Multiple Intelligences and Learning Styles: A study of Their Effect on Students' Achievement

By

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Abstract

This study is guided mainly by Gardner's work on Multiple Intelligences theory that there are at least nine possible intelligences: linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic, interpersonal, intrapersonal, naturalistic intelligence, and existentialist intelligence, and the learning style type (auditory, visual, read/write, kinesthetic) by Neil Fleming in 1987. These approaches emphasize the fair measurement of intelligence, allowing students to use intelligently mediated materials to solve problems or create products that explore the core components of a particular intelligence. The study consists of all students of the 10th, 11th, and 12th grades of a public secondary school (n = 746). The results show that for multiple intelligences, Intrapersonal Intelligence obtained the highest mean followed by Kinesthetic Intelligence, then the Naturalistic Intelligence. Using the VARK Scale, the study concluded, amongst others, that that the most prevailing types of multiple intelligences among high school students are the Intrapersonal followed by Kinesthetic Intelligence, then the Naturalistic Intelligence, while the Musical/Rhythmic Intelligence obtained the lowest mean. The study concludes with pertinent recommendations that are likely to be of value to educators, planners, and policy makers in the field of education.

Keywords: Effect, learning styles, multiple intelligences, students' achievement.

Introduction

Educators agree that learners differ in their abilities and motivation towards learning, as much as in their methods of dealing with real-life problems (Siew et al., 2015). Modern trends emphasize learner-centered learning more than ever (Toledo & Dubas, 2017), and for this reason, there has been an increasing interest in the individual differences amongst students and in approaches to dealing with them based on their intelligences and styles of learning (Al-Ahdal & Almarshedi, 2021; Ehrman et al., 2003).

The idea of learning theories arose from the fact that all learners differ in their personalities, intelligence, ways of thinking and preferred learning styles, and that knowing this difference helps provide the context and experiences that encourage students to utilize their abilities to the optimum and reach the highest degree of effective learning (Taylor & Hamdy, 2013). Many theories have dealt with learning styles and in how they approach these styles, with some focusing on the learner's personality traits (Demirbaş & Demirkan, 2003), others focusing on the their way of receiving, processing, organizing and storing information in the memory, while others have tended to focus on their learning style preferences (Demirkan, 2016) because the aim is to increase their academic achievement.

Multiple intelligence (MI) is a construct that has been around since the early 1900s and, although it remains largely untested, it has generated a great deal of interest in recent years. When MI was first proposed, it was based on the work of Gardner (1983), who identified seven

different "intelligences" or types of cognitive abilities: linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal. In 2000, Gardner revised his theory to include three more categories of intelligence: naturalistic, existential, and philosophical. Although some researchers have questioned whether MI is an accurate way of describing people's cognitive strengths or weaknesses, many psychologists and educationalists have welcomed it as a useful concept for understanding the ways in which humans learn and develop (Gardner, 2000).

The concept of Ml has also been used to promote the idea that there are many ways for people to learn (Kourou et al., 2015). According to this theory, each person has his or her own unique learning style which is a set of preferred strategies for learning and problem-solving (Barmeyer, 2004). For some people, this will include a mixture of different learning styles; for others, it will be dominated by a single one. There are many different theories of learning styles. One common approach is the so-called "diamond model" proposed by Anderson et al. (2002). In this model, the eight styles are arranged in a diamond shape to reflect the fact that no single style is superior or inferior to any of the others. Instead, each style has its own strengths and weaknesses, and each can be useful in certain situations. In other words, there is no single, best way to learn. However, most people tend to prefer certain types of activities to others for learning. For example, some people tend to find visual forms of information easier to understand than written forms, while others find it easier to learn from reading than from listening (Sankey et al., 2011).

It is a fact now that each learner has a distinctive type of intelligence and style of learning that is reflected in their ability to receive and process information more effectively (Kourou et al., 2015). Learning is more effective and efficient if activities are presented so that they correspond to the learner's preferred learning style (Gilakjani, 2012). Teaching strategies can be adapted to take into account the preferred learning style of students by presenting educational strategies for addressing them. Adapting activities to match learners' preferred styles makes learning easier and more effective.

As a result of the growing interest in learning styles and their importance in facilitating and speeding up the teaching and learning of students (Hussein et al., 2017), many classifications and models of these styles have emerged, including: the Dunn and Dunn model, the McCarthy format model, the Kolb model, the Hill model, and the VARK model, among others (Alotaibi, 2022). There are many things in common between these models, all of which have stressed the need to consider the individual differences between learners, in addition to their emphasis on education to be designed and organized to suit the learning styles of different learners. Learning styles are considered 'perception' that is related to 'multiple intelligences which is 'production-oriented'.

