VISUAL-SPATIAL LEARNING: A CHARACTERISTIC OF GIFTED STUDENTS

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Abstract

This current study investigated an important characteristics of the high achievement of students in middle school ages of 13-15 (n= 560). Thus, visual-Spatial (V/S) was measured using new V/S test. This study aims to establish a new understanding of some of the characteristics of those seen as gifted students as well as to consider some aspects of the ways selection is conducted and needs are met. It was found that those who were very able (in terms of examination performance) tend to be strongly visual-spatial, and of high working memory. It was also found that the assessment of the six school subjects measured the same ability, which is likely to be recall.

Keywords: Gifted, visual –spatial, working memory, high achievement

Visual tools are now becoming key teaching, learning and assessing tools in many classrooms. Together, students and teachers are generating mental models of how they perceive the world (Hyerle, 1996). In adjoin, the power of computers has readily make visual images available in learning.

Through the visual learning system, the learner recognizes objects, distinguishes sizes and shapes, perceives depth, notes colour, and uses visual-spatial awareness to estimate where he is. In school, visual-spatial learning underlies such varied disciplines as reading, mathematics, science, art, and athletics. Vail (1989) focuses on the connections among visual learning, reading, and writing. She considers three components of visual learning: vision, visual perception, and visual memory. Visual perception allows human beings to organize and understand, and can be seen in the following ways: they recognize visual images, remember their connotations, and distinguish the familiar from the unfamiliar. . Visual-spatial learners are excellent visualisers and must visualise in order to learn. The visualisation is a key element in the mental processing of visual-spatial learners. Thus, they think primarily in images or pictures. Visual thinking is very fast, complex and not sequential

Some research (e.g. Levin et al., 1987; Paivio, 1986) suggests that images increase the level of learning when applied to specified tasks. In addition, Hyerle (1996) noted three interrelated reasons why more and more teachers and students are using visual tools. They are:

(a) Teaching and learning in a constructivist-cognitive paradigm.
(b) New technologies and visual designs are guiding information flow.
(c) Student-centered learning and 'interactivity' are emerging as the new structures for classroom relationships.

The first reason needs to be treated with some skepticism for it failure to recognize that constructing understanding occurs in the brain of individual learners, irrespective of what the teacher does (Reid, 2013). However, the other two may be relevant.

Human visual perception starts with two-dimensional arrays of light falling on our retina. The task of the visual perception is to enable us to use the information provided in the array of light in order to react appropriately to the objects surrounding us. Therefore, one way to try and view the process of vision is to divide the problem into three parts (Wagemans *et al*, 2005):

(a) How the visual information is encoded.
(b) How it is represented and
(c) How it is interpreted

In the early 1980s, Silverman discovered an over-arching division of learning characteristics into two categories, which she termed '*auditory-sequential*' and '*visual-spatial*'. Her findings were based on extensive research.

According to Silverman (2003), the concept of the '*visual-spatial learner*' is seen as: "*learners are individuals who think in pictures rather than in words*". An additional 30% showed a slight preference for the visual-spatial learning style. Hence, only 23% were strongly auditory-sequential (Silverman, 1999).

Similarly, Hass (2003) found that about one-third of the general population (not just the gifted) from age nine to thirteen are strongly visual-spatial while a little under one-fourth are strongly auditory-sequential. Out of the rest in the middle with more balanced strengths, those who show a tendency toward visual-spatial outnumber their auditory-sequential classmates two-to-one.

In addition, Posner and Keele (1968) used three random nine-dots '*prototypes*' in an experiment to show how powerful the brain is as a classifier of visual information. To perceive an object, one must segregate it from the other visual information available in a scene which composes of the background of the figure.

The best way to identify the visual-spatial learner is by taking a comprehensive history which includes the early and current health of the child, using a checklist of characteristics and asking the child to complete tasks involving auditory sequential processing and those utilising visual-spatial abilities and comparing the results (Golon, 2004).

