Visual Intelligence Level and Its Relationship to Academic Achievement Among Female Students in the Art Education Course at the College of Education, Kuwait University

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Abstract

This study examined the level of visual intelligence and its relationship to academic achievement among female students enrolled in the Art Education course at the College of Education, Kuwait University. To collect data a visual intelligence scale was used, consisting of 25 items distributed across three dimensions. The sample comprised 107 female students enrolled in the Art Education course at Kuwait University. Evidence supporting the instrument's validity and rollability was established through a pilot study. The results showed moderate level of visual intelligence among the female students enrolled in the Art Education course at the College of Education, Kuwait University. Furthermore, the results showed a statistically significant positive association between visual intelligence level and academic achievement across all dimensions. In addition, the results revealed no statistically significant differences in the means of visual intelligence according to the year of study variable. Considering the findings, the study recommended several recommendations, the most important of which are: developing students' visual intelligence skills through targeted teaching practices and designing training programs for students to enhance their visual processing skills.

Keywords: visual intelligence, art education, university students, State of Kuwait

1. Introduction

The theory of multiple intelligences was introduced by Howard Gardner in 1983, who challenged the traditional view that intelligence is a single ability and that it is measured by a single test. Gardner pointed out that individuals possess distinct cognitive abilities across multiple domains that operate relatively independently of each other, and that an individual possesses eight types of intelligence or mental abilities, namely visual intelligence, verbal intelligence, interpersonal intelligence, kinesthetic intelligence, musical intelligence, logical intelligence, intrapersonal intelligence, and naturalistic intelligence, with each intelligence associated with distinct neural network. Varying in its level of development both within and across individuals. Individuals may demonstrate strength different forms of intelligence, Moreover, these intelligences can be cultivated and further developed through appropriate educational experiences (Šafranj & Zivlak, 2018).

Visual intelligence is one of the eight intelligences proposed by Gardner in his theory of multiple intelligence. It refer to the individual's ability to perceive, interpret and analyze information in a visual way to recognize images, visualize shapes and colors, analyze visual patterns and artwork, construct maps, engage in mental imagery, and coordinate visual–motor skills. Visual intelligence can be enhanced through instructional activities involving drawing, sculpture and other forms of artistic practice and other visually oriented learning activities (Wahab et al., 2018; Xie et al., 2024).

2. Literature Review

Visual intelligence is the ability to absorb, analyze, and understand information and things in a visual way. People who possess this type of intelligence tend to think and process information in images, or in other words, they think with their mind's eye, creating clear ideas and mental images, and they can retrieve and transform them into information (Zhang et al., 2024; Wang & Yoon, 2021).

In this context, Fan et al. (2023) define visual intelligence as the ability to accurately imagine and visualize objects, as well as to mentally manipulate these visual representations before translating them into reality. It is also referred to as spatial intelligence, which involves the capacity to perceive, interpret, and effectively utilize spatial information. This includes reading and interpreting maps, tables, and diagrams; visualizing objects and spatial relationships; estimating distances between objects or locations; and making approximate distance judgments based solely on visual perception.

Therefore, these abilities can be categorized into the following (Xie et al., 2024):

1- Spatial Awareness: This refers to an individual's ability to understand and manipulate relationship , including spatial orientation, object movement and accurate use of the four cardinal directions. involving spatial orientation, such as moving objects in space, as in a game of chess, or the ability to use the four cardinal directions accurately.

2- Object Work: This refers to the ability to use visual-motor coordination to assemble and rearrange objects, as well as the skill to decorate, embellish, or repair objects.

3- Artistic Design: This refers to the ability to execute artistic projects or tasks that require aesthetic and design sense.

Characteristics of individuals with high visual intelligence: (Li and Zhang, 2025)

They enjoy drawing, coloring, and visual arts in general they come up with novel and unusual ideas and unique solutions to problems. They may sometimes appear less organized because they tend to focus on multiple ideas and possibilities. They tend to perceive the overall picture rather than focusing primarily on minor detail.

Jamaan et al. (2019) define visual intelligence as a set of cognitive abilities involved in processing complex visual information. These abilities include extracting meaningful representations from visual input, distinguishing objects and categories, perceiving fine visual details, and drawing inferences from visual scenes.