The problem in many traditional education systems is not that some students are "learning disabled", but that many teachers are reluctant to adapt their teaching approach to students who learn in ways different than those adopted in the prevalent model (Saban, 2001). Many previous studies and research confirm the existence of problems that limit the level of performance and achievement of students in different educational stages and the secondary stage in particular (Curcio et al., 2006). Such studies emphasize the need for diversification in the choice of teaching methods and the delivery of ideas and information used by teachers, especially with regard to the need to be learner-centered (Bin-Hady, 2019), and as a result of what is based on modern trends of differences between students in their characteristics, abilities and learning styles (Maubach & Morgan, 2001), so it is visible that most students have innate preferences for learning through a style that exists or can be adapted to the requirements of the

educational situation. The provision of information and experiences according to the learning styles contributes significantly to improving the quality of the performance of the teacher and the learner alike, leading to meaningful learning and empowerment of their intelligences. Accordingly, the importance of studying this aspect among secondary school students has emerged as a basic and important stage in supporting the learning and guidance of students according to specialization and the appropriate path for their abilities and learning styles. Therefore, the research will find answers for the following questions:

1.   What are the most prevailing types of intelligence among secondary school students?
2.   What are the preferred learning styles of high school female students in a public school?
3.   Are there statistically significant differences among high school students in preferred learning styles due to grade (first, second, third) and specialization (scientific, literary, commerce)?
4.   What is the relationship between learning styles and multiple intelligences?

Literature review

Learning style

Literature has showed some definitions of learning styles. Honey and Mumford (2000) defined it as a description of the trends and behaviors that shows an individual's preferred way of learning. Learning style is the way in which the learner receives information and experiences, records, symbolizes, integrates and retains the information in her/his cognitive repository (Fleming & Bonwell, 2002; Kolb, 1984). Abbas (2017) indicated that the learning style is the way in which a student absorbs the information presented to her/him.

Talafha and Zaghloul (2009) conducted a study to investigate the prevailing learning styles among university students and the extent to which these styles vary according to grade and academic specialization. The results showed that there were no statistically significant differences in the spread of styles among the students for the grade, while there were differences at the level of specialization in favor of students of literary specialization.

Sywelem and Dahawy (2010) identified the students' preferred learning styles at the Colleges of Education in Egyptian universities and the extent of differences between grade, specialization and preferred learning style. The results revealed an impact of both grade and specialization on students' preferred learning styles (auditory, visual, read/write, kinesthetic) to varying degrees, and recommended the need for continuous awareness of students' learning styles and their role in enhancing learning.

In a related context, Al-Balhan (2007) conducted an experimental study to find out the impact of learning styles on academic achievement among middle school students in Kuwait, his results showed the superiority of the group who received education according to their preferred learning styles.

Dasari (2006) and Abu Ghazal (2008) indicated that the visual learning style took precedence among students with the presence of other styles in different proportions, and also showed a positive impact on achievement and the attitude to teaching when taking into account the learning styles which confirmed that teaching methods matching learning styles increase the chances of academic success.

The study of Hilan et al. (2010) indicated that there were no differences in self-efficacy attributed to the most preferred learning styles and the school year of the students. Neither were

there differences between preferred learning styles, academic year and cumulative averages. Yahaya and Yahaya (2010) showed that the most dominant learning style was visual. They recommended that the teacher should be aware of students' learning styles to increase academic performance.

Jaafar et al. (2016) studied the prevailing learning styles among the students and their relationship to grade, academic year, and scientific specialization. The results showed that the cognitive style is the most prevalent pattern in learning styles due to the gender variable, while no statistically significant differences were shown due to the variables of the school year, specialization, and general average.

Multiple intelligences

Gappi (2013) stated that the Multiple Intelligences Theory emphasizes the fair measurement of intelligence, allowing students to use intelligently mediated materials to solve problems or create products that explore the core components of a particular intelligence. In addition, it advocated that each intelligence needed to be directly evaluated in the context in which it operates instead of using decontextualized standardized test questions. Since Gardner proposed the theory of multiple intelligences, he has continuously expounded the significance of the eight intelligences in his related works (Armstrong, 2009).