Visual-spatial learners learn better visually than auditorally. They do not learn from repetition and drill. They are whole-part learners who need to see the big picture first before they learn the details. They are non-sequential, which means that they do not learn in a step-by-step manner in which most teachers teach. Furthermore, Silverman, (2002) mentions they could find correct solutions without taking independent steps. Thus, the instruction to '*show your work*' may be impossible for them. They may have difficulty with easy tasks, but show amazing ability with difficult and complex tasks. They are systems thinkers who can orchestrate large amounts of information from different domains, but they often miss the details. However, they tend to be organizationally impaired and unconscious about time. They are often gifted creatively, technologically, mathematically or emotionally.

Kerr (1991) suggested a few features which may help to pick out the visual-spatial student, summarized below:

(1) Draws models or builds with technical skill and imagination;
(2) Surpasses peers in ability to create cartoons, painting, sculpture or architectural or mechanical models;
(3) Has high scores on the Raven progressive matrices or other test of spatial/visual reasoning;
(4) Has high scores on the figural section of the Torrance tests of creative thinking (measure creative abilities of fluency, flexibility, originality and elaboration);
(5) Has high scores in any engaging in work-based activities that require spatial/ visual ability such as art, mechanical drawing, architecture designing, etc.

There are many researchers who have offered lists of visual-spatial characteristics (e.g. Silverman, 1999; Golon, 2004; Pittelkow, 2003; Codd, 2006). Some of these characteristics are summarised in (Table.1) Following the approach adopted by Penny (2003).

Table 1 Characteristics of Visual-spatial Learners

The Visual-Spatial Learner
□ Is a whole-part learner
□ Has visual strengths
□ Learns concepts all at once
□ Is a good synthesizer
□ Sees the big picture; may miss the details
□ Is better at math reasoning than computation
□ Reads maps well
□ Must visualize words in order to spell them
□ Learns best by seeing relationships
□ Has excellent long-term memory
□ Prefers keyboarding to writing
□ Creates unique methods of organization
□ Develops own methods of problem solving
□ Performs better in untimed situations
□ Masters other languages through immersion
□ …

Silverman (2002) compared the visual-spatial characteristics with the auditory sequential characteristics. She found they possessed characteristics which is entirely different from each other. In a traditional classroom setting, the visual-spatial learner faces a number of disadvantages. School is usually an environment based on language and number in which the curricula, textbooks, classroom management techniques, teaching methods are based on the verbal and symbolic (Haas, 2003a).

In addition, Silverman (2002) offers several ways used to identify the visual-spatial learner, and they consist of a multi-trait, multi-factor, and a multi-method study incorporating:

(a) Self-rating by students
(b) Observer reports by parents
(c) Observer reports by teachers
(d) Subjective assessment by teachers

Towards the end of the 1970s, research on the visualizer-verbalizer cognitive style dimension began to generate educational literature (Kozhevnikov, *et al.*, 2005). In addition, Paivio (1971) was designing an '*individual differences questionnaire*' to evaluate the extent to which different people habitually use imagery versus verbal thinking.

Krutetskii (1976) proposed that individuals could be classified into groups according to how they process mathematical information. Also, Krutetskii found that the first group was the '*analytic type*', consisting of people who prefer verbal-logical modes when attempting to solve problem and the second group was the '*geometric type*': those who prefer using imagery.

According to Vail (1989), visual perception allows human beings to organize and understand, and can be seen in the following ways: they recognize visual images, remember their connotations, and distinguish the familiar from the unfamiliar. Children who exhibit strong visual-spatial abilities combined with auditory sequential weaknesses are considered to be visual-spatial learners. Visual-spatial learners are excellent visualizes and must visualize in order to learn. The visualization is a key element in the mental processing of visual-spatial learners. They think primarily in images or pictures. Visual thinking is very fast and complex but is not sequential.

