahue & Ozmun, 2006; Malina et al., 2004), basketball Free-throw performance averaged three successful attempts out of ten ($M = 3$, $SD = 1.02$). Basketball dribbling with direction change averaged 11.32 s, and soccer zigzag dribbling averaged 14.2 s, both of which were within normative bounds (Williams & Lacy, 2018; Sporiš et al., 2010). The best-performing skill was handball shooting, with 17 out of 30 shots, being successful, suggesting either excellent motor coordination or previous experience (Al-Khayat & Al-Hayali, 2001).

The Multiple Intelligence Inventory revealed that the preponderance of bodily-kinesthetic intelligence ($M = 3.6$) was indicative of the sport-related technical skills and vigorous physical exercise (Kutz et al., 2013; Shearer, 2004). Naturalistic ($M = 2.9$) and existential ($M = 3.1$) intelligences were also comparatively high, perhaps as a result of environmental and cultural influences (Armstrong, 2009; Gardner, 1999). Interpersonal ($M = 2.1$) and musical-rhythmic ($M = 1.9$) intelligences were lowest, presumably due to little exposure to or focus on these areas, but visual-spatial ($M = 2.8$) and intrapersonal ($M = 2.8$) intelligences were intermediate (Ekici, 2011; Rahayu et al., 2024). These results provide credence to Gardner's (1983, 1999) theory, suggesting that to promote inclusive and successful learning, education could encourage weaker domains while utilizing dominant intelligences.

Selective links between cognitive profiles and performance were demonstrated via correlation analysis. Upper limb explosive power and visual-spatial intelligence had a positive correlation ($r = .247$, $p < .05$), which could be attributed to the fact that visual abilities include visual sharpness, depth perception, contrast sensitivity, and visuomotor reaction speed (Ramyarangsi et al., 2024). These abilities enable athletes to effectively observe and respond to visual stimuli during sports activities. Its prominent role in both motor and skill proficiency was supported by the correlations between bodily-kinesthetic intelligence and sprinting speed ($r = .209$, $p < .05$), basketball dribbling ($r = .221$, $p < .05$), and handball shooting ($r = .212$, $p < .05$) (Shearer, 2004). Lower limb strength ($r = .299$, $p < .01$) and sprinting speed ($r = .209$, $p < .05$) were associated with interpersonal intelligence, suggesting the possible influence of social and motivational involvement on physical performance (Rahayu et al., 2024). Handball shooting was linked to logical-mathematical intelligence ($r = .245$, $p < .05$), which is in line with the importance of reasoning and judgement in strategic activities (Bracero-Malagón et al., 2022). Weak or non-significant relationships were found for other intelligences, such as verbal-linguistic, musical-rhythmic, and naturalistic, highlighting the task-specific influences of cognitive abilities.

While visual-spatial intelligence did not exhibit significant connections, perhaps because of task simplicity or developmental stage, bodily-kinesthetic and logical-mathematical intelligences were the most relevant predictors of technical skills. These findings support Gardner's (1999) claims and earlier research (Shearer, 2004; Ekici, 2011; Kutz et al., 2013; Ruiz Pérez et al., 2014; Bracero-Malagón et al., 2022) by showing that technical skill performance is dependent on both physical aptitude and cognitive involvement.

The study's main research question how multiple intelligences relate to physical fitness and technical skills was addressed: all nine intelligences were present, with bodily-kinesthetic dominance. Significant relationships were observed: visual-spatial, bodily-kinesthetic, and interpersonal intelligences with physical fitness; bodily-kinesthetic and logical-mathematical intelligences with technical skills. Hypotheses were partially supported: bodily-kinesthetic intelligence consistently predicted both domains, while logical-mathematical, interpersonal, and visual-spatial intelligences showed selective associations.

Several limitations need to be noted. The sample was limited to a single governorate, which decreased generalizability, and the cross-sectional methodology restricts causal inference. Socioeconomic and cultural elements were not under control. Furthermore, even while standardized tests are trustworthy, they cannot fully reflect all the subtleties of cognitive or motor performance.

Conclusion

According to the study, elementary-aged students have a wide variety of multiple intelligences, with bodily-kinesthetic intelligence being the most reliable indicator of both technical skill competency related to a sport and physical fitness. The selective contributions of interpersonal, visual-spatial, and logical-mathematical intelligences emphasize the significance of task-specific cognitive demands in motor and skill performance.

These findings have several practical implications. To maximize skill acquisition and motor development, physical education courses should first be customized to children's cognitive profiles, with an emphasis on bodily-kinesthetic capabilities. Second, to promote holistic athletic development, instructors can use strategy-based drills, spatial awareness exercises, and cooperative learning activities to engage and develop students' logical-mathematical, visual-spatial, and interpersonal intelligences. Third, by recognizing students' many intelligences, tailored interventions can be made to help weaker domains supplement the development of technical and physical skills. Lastly, these realizations might promote lifetime physical exercise and consistent participation in sports, which would improve mental and physical health. Future studies ought to use intervention-based or longitudinal designs, involve larger populations, and investigate the long-term effects of intelligence-informed training regimens on technical and physical development.

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***Declaration of interests*:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The authors declare no conflict of interest

***Data availability*:** All collected data are included in the manuscript. Raw data are available upon reasonable request to the corresponding author.

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