Multiple Intelligences Theory advocates the superiority of an individual-centered curriculum (Gardner, 1987), which emphasizes that learning is highly individualized and that schools need to provide appropriate educational choices tailored to students' individual needs. In terms of curriculum scope, there is a call for the expansion of the school's curriculum, which must provide students with a wide range of learning activities and materials in order to develop their intelligences fully (White et al., 1995).

Considering the multiple intelligences approach in classrooms, teachers will be able to offer students authentic learning, optimally using their abilities. Using this theory, students become more active, engaged learners (Lunenburg & Lunenburg, 2014). In this regard, Luo & Huang (2019) pointed out the need to study the multiple intelligences of teachers and the activities they used in the classroom, as research is relatively limited on the intelligences of teachers. It is useful for teachers to focus their preferred type of intelligence to create teaching opportunities that fit their intelligence in a better way.

Given the importance of multiple intelligences for both the teacher and the learners, Hannifin (2014) illustrated how to use the theory of multiple intelligences as a basis for obtaining suggestions for better classroom practices.

The theoretical framework used in this case is largely founded on Gardner's work on multiple intelligences. Gardner (2011) first proposed a theory of seven intelligences, which he later extended to include a total of nine intelligences. He named seven different types of intellect, including linguistic, musical, spatial, bodily-kinesthetic, logical-mathematical, interpersonal, and intrapersonal. He later added philosophical intelligence and naturalistic intelligence. (Hall et al., 2017, p.431).

Gardner's theory of multiple intelligences and the theory of learning styles have been the focus of attention of many scholars in the field of individualized teaching. Practically, some educators try to use both theories in teaching by assigning similar functions, while Gardner sees multiple areas of intelligence as "production-oriented" abilities, and learning styles are different from this as features for "perception" (Can, 2007).

Methods

Research design

The current research followed the quantitative approach through which the research questions were answered. The researcher used descriptive statistics, t-test, one-way analysis of variance (ANOVA), Pearson moments product correlation and Structural Equation Modeling (SEM).

Sample

The research sample consists of all students of the 10th, 11th, and 12th grades of a public secondary school. The school was chosen purposefully because it is one of the best schools in terms of students' performance and Education and Training Quality Authority (BQA) evaluation, and received "Excellent" in the BQA evaluation. Demographic information of the sample based on their specialization and grades is shown in Table 1.

Table 1 *Participants who took the multiple intelligences and learning styles scales*

Variable		Multiple Intelligences		Learning Styles	
		N	**Percent**	**N**	**Percent**
Specialization	Literacy	203	27.21	203	10.7
	Commerce	130	17.43	130	21.1
	Scientific	413	55.36	413	46.9
	Total	746	100	737	100
Grade	10th	183	24.5	177	23.9
	11th	284	38.1	279	38.0
	12th	279	37.4	281	38.1
	Total	746	100	737	100

Instruments

The researcher used two scales: Multiple Intelligences and VARK Scale.

Multiple Intelligences Scale was developed by Mckenzie (1999). The scale was translated into Arabic by Abdulqader and Abuhashim (2007). It consists of 80 items distributed on eight types of intelligence. Each item has five options (Fully Applied to me, highly applied to me, Sometimes applied to me, rarely applied to me, never applied to me). Each type of intelligence is treated as a separate category. They also examined the validity and reliability of the Arabic version of the scale.

The VARK Scale was prepared by Fleming and Bonwell (2002). This scale has been translated into Arabic in previous studies, including Abbas (2017), Bani Hamad (2009), Al-Zaghal (2006), and is available on the internet. The researcher reviewed the translated version and compared it with the original version and what is contained in the electronic questionnaire on the network http://vark-learn.com. The scale consists of 16 questions to measure students' preferred learning styles. Each question has four alternatives, each of which is related to a style of learning (visual, auditory, read/written, kinesthetic). Students were asked to choose one of four situations according to the style in which they preferred to interact personally. To check the validity of the scale, it was be presented to a group of experts specializing in teaching methods, psychology, and English to ensure the correctness of the translation and the integrity of the content.

For the reliability of the scale, the test-retest method was used. The scale was applied to a random sample of 15 students, and after an interval of two weeks it was administered to the same sample again. The Pearson correlation coefficient was be calculated. The reliability estimates for the scores of the VARK subscales were .85, .82, .84, and .77 for the visual, aural, read/write, and kinesthetic subscales, respectively, which are considered adequate given that the VARK is not used for high-stakes decisions.