It is possible to relate the visual-spatial characteristic to the ideas suggested by Riding and Cheema (1998) (see Table.2).

Table 2 Characteristic Differences of Visualiser /Verbaliser

Visualiser	**Verbaliser**
1. Image oriented	4. Word oriented
2. Fluency with illustrations	5. Fluency with words
3. Has vivid dream	6. Seldom dreams
4. Prefers to have someone show them	7. Prefers to read about the idea
5. Enjoys Jagsaw puzzles	8. Enjoys word games
6. Subjective self-oriented	9. Objective task oriented
7. Left eye movement	10. Right eye movement
8. Understands visuals	11. Understands semantic complexity
9. Manipulates and transforms images	12. Manipulates and transforms symbols

(Source: Jonassen and Grabowski, 1993:192)

Visual memory is a part of memory preserving some characteristics of our senses pertaining to visual experience. The human is able to place in memory, information that resembles objects, places, animals or people in some kind of a mental image. However, some authors refer to this experience as an 'our mind's eye' (West, 1991)

During the period from the late 1950s through to 1980, many experiments on short-term or working memory were published. Most of these studies dealt only with verbal materials (e.g. Sperling, 1960; Klemmer, 1963; Philips, 1974). However, Pascual-Leone (1970) used a visual test to measure working memory. In addition, Baddeley and his co-workers (eg. Baddeley, 1986) have proposed separate stores for verbal (phonological) information and visuo-spatial information. Some studies have provided some evidence for distinguishing visual from verbal (Smith, 1997).

Visual memory has the capacity to store large amounts of details from visual information (Standing, Canezio and Haber, 1970). Individuals will perform with high recognition when they recall details from pictures. A number of studies (eg. Hitch *et al.*, 1989; Snodgrass et al., 1972) investigated the effect of visual and verbal materials on human memory, and they found that visual information is stronger than verbal information in facilitating recall. This is a very important observation given the high dependence of the verbal information in school learning.

Pavio (1971, 1986), in his '*Dual-code theory*', suggests that visual and verbal information are processed differently along distinct channels with the human mind creating separate representations for information processed in each channel. He assumed that pictures have superiority for encoding information in the memory over concrete words or abstract words and he indicates that verbal and visual information are encoded by different systems, one system for visual images and the other for verbal language. The two systems are interconnected in that, when stimuli are represented as an image in the visual system, they can be represented as verbal language in the other system.

Baddeley and Hitch (1974) in their '*working memory model*' proposed the Visuo-spatial Sketchpad as one of three components for working memory. It holds the information it gathers during the initial processing of it and if it is retrieved later from the long-term memory to produce the recollection of an image. However, some people use their visuo-spatial sketchpad often in normal thought processes, while others use it very little.

Learner Characteristics and Giftedness

This discussion faces a very real problem. Many researchers have assumed that intelligence tests (which can measure IQ) actually measure intelligence. In other words, they imply that intelligence testing defines intelligence. They then relate the outcomes from intelligence testing to measures of what is known as various cognitive styles. On this basis, it is possible to draw conclusions about intelligence and specific cognitive characteristics. However, it is equally possible to argue that intelligence tests are simply like any other kind of school tests and merely measures performance but that the performance is not related to any specific discipline like mathematics, history, language or physics. Thus, an intelligence test is simply a '*content-neutral*' academic test. It is then possible to conclude that certain learning characteristics are related to school testing outcomes. Thus, the following discussion needs to be interpreted with this in mind.

Students vary enormously in the way they learn but sometimes education does not take account of these differences. This is largely because most educational systems have developed in ways which are dependent on linguistic and logical-mathematical emphases and thus learners who cope well with such approaches have benefitted most. In particular, schools have not reflected many of the different and creative ways by which the student can learn (Teele, 2000).