This concept differs from traditional notions of general intelligence (g) and even from visual-spatial intelligence. While the latter focuses on spatial relationships, mental rotation, and orientation, visual intelligence emphasizes the capacity of sensory-cognitive systems to distinguish visual elements and understand their formal and perceptual properties. Recent studies indicate the existence of distinct visual abilities that can be differentiated from general intelligence (Li and Zhang, 2025; Zhang et al., 2024).

Visual intelligence has significant educational implications, as teachers can enhance students' visual observation and analytical abilities through guided exercises using images and scientific diagrams. Professionally, many jobs, such as radiology, design, and forensic visual analysis, rely heavily on these skills, and visual intelligence tests can contribute to candidate selection or the design of advanced training programs (Xie et al., 2024).

Neurological evidence suggests that the higher visual cortex includes multiple pathways responsible for representing shape, surface, and appearance, as well as others responsible for movement and position. Furthermore, recent research in cognitive science and neurocomputation reveals similarities between brain representations and those learned by deep neural networks, fostering a deeper understanding of the cognitive structure of visual intelligence (Li and Zhang, 2025). Visual intelligence helps with interpreting, understanding and appreciating the inherited world, because it is a vital process. Without visual perception, which is used for spatial relationships, we cannot communicate about space and understand the relationships that connect things. We cannot give or receive instructions to find the location of things or accomplish simple tasks. We cannot describe the changes resulting from dividing, grouping, or moving shapes in space. The importance of visual intelligence lies in the fact that it enables us to perceive the qualities of shape recognition (Wahab et al., 2018; Torrez et al., 2019).

Visual intelligence develops students' visual literacy skills and enhances their ability to understand the visual influences of their surroundings. This strengthens their connection to the environment, encourage the generation of new ideas, captures students' attention, and cultivates positive attitudes. In addition to oral communication, learning context can also be presented through visual representation. Furthermore, visual intelligence enhances students' observational skills through examining and interpreting models. Students acquire various cognitive skills, including analysis, comparison, and inference (Aspanani & Omid, 2023; Alnasraween et al., 2025).

Students with strong visual intelligence possess several characteristics, including: a quick response to shapes, images, and colors; an inclination to describe things imaginatively; keen observational skills; enjoyment of solving visual puzzles; the ability to remember places through images or descriptions; and a sense of enjoyment in playing with colorful blocks and reading pictures in books (Hammadi, 2022; Slota et al., 2018).

Visual intelligence skills can be described as follows:

1. Shape analysis skills: This refers to the ability to perceive relationships in drawings and identify their characteristics.

2. Shape connection skills: This means the ability to connect the elements of a shape and discover similarities and differences between them.

3. Ambiguity perception and interpretation skills: This refers to the ability to clarify shortcomings and flaws in drawings.

4. Meaning extraction skills: This refers to the ability to derive new meanings from visual shapes and to infer scientific concepts and principles from models and forms.

Abdel Fattah (2021) conducted a study aimed at designing reinforcement books based on integrating visual cues and educational game stimuli in interactive video to develop visual literacy skills and learning engagement among hearing-impaired students. The study sample consisted of 28 students (male and female) divided into three experimental groups. The research instruments included a visual literacy skills test, a learning engagement scale, and an achievement test. The results revealed statistically significant differences in the post-test scores among the three groups for each of the three groups (visual literacy skills test, learning engagement scale, and achievement test), favoring the experimental group.

Mutshar (2021) conducted a study aimed at revealing the effect of teaching geography using computers on developing visual-spatial intelligence among fifth-grade female students in the humanities track. She used a visual intelligence test as a research instrument. The study sample consisted of 64 female students, divided into two groups: an experimental group of 31 students and a control group of 33 students. The results showed statistically significant differences between the experimental and control groups on the visual intelligence test, favoring the experimental group.