The author employed structural equation modeling to look at the relationship between students' behavioral involvement, types of motivation, and need satisfaction. (SEM). These analyses were done using a three-step procedure. The first stage was to define a measurement model that permitted free covariation between all latent variables. An acceptable fit shows that the observed variables fit the latent constructs well in this step, which is a requirement for a well-fitting model when structural paths are added. To make the measurement model a complete SEM model, the second and final stage is to incorporate the proposed structural relations.

Results

RQ1: What are the most prevailing types of intelligence among secondary school students?

Table 2 *Multiple intelligence (N = 746)*

Intelligence Type	M	SD	Rank
Social/Interpersonal Intelligence	3.51	0.70	6
Visual/Spatial Intelligence	3.55	0.65	5
Bodily/Kinesthetic Intelligence	3.68	0.67	2
Inner/Interapersonal Intelligence	4.01	0.56	1
Naturalistic Intelligence	3.61	0.61	3
Verbal/Linguistic Intelligence	3.23	0.72	7
Logical/Mathematical Intelligence	3.59	0.66	4
Musical/Rhythmic Intelligence	3.02	0.93	8

Table 2 shows that the mean and standard deviation of the scores of multiple intelligences among high school students in a public school ranged between (3.02– 4.01) where the Intrapersonal Intelligence obtained the highest mean (4.01) followed by Kinesthetic Intelligence with a mean (3.68), then the Naturalistic Intelligence with a mean (3.61), while the Musical/Rhythmic Intelligence obtained the lowest mean (3.02). The mean and standard deviation of the scores of multiple intelligences among high school students by gender and specialization are shown in tables 3 and 4, respectively. It is obvious that among the three grade levels, the Inner/Intrapersonal Intelligence came first, and the Inner/Intrapersonal Intelligence came second, while the Musical/Rhythmic Intelligence came last in the three grade levels. Interestingly, the same results were found across the three majors, and this is what has been shown (Table 5) when ANOVA was used to examine if there were statistically significant differences among secondary school students in the prevailing types of intelligences due to grade (first, second, third). The results showed that there were no statistically significant differences among secondary school students in the prevailing types of intelligence due to grade, except for musical intelligence $F_{(2, 743)} = 4.041$, $p = 0.018$ (Table 5). Whereas the results showed that there were statistically significant differences among secondary school students in all the types of intelligence due to specialization except Bodily/Kinesthetic, $F_{(2,743)} = 0.985$, p = 0.374, .98 and Musical/Rhythmic, $F_{(2,743)} = 0.114$, p = 0.892 as shown in table 6.

Table 3 *Multiple intelligence by grade*

Intelligence Type	10th Grade (183)		11th Grade (284)		12th Grade (279)	
	M	SD	M	SD	M	SD
Social/Interpersonal Intelligence	3.29	.712	3.17	.716	3.17	.716
Visual/Spatial Intelligence	3.17	.716	3.50	.632	3.56	.673
Bodily/Kinesthetic Intelligence	3.66	.653	3.65	.687	3.72	.672
Inner/Interapersonal Intelligence	4.05	.588	3.96	.550	4.02	.544
Naturalistic Intelligence	3.65	.595	3.57	.604	3.62	.619
Verbal/Linguistic Intelligence	3.29	.712	3.17	.716	3.24	.728
Logical/Mathematical Intelligence	3.62	.676	3.56	.641	3.60	.667
Musical/Rhythmic Intelligence	3.12	.884	2.90	.962	3.08	.920

Table 4 *Multiple intelligence by specialization*

Intelligence Type	Scientific (413)		Literacy (203)		Commerce (130)	
	M	SD	M	SD	M	SD
Social/Interpersonal Intelligence	3.56	.682	3.50	.765	3.40	.697
Visual/Spatial Intelligence	3.60	.631	3.56	.682	3.47	.665
Bodily/Kinesthetic Intelligence	3.71	.674	3.64	.670	3.65	.674
Inner/Interapersonal Intelligence	4.04	.535	4.03	.623	3.91	.554
Naturalistic Intelligence	3.69	.585	3.56	.644	3.48	.608
Verbal/Linguistic Intelligence	3.31	.701	3.12	.783	3.13	.670
Logical/Mathematical Intelligence	3.67	.619	3.46	.767	3.52	.648
Musical/Rhythmic Intelligence	3.01	.947	3.03	.930	3.05	.905