Sadler-Smith and Riding (1999) argued that what they call cognitive style has an important role to play in determining an individual's instructional preferences and that this may affect learning performance. In addition, Rogers (1986) concludes that the gifted generally differ in degree and not in any kind of cognition. Thus, gifted students tend to acquire and process information and solve problems better, faster or at earlier ages than other students (Robinson and Clinkenbeard, 1998)

Also, cognitive style has been defined as "*cognitive characteristic modes of functioning that we reveal through our perceptual and intellectual activities in a highly consistent and pervasive way*" (Hashway, 1998: 51). Although, it is useful, it has resulted to all kinds of assumptions: for example, it assumes that learners are consistent and fails to allow for considerable diversities of styles in different contexts. It also implies that individual learners are unlikely to be able to function in two (or more) very different ways. Thus, there can be no assumption that a strongly visual-spatial learner is, by definition, one who does *not* operate in the auditory-sequential. Learners may be well strong in both.

Saracho (1997) suggests understanding (gifted and non-gifted) cognitive styles and their relationship to learning could be reduced to a few points:

(a) Cognitive style identifies the ways individuals react to different situations.
(b) Cognitive style influences how abilities develop.
(c) Cognitive style describes consistencies in using cognitive processes.
(d) Cognitive style does not describe the content or cognitive level of an individual's performance.

Saldler-Smith and Riding (1999:359) considered the importance of an individual learner's cognitive style and their instructional and assessment preferences such as:

“(a) Assist in the design of learning programmes which acknowledge learners' style and preferences;
(b) Contribute to the development of models of individual differences in learning and cognition;
(c) Provide directions research into the validity of matching instructional methods to learners' style and preferences”.

Diseth and Martinsen (2003) analysed the relationship between approaches to cognitive style and academic achievement in a sample of 192 students. They found that style had indirect effects on achievement, (possibly by means of examination procedures and the nature of the curriculum)

Milgram, Dunn, and Price (1993) investigated cognitive styles of gifted adolescents in nine countries. They compared gifted adolescents in one specific area, in different culture, and found that young people who were gifted in the same area shared some cognitive style preferences even though they lived in very different cultures (see Milgram, 2000).

Burns et al (1998) investigated the differences between the cognitive style preferences of high academic achievement students in same-age students with average or below average academic achievement. They found that cognitive style inventories should be used as they were originally intended: as informative diagnostic instruments to measure the learning style preferences of an individual student.

Usama (2002) found that intellectually gifted students have a cognitive flexibility to move from one mental process to another. His study also showed that cognitive style in combination with intelligence plays an important role in academic performance.

Silverman (1989, 2002) identifies two types of gifted visual-spatial learners. The first is children identified as gifted who score extremely highly on an IQ tests because of their great ability both with tasks using visual-spatial processing and those requiring auditory sequential thinking processes. The second is children who have great ability in visual-spatial processing and marked weaknesses in auditory sequential processing.

Gardner (1985) in his theory of multiple-intelligences pointed out that a visual-spatial intelligence is one of seven intelligences that the brain can have. It lends itself not only to the visual arts but also to mathematics and science.

It is possible that visual-spatial learner possesses a better developed working memory loop. Equally, it is possible that the way information is stored gives a preference for information stored in the visual-spatial way. In an interesting experiment some years ago, it was found that presenting questions in visual form helped some students, symbolic form helped others (but not as many) while presenting in both forms gave the best overall results (Johnstone, 1993) This could be explained by the use of both working memory loops or it could be explained by the idea that storing information in two forms gives the greater advantage in terms of creating more usable links.

The Study Sample

A total of five hundred and sixty students were selected from thirteen public middle schools who participated in the study. The schools were not chosen at random, because it was important to select a sample which is typical of the Kuwaiti population. Two criteria were used to select the schools; the three most populated areas and the school that represented 57%

of the total number of students in the all middle stage schools in Kuwait. Therefore, the schools were selected from the largest schools.