Liu et al. (2021) carried out a study to explore whether visual-spatial ability predicts the academic achievement of university students. The study sample consisted of 499 Chinese students. The visual-spatial abilities, numeracy skills, and reading skills were assessed. The students' academic achievement data over consecutive years were gathered. The results showed that visual-spatial ability predict students' achievement, but primarily indirectly—that is, its impact on achievement is mediated through numeracy and reading skills. The study concluded that developing visual-spatial skills could improve important learning outcomes such as numeracy and reading, thereby leading to overall improved achievement.

Syafiqah et al. (2021) conducted a study aimed at identifying the general description of visual intelligence of seventh-grade middle school students in mathematics and shape recognition. This study was conducted in a school in Indonesia and used the descriptive analytical method. The study sample consisted of seventh-grade students, and data were collected using tests and interviews. The results showed that students with high visual intelligence scores were able to find and visualize geometric shapes more effectively than those with lower visual intelligence.

As for Jamaan et al. (2019) they aimed to determine the effect of the problem-solving-based learning model and visual-spatial intelligence on the development of the student's geometric achievement. The study sample consisted of (64) eighth-grade students, who were divided into two groups, experimental and control, with (32) students in each group. The results of the study showed that there were statistically significant differences between the experimental and control groups in the development of geometric achievement, which are attributed to the learning model (problem-solving-based learning and visual-spatial intelligence (experimental group), and the traditional method) in favor of the experimental group.

Jim et al. (2024) conducted a study aimed at building a predictive model for classifying university students academically based on their visuospatial skills. This study explored, using artificial intelligence, students' visuospatial skills and personality traits to build an expert system that defines predicting academic performance as a classification problem corresponding to five categories: excellent, good, average, passing, and weak. Accordingly, a classification prediction model for student performance was designed using deep neural networks. The study sample consisted of 781 university students. The results showed that visuospatial skills play an important role in the professional learning of science and engineering students, and that the classification model designed in this paper exhibits high accuracy in predicting grades. This paper not only contributes to filling gaps in current research but is also expected to provide a scientific basis for educational practice and promote the development of education towards greater intelligence and personalization.

2.1 Problem Statement

The field of art education has witnessed a growing interest in cognitive structures that contribute to enhancing learning and developing students' academic performance. Visual intelligence is considered one of the most important of these structures because of its association with the ability to analyze visual patterns, distinguish details, and organize information visually skills that are central to learning the arts and carrying out practical tasks within this discipline. Although art education programs in colleges of education including the College of Education at Kuwait Universityrely primarily on the visual representation of concepts, the structural analysis of artworks, and creative thinking based on visual processing, the level of visual intelligence among female students, and its actual contribution to explaining differences in academic achievement within art courses, remains insufficiently clear.

Recent literature indicates that students with higher visual abilities often perform better in courses requiring spatial reasoning, structural analysis, and visual representation. However, this relationship has not consistent across different educational contexts, necessitating further investigation within the Kuwaiti academic environment. This issue is particularly important given that female students' achievement in art education courses may be influenced by various factors, such as design skills, artistic motivation, and teaching methods. The unique contribution of visual intelligence still requires rigorous empirical examination.

Therefore, the research problem lies in the limited availability of local scientific evidence demonstrating the level of visual intelligence among female art education students at the College of Education, Kuwait University, and the extent to which this level correlates with their academic achievement in the course. Hence, the need arises for an analytical study that seeks to identify the level of visual intelligence among female students, determine the nature of its relationship to their academic achievement, and investigate whether visual intelligence is a significant explanatory variable that can contribute to improving art teaching methods and improving learning outcomes.

2.2 Research Questions

Question 1: What is the level of visual intelligence among female students enrolled in the Art Education course at the College of Education, Kuwait University?

Question 2: Does the level of visual intelligence among female students enrolled in the Art Education course at the College of Education, Kuwait University, vary according to their academic year?

Question 3: Is there a statistically significant correlation between the level of visual intelligence and academic achievement among female students enrolled in the Art Education course at the College of Education, Kuwait University?

2.3 Significance of the Study

This study is expected to shed light on an important variable, namely visual intelligence, and provide theoretical frameworks that other researchers can refer to. It is also anticipated that the results of this study will draw the attention of decision-makers in educational institutions to the importance of considering and developing visual intelligence in students. Furthermore, this study is expected to provide a psychometrically sound measure that researchers can utilize.