Table 5 *Multiple intelligence of students according to grade*

Intelligence Type	Grade	N	Mean	SD	df	F	p
Verbal/Linguistic	10th	183	3.29	.712			
	11th	284	3.17	.716	2,743	1.735	.177
	12th	279	3.24	.728			
Logical/Mathematical	10th	183	3.62	.676			
	11th	284	3.56	.641	2,743	.556	.574
	12th	279	3.60	.667			
Visual/Spatial	10th	183	3.57	.631			
	11th	284	3.50	.632	2,743	1.027	.359
	12th	279	3.56	.673			
Bodily/Kinesthetic	10th	183	3.66	.653			
	11th	284	3.65	.687	2,743	.781	.458
	12th	279	3.72	.672			
Musical/Rhythmic	10th	183	3.12	.884			
	11th	284	2.90	.962	2,743	4.040	.018
	12th	279	3.08	.920			
Inner/Interapersonal	10th	183	4.05	.588			
	11th	284	3.96	.550	2,743	1.655	.192
	12th	279	4.02	.544			
Social/Interpersonal	10th	183	3.54	.706			
	11th	284	3.45	.703	2,743	1.505	.223
	12th	279	3.54	.699			
Naturalistic	10th	183	3.65	.595			
	11th	284	3.57	.604	2,743	.891	.411
	12th	279	3.62	.619			

Table 6 *Multiple intelligence of students according to specialization*

Intelligence Type	Specialization	N	Mean	SD	F	df	p
Verbal/Linguistic	Scientific	413	3.11	.783			
	Literacy	203	3.12	.699	6.395	2,743	.002
	Commerce	130	3.31	.700			
Logical/Mathematical	Scientific	413	3.46	.765			
	Literacy	203	3.51	.647	6.615	2,743	.001
	Commerce	130	3.66	.619			
Visual/Spatial	Scientific	413	3.47	.656			
	Literacy	203	3.46	.665	4.358	2,743	.013
	Commerce	130	3.60	.631			
Bodily/Kinesthetic	Scientific	413	3.64	.670			
	Literacy	203	3.64	.674	.985	2,743	.374
	Commerce	130	3.71	.674			
Musical/Rhythmic	Scientific	413	3.02	.930			
	Literacy	203	3.05	.905	.114	2,743	.892
	Commerce	130	3.01	.946			
Inner/Interapersonal	Scientific	413	4.03	.623			
	Literacy	203	3.91	.553	3.776	2,743	.023
	Commerce	130	4.04	.535			
Social/Interpersonal	Scientific	413	3.50	.764			
	Literacy	203	3.40	.697	3.567	2,743	.029
	Commerce	130	3.56	.681			
Naturalistic	Scientific	413	3.55	.643			
	Literacy	203	3.48	.607	8.767	2,743	.000
	Commerce	130	3.69	.584			

RQ2: What are the preferred learning styles of high school female students in a public school?

Table 7 *Preferred learning styles*

Learning Styles	N	%	M	SD	Rank
Kinesthetic	199	27%	3.79	0.94	2
Visual	95	13%	3.15	0.67	4
Auditory	283	39%	4.10	0.83	1
Read/Write	157	21%	3.56	0.58	3

Table 7 shows that the mean scores of learning styles among secondary school students in a public school ranged between (3.15– 4.10), where the auditory style obtained the highest mean (4.10) followed by the kinesthetic style with a mean (3.79), followed by the read/write style with a mean (3.56), while the visual style got the lowest mean (3.15). This shows that both the auditory and kinesthetic style are the preferred learning styles of secondary school students in a public school. The mean and standard deviation of the scores of multiple intelligence among high school students by gender and specialization are shown in tables 8 and 9, respectively. The results show that the Auditory style came first for all the students in the three grade levels, the Visual style came second for the 11th and 12th grades, and the Kinesthetic style came as the third preferred learning style. Similarly, for the specialization, the most preferred learning style is Auditory followed by Kinesthetic for the three specializations. Read/Write came in third place and Visual in the fourth place for preferred learning style for students in the scientific and commerce specializations.