The gifted students were selected in the following way:

- Overall-gifted: Those who achieve over 91% in the total marks in the six subjects studied at this stage. They were enriched in an enrichment centre.
- Semi-gifted: Those who achieve from 85% to 91% in the total marks for the six subjects and who also achieve >90% in 2 or 3 of them.
- Non-gifted: Those who achieve less than 85% in the total marks.

The phrases *overall-gifted, semi-gifted* and *non-gifted* carry unfortunate meanings.

Measuring and procedure

Furthermore, the students completed two measurements test which are: working memory capacity test (the figural intersection test) and a visual-spatial test.

Working memory

There are three reasons for using the Figural Intersection Test (FIT); they are:

(a) The test has been widely used and its outcomes is related to the better known Digit Span Backwards Test. Results from its widespread use show that the test is both reliable and valid (see El-Banna, 1987).

(b) It is a written test and is, therefore, easy to administer.

(c) It is based on shapes. This means that it is probably fairly independent of culture and education environment.

El-Banna (1987: 49) notes that the measurement of working memory (holding-thinking space) must employ a method which meets the following requirements:

“(1) The task used must require some transformation of the input data and operations to ensure that it measures both holding and thinking processes;

(2) The task must be unfamiliar to the student to ensure that the individual differences in holding-thinking space are not due to strategies or operations used by students rather than to their holding-thinking space alone;

(3) In order to reduce measurement errors, it is useful to use more than one task with different stimuli to ensure that whatever the stimuli are, the size for holding these stimuli and working through is the same.”

Visual-Spatial Test

Although visual-spatial ability is often discussed, no specific test was found to measure it (Silverman, 1989, 2004). Thus, it was necessary to develop a test for this purpose. Looking at the literature (eg. Johnson, 1996; Silverman, 1989, 2004; Golon, 2004; Hudson, 1960), the following skills were identified as part of visual-spatial learner characteristics:

Table 3 Skills related to Visual-spatial Ability

Skill to be Measured
• Discrimination between different forms and shapes
• Focus in the counting of shapes, in different sizes and position
• Distinguish between figures, their backgrounds and inverse images
• Estimation of distances and velocities
• Accurate perception of shapes and number of shapes
• Speed tracking information visually

The test was designed to reflect ability in these skills. Several early versions (with 57 items) were tried out with experienced teachers and researchers and numerous modifications were incorporated until the final test, which comprises of 33 items with some of these items containing sub-items with the maximum score being 46 that was developed. The test was computer based allowing for movement, colour and simple forms of animation.

The specification of the test is shown in (table.4); the test had a specification which reflected the skills found in the literature which were thought to be associated with visual-spatial ability.

Table.4 Visual-spatial Ability Test Specification

Q	Items	Description	Skill Measured
1	5	Find the different shape	Discrimination between different forms and shapes
2	5	Counting of the object	Focus in the counting of shapes, in different sizes and position
3	4	Shape and the facing form	Distinguish between figures and their
	2	Points to fix a hidden form between	
4	4	Distances between the shapes	Estimation of distances and velocities
5	4	Assembling of shapes is geometrical	Accurate perception of shapes and number of shapes
6	5	True picture from a piece of folded paper	Speed tracking information visually
	4	Product from move of object	

The test which was described by Hindal *et al*. (2009) uses a computer and data projector. The students were shown a series of visual representations, often for a very short fixed length of time and then asked a question which they recorded on paper. This procedure has many advantages: it allows the use of pictures and animation; it allows the use of colour; it gives a tight control of timing as every class would meet exactly the same test at exactly the same speed, and it is being projected for the whole class at once.

After all the modifications were completed, the test was then used with the sample of n = 560 (boys = 279, girls = 281).

Analysis

Examination marks were standardized where appropriate. In this, the means and standard deviations of the six sets of marks were all brought to a common mean (60% was chosen) and common standard deviation (10 was chosen). This meant that a mark in each subject carried the same weight and it offers a spread of marks which was convenient.