3. Methods

This study employed a descriptive correlational approach.

3.1 Study Population and Sample

The study population consisted of all female students enrolled in the Art Education course at the College of Education, Kuwait University, totaling (107). The study sample was selected using a comprehensive survey method, and Table 1 below shows the study sample according to its demographic data.

Table 1. Description of the Study Sample According to Its Demographic Variables

Variable	Category	Frequency	%
Year of study	1	29	27%
	2	27	25%
	3	25	23%
	4	26	24%
	107		
Total			100%

3.2 Study Instrument

The study instrument was developed after reviewing previous studies and theoretical literature, such as the studies by Al-Fahd (2015) and Jamea et al. (2014). The instrument consisted of 26 items distributed across three-dimension s:

Dimension 1: Visual Perception and Observation

Dimension 2: Photographic Memory and Visual Imagination

Dimension 3: Visual Problem Solving and Spatial Thinking

Responses to the study instrument were designed according to the five-point Likert Scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree). Strongly Agree was awarded five points, Agree four points, Neutral three points, Disagree two points, and Strongly Disagree one point.

The following equation was used: (Highest score on the scale – Lowest score)/3 = (5 – 1)/3 = 1.33. Therefore, the means were as follows: (1.00–2.33) low values, (2.34–3.67) moderate values, (3.68–5.00) high values (Alnasraween, & Alzoubi, 2026).

3.3 Instrument Validity

The validity of the study instrument was verified through the following procedures.

3.3.1 First: Expert Validity

The study instrument was presented to a panel of experts, all academics specializing in educational psychology and curriculum at Kuwait University, to assess the suitability of the items in terms of their wording, their relevance to the field, and their effectiveness in achieving the intended objective. Modifications were made based on the feedback received.

3.3.2 Second: Construct Validity Indicators

To determine construct validity indicators, the study instrument was administered to a pilot sample of 25 female students, drawn from both the study population and outside the main sample. Pearson's correlation coefficient was calculated for each item and its corresponding dimension. Correlation coefficients ranged from 0.56 to 0.68, all of which were deemed suitable for the purposes of this study.

Correlation coefficients were also calculated for the study dimensions and the total scale score, as shown in Table 2.

Table 2. The Correlation Coefficients Between the Dimensions and the Tool as a Whole

#	Dimensions	Visual perception and observation	Pictorial memory and visual imagination	Visual problem-solving and spatial reasoning	The instrument as a whole
1	Visual perception and observation	-	0.57	0.65	0.73
2	Pictorial memory and visual imagination	-	-	0.56	0.78
3	Visual problem-solving and spatial reasoning	-	-	-	0.69

Table 2 shows that the values of the inter-dimensional correlation coefficients between the dimensions of the study instrument, on the one hand, and between these dimensions and the total score, on the other, were all acceptable for the purposes of the current study.

3.4 Instrument Reliability

Table 3. Cronbach's Alpha Reliability Coefficients

#	Dimensions	Items Number	Cronbach Alpha
1	Visual perception and observation	8	0.83
2	Pictorial memory and visual imagination	9	0.80
3	Visual problem-solving and spatial reasoning	8	0.84
	The tool as a whole	25	0.86

The reliability coefficients were estimated using the internal consistency method based on Cronbach's Alpha equation after applying the study instrument to the pilot sample, which consisted of (25) male and female teachers. Table 3 presents the values of the obtained reliability coefficients.

The results in Table 3 show that the overall reliability coefficient of the instrument, using Cronbach's alpha, was 0.86, while the reliability coefficients for the individual dimensions ranged between (0.80 and 0.87), which are acceptable values for this study.

4. Study Results

4.1 Question 1: What is the Level of Visual Intelligence Among Female Students Enrolled in the Art Education Course at the College of Education, Kuwait University?

To answer this question, the means and standard deviations of the visual intelligence level of female students enrolled in the Art Education course at the College of Education, Kuwait University were calculated, and Table 4 shows the results.