Table 8 *Preferred learning styles by grade*

Learning Styles	10th Grade (177)		11th Grade (279)		12th Grade (281)	
	M	SD	M	SD	M	SD
Kinesthetic	3.56	0.67	3.71	0.77	3.83	0.76
Visual	3.44	0.87	3.30	0.95	3.46	0.67
Auditory	3.86	0.79	4.02	0.91	4.55	0.97
Read/Write	3.35	0.99	3.54	0.80	3.54	0.75

Table 9 *Preferred learning styles by specialization*

Learning Styles	Scientific (413)		Literacy (203)		Commerce (130)	
	M	SD	M	SD	M	SD
Kinesthetic	3.65	0.84	3.49	0.75	3.85	0.84
Visual	3.34	0.61	4.06	0.57	3.11	0.61
Auditory	4.09	0.90	4.21	0.83	3.99	0.90
Read/Write	3.47	0.68	3.43	0.78	3.24	0.68

It is clear from Table 5 that the values of the levels of significance were less than 0.05 for both the visual style and the kinesthetic style, and this indicates statistically significant differences among secondary school students in both the visual style and the kinesthetic style attributed to the grade variable, and from the mean it can be deduced that these differences were in favor of grade in the visual style, and in favor of males in the kinesthetic style, and this result is consistent with the result of the study [28]. 0.05 (for both the auditory style and the reading/writing style, this means that the hypothesis accepts these two styles, and also, indicates that there are no statistically significant differences among high school students in these two styles attributable to the grade variable.

This shows that female students were more likely to prefer the visual learning style, and male students were more likely to prefer the kinesthetic learning style, while the students' degrees of preference for both the auditory style and the reading/written style were similar. It is noted that students prefer in their learning the kinesthetic activity and simulation of reality.

RQ3: Are there statistically significant differences among high school students in preferred learning styles due to grade (first, second, third) and specialization (scientific, literary, commerce)?

To answer this question, ANOVA was used for independent samples to test the hypothesis that there are no statistically significant differences at a level of significance (0.05) in high school students in preferred learning styles attributed to the grade, the results in table 10 show that there were no statistically significant differences among high school students in preferred learning styles due to grade (first, second, third), except for Kinesthetic, , $F_{(2,731)}$ = 4.383, p = 0.013 as shown in Table 10. Table 11 shows that there were no statistically significant differences among high school students in preferred learning styles due to specialization (Scientific, Literary, Commerce).

Table 10 *Preferred learning styles of the students according to grade*

Learning Styles	Grade	N	Mean	SD	F	df	p
Visual	10th	183	4.01	.607	1.770	2,731	.171
	11th	284	3.97	.568			
	12th	279	3.91	.565			
Auditory	10th	183	3.95	.577	1.303	2,731	.272
	11th	284	3.96	.593			
	12th	279	4.05	.597			
Read/Write	10th	183	4.01	.579	.831	2,731	.436
	11th	284	4.01	.589			
	12th	279	4.07	.558			
Kinesthetic	10th	183	4.00	.571	4.383	2,731	.013
	11th	284	4.03	.586			
	12th	279	4.03	.573			

Table 11 *Preferred learning styles of the students according to Specialization*

Intelligence Type	Specialization	N	Mean	SD	F	df	p
Visual	Scientific	130	4.00	.596	.654	2	.520
	Literacy	203	3.93	.574			
	Commerce	413	3.95	.574			
Auditory	Scientific	746	3.95	.577	.361	2	.697
	Literacy	130	4.01	.556			
	Commerce	203	3.98	.593			
Read/Write	Scientific	413	4.03	.598	.122	2	.885
	Literacy	746	4.01	.589			
	Commerce	130	4.05	.584			
Kinesthetic	Scientific	203	4.02	.580	.514	2	.598
	Literacy	413	4.032	.568			
	Commerce	746	4.03	.573			

RQ4: What is the relationship between learning styles and multiple intelligences?

The relationships between the study variables were obtained using Pearson correlation. It is observed that all the relationships are positive, regardless they are significant or not. It was also found that three (Visual, Auditory, Read/Write) out of the four learning styles are significantly related to students' achievements. On the other hand, five intelligence types (Verbal/Linguistic, Visual/Spatial, Bodily/Kinesthetic, Inner/Intrapersonal, Naturalistic) out of eight are significantly related to students' achievement.

The relationship between intelligence types and learning styles was also examined. Results showed that there were significant correlations between Visual learning style with Verbal/Linguistic (0.65), Logical/Mathematical (0.59), Visual/Spatial (0.73), Bodily/Kinesthetic (0.45), and Naturalistic (0.62). Auditory learning style is correlated with Verbal/Linguistic (0.81), Musical/Rhythmic (0.36), and Inner/Intrapersonal (0.63). Read/Write learning style is only correlated with Verbal/Linguistic (0.66). Finally, the Kinesthetic learning style is correlated with Visual/Spatial (0.54), Bodily/Kinesthetic (0.84), Social/Interpersonal (071), and Naturalistic (0.41).