Various measurements were correlated to see the extent to which high performance in one measure is related to high performance in another measure. As the data were found to be approximately normally distributed, Pearson correlation was employed. Of course, correlation on its own does not imply causation. Also, the mean were compared using a t-test

Results

Marks in six subjects were considered (Islamic Studies, Arabic language, English language, Mathematics, Science, and Social Studies). Each was considered on its own. However, to get a total mark, the marks in the six subjects was standardized before it was added.

Unfortunately, standardization is not carried out in Kuwait before adding up marks in determining who is '*gifted*'. However, it was carried out here (see table.5)

Table 5 The Unstandardized Examination Marks: Descriptive Statistics

	Social Studies	*Islamic Studies*	*Mathematics*	*Science*	*English*	*Arabic*
Maximum	100	100	100	100	100	98
Minimum	28	21	22	26	8	28
Mean	82.4	82.4	74.9	80.2	79.5	73.3
Standard deviation	**17.2**	**15.3**	**18.3**	**15.6**	**18.5**	**15.3**

The marks were correlated with each other to see to what extent high performance in any one subject corresponds to high performance in the others. The results shown in (table 6) Performance in all the subjects correlates with all the other subjects to a very high degree. This suggests that the examinations in the six subjects might be simply testing the same thing. This can be checked by carrying out a Factor Analysis on the six sets of data to see if there is more than one factor. This was done using Principal Components Analysis. It was found that one component accounted for slightly more than 87% of the variance which is quite remarkably high. The six subjects loaded on to this factor [A loading is the correlation of the marks in each subject with the factor (component) found.]; Loadings of Social Studies was 0.93, Islamic Studies 0.92, Mathematics 0.93, Science 0.96, English 0.93, and Arabic 0.94. Hence, this indicates that all six subject assessments were measuring one factor (or component).

Table 6 Inter-subject Correlations

	Islamic Studies	*Mathematic*	*Science*	*English*	*Arabic*
Social Studies	0.86	0.83	0.87	0.82	0.84
Islamic Studies		0.83	0.85	0.81	0.80
Mathematic			0.88	0.84	0.85
Science				0.86	0.88
English					0.87

In looking at the assessments used, 80% of the questions are multiple-choice questions. The use of these has been extensively criticized on the basis of numerous studies (see Johnstone and Ambusaidi, 2000). Indeed, most of the questions tend simply to measure recall of information. It is, therefore, likely that recall skills is the single factor found.

There is a difficulty in relating cognitive styles to any concept of intelligence. For example, Riding and Pearson (1995) and Riding and Agrell, (1997) reported that no significant relationships were found between cognitive styles and intelligence but this may simply reflect the measurement tools used. However, it is known that field dependency is strongly related to examination performance which is often linked on to an idea of intelligence. Much depends on how intelligence is seen.

Here, the measured visual-spatial scores were correlated with academic performance in all six subjects and the total mark, using Pearson correlation. There was a positive correlation between the visual-spatial learner characteristic and the total mark [$r = 0.33$, $n = 560$, $p < 0.001$]. Table 7 shows visual-spatial test highly correlated with all six subject.

Table 7 Correlations of Visual-Spatial style with Subject Marks

	Social Studies	***Islamic***	***Math***	***Science***	***English***	***Arabic***	***Total Mark***
Visual-Spatial Test	0.28	0.23	0.31	0.33	0.33	0.34	0.33
	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001

It is clear that the results of the visual-spatial test correlate very significantly with the performance in all subjects. Silverman (2004) has found that many highly gifted visual-spatial learners were successful at many tasks given in many ways although there were some visual-spatial learners who seemed to depend almost entirely on this way of learning. The first group could choose to learn visually spatially as a preferred learning style; while the latter group had to use this learning style.