Table 4. Means and Standard Deviations of the Visual Intelligence Level of Female Students Enrolled in the Art Education Course at the College of Education, Kuwait University

#	Dimensions	Means	SD	Rank	Level
1	Visual perception and observation	3.42	0.59	2	Moderate
2	Pictorial memory and visual imagination	3.41	0.69	3	Moderate
3	Visual problem-solving and spatial reasoning	3.28	0.73	1	Moderate
Total Degree		3.37	0.59	Moderate	

Table 4 reveals that the visual intelligence level of the students enrolled in the Art Education course at the College of Education, Kuwait University, was moderate, with a mean score of 3.37 and a standard deviation of 0.59. All dimensions were at Moderate level. The area of "Visual Perception and Observation" ranked first with a mean score of 3.42 and a standard deviation of 0.59, while the area of "Visual Problem Solving and Spatial reasoning" ranked third with a mean score of 3.28 and a standard deviation of 0.73.

The means for each dimension were also conducted as follows:

First: The Dimension of "Visual Perception and Observation"

The means and standard deviations for the items in this dimension were calculated as follows:

Table 5. Means and Standard Deviations for the Items in the Dimension of "Visual Perception and Observation," Sorted in Descending Order

#	Item	Mean	SD	Rank	Level
1	I easily notice the details of color and shadow in artwork	3.75	0.73	1	High
2	I can quickly distinguish between visually similar shapes.	3.70	0.82	2	High
7	I can quickly differentiate between foreground and background elements in a visual scene.	3.64	0.99	3	Moderate
6	I notice the visual effect of lines and texture in artwork	3.51	0.93	4	Moderate
8	I focus on the details of an artwork more than its overall appearance.	3.38	1.13	5	Moderate
5	I can see balance or imbalance in a composition without much effort.	3.25	0.87	6	Moderate
3	I notice the relative relationships between the elements of an artwork's composition.	3.15	0.83	7	Moderate
4	I can identify errors in proportion or composition in a painting.	2.98	0.98	8	Moderate
	Total Degree	3.42	0.59		Moderate

The results in Table 5 show that item 1, which stated, "I can easily notice the details of colors and shadows in artworks," ranked first with a mean score of 3.75 and a standard deviation of 0.73, indicating a high score. Item 4, which stated, "I can distinguish errors in proportion or composition in a painting," ranked last with a mean score of 2.98 and a standard deviation of 0.98, indicating a moderate score.

Second: The Dimension of "Visual Memory and Visual Imagination"

The means and standard deviations for the dimension items were calculated as follows:

Table 6. Means and Standard Deviations for the Items in the Dimension of Visual Memory and Visual Imagination, Sorted in Descending Order

#	Item	Mean	SD	Rank	Level
17	I visualize new scenes when I hear words or music.	3.79	1.16	1	High
10	I imagine how an artwork will look before I execute it.	3.73	1.04	2	High
16	I often have visual images in my mind when I think about an artwork.	3.66	1.04	3	Moderate
13	I use visual imagery to solve design problems.	3.55	1.07	4	Moderate
9	I can recall a detailed image of a work of art I've seen before.	3.37	1.00	5	Moderate
12	I can jot down visual details from memory after seeing a short image.	3.23	1.01	6	Moderate
15	I find it easy to translate a mental idea into a sketch.	3.18	1.23	7	Moderate
11	I maintain a mental image of the composition while working without referring to a reference.	3.12	1.09	8	Moderate
14	I control the perception of distance and depth within my mental imagery.	3.10	1.05	9	Moderate
Total Degree		3.41	0.69		Moderate

The results in Table 6 show that item 17, which stated, "I imagine new scenes when I hear words or music," ranked first with a mean score of 3.79 and a standard deviation of 1.16, indicating a high level. Item 14, which stated, "I control the perception of distances and depth within the mental image," ranked last with a mean score of 3.10 and a standard deviation of 1.05, indicating a moderate level.