Table 12 *The Correlations between multiple intelligence, learning styles and students' achievement*

Intelligence Type	Visual	Auditory	Read/Write	Kinesthetic	Achievement
Verbal/Linguistic	.651	.805	.654	.250	.827
	.043*	.006**	.030*	.589	.026*
Logical/Mathematical	.587	.452	.314	.286	.456
	.008*	.916	.703	.094	.077
Visual/Spatial	.733	.263	.115	.537	.725
	.021*	.714	.888	.025*	.008*
Bodily/Kinesthetic	.452	.222	.278	.840	.738
	.030*	.625	.441	.000**	.000**
Musical/Rhythmic	.304	.356	.226	.240	.283
	.320	.044*	.138	.518	.238
Inner/Interapersonal	.244	.625	.437	.128	.370
	.227	.022*	.318	.857	.018*
Social/Interpersonal	.044	.401	.017	.712	.297
	.229	.075	.636	.042*	.636
Naturalistic	.622	.415	.156	.410	.656
	.041*	.092	.129	.045*	.029*
Achievement	.722	.610	.456	.310	1
	.011**	.012*	.029*	.095	
** Correlation is significant at the 0.01 level (2-tailed).					

Structural equation modeling was used to examine if multiple intelligences have a direct effect on students' achievement, learning styles have a direct effect on students' achievement, and if there is a significant relationship between Multiple intelligences and learning styles.

The data were checked for missing values and outliers. The measurement model was then checked using CFA approach using AMOS version 27 software (Arbuckle, 2017) to measure the validity of the construct items. A number of indices were checked to examine the model fit. The first index the researcher looked at is the model chi-square ($\chi^2 < 2.0$), in addition to the standardized root mean square residual (SRMR), the root mean square error of approximation (RMSEA < 0.08), the comparative fit index (CFI > 0.9) and Tucker–Lewis index (TLI > 0.9). After examining the fit of the data, the structural model was performed using structural equation modeling (SEM). The measurement model appeared to fit the data well, according to Arbuckle and Wothke (1999), as indicated in Table 13.
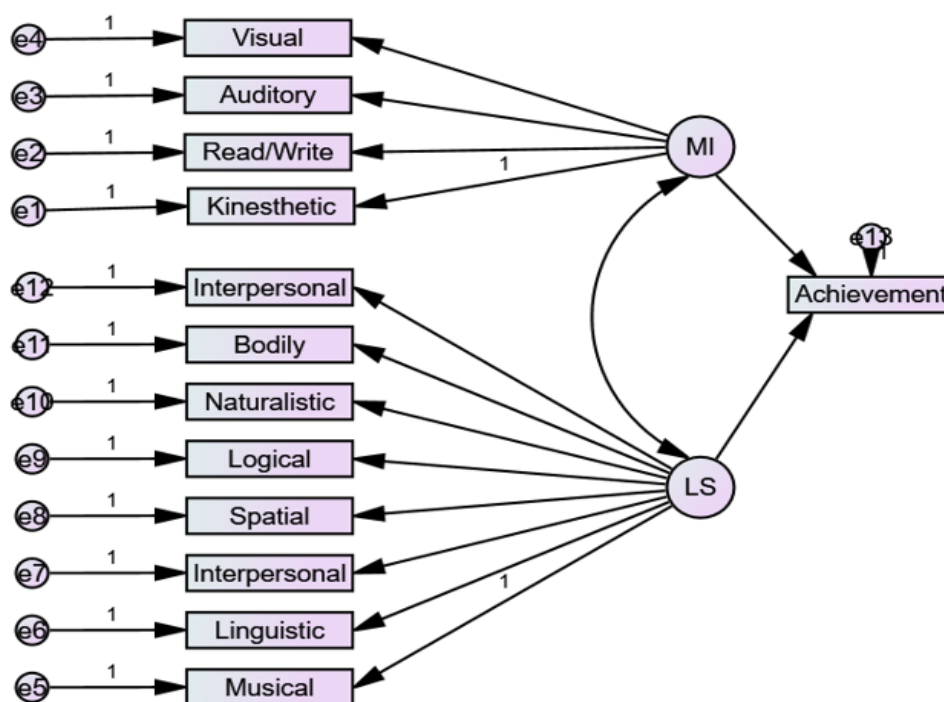
Figure 1. *Multiple intelligent and learning styles impact on students' achievement.*

The effect of the multiple intelligences and learning styles on students' achievement was examined using structural equation modeling. The results indicated that multiple intelligences were significantly correlated with learning styles ($\beta = 0.58$, $p < 0.01$), t-value (2.86, $P < 0.05$). Moreover, multiple intelligences were significantly related to students' achievement ($\beta = 0.67$, $P < 0.05$), t -value (2.64, $P < 0.05$). Learning styles were also significantly related to students' achievement ($\beta = 0.48$, $P < 0.05$), t-value (2.55, $P < 0.05$). The students' achievement was found to be predicted by multiple intelligences and learning styles, resulting in R^2 of 0.28. This means that multiple intelligences and learning styles explained 28% of the total variance in students' achievement.