Again, as '*giftedness*' in Kuwait is determined largely by performance in school subjects, it means that those who are seen as '*gifted*' in Kuwait will tend to be those who are more visually-spatially equipped. This can be illustrated by dividing the sample into three groups according to the test result in the visual-spatial test: High visual-spatial (HV/S), Medium visual-spatial (MV/S), and Low visual-spatial (LV/S):

- HV/S: those who scored above the mean, their sample population are classified as high visual-spatial learners (i.e. HV/S> mean+½StD),
- MV/S: those who may be located between the above two categories (mean ±½StD)
- LV/S: those who scored score less than ½StD below the mean (i.e. LV/S <mean-½StD)

Half of a standard deviation was used simply because this allowed the formation of three very approximately equal groupings; High visual-spatial (HV/S) n=177, Medium visual-spatial (MV/S) n=217, and Low visual-spatial (LV/S) n= 166 out of 560 students.

Again, it is clear from the table 8, that those perceived to be '*gifted*' tend to be better in the visual-spatial test. Comparisons of the mean scores between each academic levels One-Way Analysis of Variance (ANOVA) procedure were used to test the null hypothesis that the means are equal. This gives a probability value [F (2, 557) = 25, p < 0.001]. Despite reaching statistical significance, the actual difference in mean scores between the groups was high. The effect size, calculated using eta squared, was 0.11 which mean a Medium effect (see Pallant, 2005). Post-hoc comparisons using the Tukey's HSD test indicated that the mean score for group N (M=15.8, SD=5.1) was significantly different from group G (M=19.3, SD= 5.1). Group g (M=18.2, SD= 4.5) and it differs significantly from Group N.

This result confirms the conclusions from the correlation of the relationship between visual-spatial and working memory as there was a high correlation between the two variables [r= 0.21, n=560, p<0.001]. It is possible to interpret this correlation in terms of information processing.

Being a visual-spatially able means a strong tendency to see things in terms of pictures, diagrams or spatial relationships; and these must being stored in long term memory. Visual-spatial characteristic relate to long term memory and the way it works. This might relate to the presence of the significant correlations although the exact explanation awaits further research.

It is possible that recall skills might involve the student efficiency in the remembering process, the efficiency of recall from long term memory and the skills associated with producing answers in the forms required by the examination paper. In this case, multiple choices dominated and it is possible that skills of handling multiple choice questions are part of the process of recall.

The outcomes from this analysis raise some interesting questions. If '*giftedness*' is being assessed primarily on the basis of an overall examination mark and the marks in all the separate subjects are essentially based on aspects of recall skills, then it is clear that those perceived as 'gifted' are those who are best at recall skills. Therefore, 'giftedness' in Kuwait is being defined in terms of recall. Of course, recall might be the essential underpinning of many higher order cognitive skills relating to successful academic performance. However, evidence would have to be found to support this.

Discussion

A strong correlation was found between the results of the visual-spatial test and performance in all of the examinations. It does seem that being more visual-spatial is an advantage in recall situations and this can be interpreted in that the more visual-spatial the students are, the more they tend to see things holistically and this enables them to find answers to questions more easily.

It is, therefore, clear that the students in middle schools in Kuwait tend to do better in all subjects if they are visually spatial. The effect is slightly stronger with mathematics and science and sometimes with language. Thus, those selected as gifted into Kuwait will tend to be strongly visual-spatial, with high capacity working memories. The ANOVA analyses confirm this.

Looking at the results here, it is possible that the higher levels in the characteristic which had been measured give the students an advantage in acquiring and processing information more rapidly and more efficiently and, therefore, been able to recall the information more reliably.

Perhaps the most important outcome is the observation that the selection of students as gifted is based largely on recalls skills and that these skills are related to certain cognitive characteristics. This raises the question: is giftedness to be seen largely in terms of recalls skills? Of course, being skilled at a recall *could* mean that the students can develop higher order thinking skills (like application, analysis and evaluation) more effectively but the research here cannot confirm this.

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