Third: The Dimension of "Visual Problem Solving and Spatial Thinking"

Means and standard deviations for the dimension items were calculated as follows:

Table 7. The Means and Standard Deviations for the Items in the Dimension of "Visual Problem Solving and Spatial Thinking," Sorted in Descending Order

#	Items	Mean	SD	Rank	Level
25	I can visualize how to integrate different elements into a single, cohesive design.	3.45	1.07	1	moderate
19	I can mentally rotate the shape to see how it looks from different angles.	3.43	1.06	2	moderate
18	I develop innovative visual solutions when faced with design constraints.	3.34	1.07	3	moderate
20	I find a visual way to arrange multiple elements within a limited space.	3.31	0.98	4	moderate
21	I assess which composition will work best visually before implementing it.	3.31	1.04	5	moderate
22	I often use form simplification techniques to solve complex design problems.	3.31	1.00	6	moderate
23	I utilize spatial relationships to enhance artistic composition.	3.29	0.93	7	moderate
24	I find it easy to estimate proportions and volumes when working freely without measuring tools.	2.83	1.09	8	Moderate
Total Degree		3.28	0.73		Moderate

Table 7. shows that item 25, which stated, " I can visualize how to integrate different elements into a single, cohesive design" ranked first with a mean of 3.45 and a standard deviation of 1.07, indicating an average level. Item 24, which

stated, "I find it easy to estimate proportions and volumes when working independently without measuring tools," ranked last with a mean of 2.83 and a standard deviation of 1.09, also indicating a moderate level.

4.2 Question 2: Does the Level of Visual Intelligence Among Female Students Enrolled in the Art Education Course at the College of Education Year of Study

To answer this question, the means and standard deviations of the visual intelligence levels of female students enrolled in the Art Education course at the College of Education, Kuwait University, were calculated according to their academic year. Table 8 shows the results.

Table 8. Means and Standard Deviations of Visual Intelligence Levels

Dimensions	Year of study	Mean	Standard Error
Visual perception and observation	1.00	3.500	.134
	2.00	3.309	.080
	3.00	3.488	.131
	4.00	3.625	.151
Pictorial memory and visual imagination	1.00	3.462	.159
	2.00	3.415	.095
	3.00	3.328	.155
	4.00	3.481	.179
Visual problem-solving and spatial reasoning	1.00	3.243	.170
	2.00	3.241	.102
	3.00	3.381	.165
	4.00	3.350	.191
Total Degree	1.00	3.404	.137
	2.00	3.325	.082
	3.00	3.396	.133
	4.00	3.485	.154

Table 8 shows apparent differences between the mean scores of visual intelligences among female students enrolled in the Art Education course at the College of Education, Kuwait University. To determine whether these differences were statistically significant, a multivariate analysis of variance (MANOVA) was performed, as shown in Table 8.

Table 9. The Results of MANOVA Test to Examine the Significance of the Differences Between the Mean Scores of Visual Intelligence Among Study Sample

Source of variance	**Dimension**	**Sum square**	**df**	**Mean Square**	**F**	**Sig**
Year of study	Visual perception and observation	1.497	3	0.499	1.457	0.231
	Pictorial memory and visual imagination	0.260	3	0.087	0.180	0.910
	Visual problem-solving and spatial reasoning	0.386	3	0.129	0.235	0.872
	Total Degree	0.339	3	0.113	0.318	0.812
Error	Visual perception and observation	35.266	103	0.342		
	Pictorial memory and visual imagination	49.619	103	0.482		
	Visual problem-solving and spatial reasoning	56.281	103	0.546		
	Total Degree	36.556	103	0.355		
Total	Visual perception and observation	1288.688	107			
	Pictorial memory and visual imagination	1298.765	107			
	Visual problem-solving and spatial reasoning	1209.719	107			
	Total Degree	1255.658	107			

Table 9 showed no differences at the significance level (α=0.05) between the arithmetic means of the visual intelligence level among female students of the art education course at the College of Education, Kuwait University, with regard to the academic year.

4.3 Question 3: Is There a Statistically Significant Correlation Between Visual Intelligence and Academic Achievement Among Female Students Enrolled in the Art Education Course at the College of Education, Kuwait University?

To answer this question, Pearson's correlation coefficient was calculated between visual intelligence and academic achievement among female students enrolled in the Art Education course at the College of Education, Kuwait University. Table 10. shows the results.

Table 10. The Pearson Correlation Coefficients Between Visual Intelligence and Academic Achievement.

#	Dimensions	Grade Point Average (GPA)
1	Visual perception and observation	**0.34
2	Pictorial memory and visual imagination	**0.46
3	Visual problem-solving and spatial reasoning	**0.42
Total Degree		**0.47

The results in Table 10 shows a statistically significant positive correlation (α=0.05) between visual intelligence and academic achievement among female students enrolled in the Art Education course at the College of Education, Kuwait University. The correlation coefficient between the total score on the visual intelligence scale and the GPA was 0.47. The results also indicate a statistically significant positive correlation (α=0.05) between all dimensions and the GPA.

5. Limitations

The study sample was limited to female students because this department only accepts female students; therefore, generalizing the results of this study to mixed samples is not recommended.

6. Discussion

This study aimed to determine the level of visual intelligence and examine its relationship to academic achievement among female students enrolled in the Art Education course at Kuwait University. The study revealed a moderate level of visual intelligence among the students. This result may be attributed to the possibility that visual intelligence is a relatively stable cognitive ability and is not significantly affected by progression through university years. Cognitive structures associated with visual intelligence, such as the ability to visualize shapes, perceive spatial relationships, and visually represent information, often develop in early stages of growth and stabilize by the end of adolescence, thus may reduce the impact of the university environment or years of study on their development.

On the other hand, opportunities for visual learning are relatively accessible to all students, regardless of their year of study. Furthermore, the similarity of students' academic backgrounds upon entering university may contribute to a consistency in visual intelligence levels across academic years. This is relatively consistent with what Morawietz et al. (2024) indicated, namely that spatial and visual abilities are key components of intelligence according to cognitive models such as the Cattell-Horn-Carroll (CHC) model. These abilities are classified under visual thinking skills, and these models assert that spatial abilities develop gradually during childhood and adolescence, reaching a level of relative stability in late adolescence and early adulthood, the age at which students enter university. This means that individual differences in visual intelligence become more stable and are not usually affected by short-term educational factors or by transitioning from one year of university to the next, which explains the lack of significant differences between students in different years.

This result may be attributed to the fact that students with higher abilities in visually processing and mentally representing information tend to achieve better levels of academic performance compared to students who do not possess visual intelligence. This relationship can also be explained by several psycho cognitive mechanisms. Visual intelligence contributes to enhancing the ability to organize information, interpret symbols, and perceive spatial relationships skills directly linked to higher-order thinking processes such as analysis, synthesis, and problem-solving. Furthermore, learners with strong visual intelligence employ effective learning strategies based on mental imagery, mind mapping, and visual representation of concepts. This facilitates their understanding and retention of academic content, thereby raising their academic achievement. This reflects the role of these cognitive abilities in supporting the cognitive processes that contribute to successful academic performance across various learning domains. This finding is partially consistent with Mutshar's (2021) study, which demonstrated an increase in visual intelligence among the experimental group. The results also align with Wahab et al. (2018) assertion that visual intelligence aids in interpreting, understanding, and appreciating the surrounding world. It is a vital process, and without visual perception, which utilizes spatial relationships, communication about space and understanding the connections between objects would be highly limited. Instructions for locating objects or performing simple tasks would be ineffective, and changes resulting from the division, grouping, or movement of shapes in space would be more difficult.

7. Conclusion

This study results highlighted the important role of visual intelligence in students' academic achievement Uh the significant positive association uh found across all the dimensions which suggested that the students with higher levels of visual intelligence tend to demonstrate better academic performance. At the same time the absence of significant differences in visual intelligence according to year of study indicates that this ability may not be necessary to develop because of progressing through university alone. Therefore, great attention should be given to intentionally developing student visual intelligence through appropriate teaching practices and targeted training programs and integrating activities that encourage visual processing, interpretation, and representation into the learning process may contribute to supporting students' academic achievement and enhancing their overall learning experience.

8. Recommendations

Considering the study's findings, the following are recommended:

• Developing students' visual intelligence skills through targeted teaching practices

• Designing training programs for students to develop visual processing skills

• Encouraging faculty members to consider individual differences in visual intelligence

• Conducting further research studies and addressing other variables.

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