Table 13 *Summary of model-fit of the confirmatory factor analysis*

Hypothesized relationship	Standardized estimates	t-values
Multiple intelligences ⟷ Learning styles	0.58	2.86
Multiple intelligences → Achievement	0.67	2.64
Learning styles → Achievement	0.48	2.55
Squared multiple correlation (R^2)		
Multiple intelligences	0.19	
Learning styles	0.120	
Achievement	0.364	
Model fit statistics		
$\chi^2 = 152.32$; df $= 65$; $p < .001$; CFI $= .921$; TLI $= .913$; RMSEA $= .049$		

Discussion

The results showed that the most prevailing types of multiple intelligences among high school students are the Intrapersonal followed by Kinesthetic Intelligence, then the Naturalistic Intelligence, while the Musical/Rhythmic Intelligence obtained the lowest mean. This finding is supported by Rawashdeh et al. (2010) which showed that the visual style is the most preferred style among the learners, followed by the kinesthetic style and then the auditory. Furthermore, Dasari (2006) and Abu Ghazal (2008) indicated that the visual learning style was the most preferred among students with the presence of other styles in different proportions. Jaafar et al. (2016) showed that cognitive style is the most prevalent pattern in learning styles due to the gender variable.

The study also tried to check if there are significant differences among secondary school students in the prevailing types of intelligence due to grade (first, second, third) and specialization (scientific, literary, commerce). The results showed that there were no statistically significant differences among secondary school students in the prevailing types of intelligence due to grade, except for musical intelligence, whereas the results showed that there were statistically significant differences among secondary school students in all the types of intelligence due to specialization except Bodily/Kinesthetic. This finding is in line with Talafha and Zaghloul (2009) which concluded that there were no statistically significant differences in the spread of styles among the students for the grade, while there were differences at the level of specialization in favor of students of literary specialization. In the same vein, Jaafar et al., (2016) showed that no statistically significant differences were there due to the variables of the school year, specialization, and general average.

Furthermore, the results showed that the preferred learning style among secondary school students in a public school was the auditory style which obtained the highest mean followed by the kinesthetic style with a mean, followed by the read/write style, while the visual style got the lowest mean. This shows that both the auditory and kinesthetic style are the preferred learning styles of secondary school students in a public school.

Similarly, the study probed if there were statistically significant differences among secondary school students in the preferred learning styles due to grade (first, second, third) and specialization (scientific, literary, commerce). The study found that the secondary school students showed a significant difference in their preferred learning style in the Kinesthetic style. No significant difference was found in students' preferred learning style and according to their specialization. This finding is consistent with the study of Hilan et al. (2010) which indicated that there were no differences between preferred learning styles, academic year and cumulative averages. On the contrary, the study diverges from Sywelem and Dahawy (2010) who found an impact of both grade and specialization on students' preferred learning styles (auditory, visual, read/write, kinesthetic) to varying degrees, and recommended the need for continuous awareness of students' learning styles and their role in enhancing learning.

Further, the study explored the relationship between learning styles and multiple intelligences. The results show that there were significant correlations between Visual learning style with Verbal/Linguistic, Logical/Mathematical, Visual/Spatial, Bodily/Kinesthetic, and Naturalistic. Auditory learning style is correlated with Verbal/Linguistic, Musical/Rhythmic, and Inner/Interapersonal. Read/Write learning style is only correlated with Verbal/Linguistic. Finally, the Kinesthetic learning style is correlated with Visual/Spatial, Bodily/Kinesthetic, Social/Interpersonal, and Naturalistic.

Finally, the study investigated the impact of multiple intelligences and learning styles on students' achievements. The results indicated that multiple intelligences were significantly correlated with learning styles. Moreover, multiple intelligences were significantly related to students' achievement. Learning styles were also significantly related to students' achievement. The students' achievement was found to be predicted by multiple intelligences and learning styles. This correlation is confirmed by Al-Balhan (2007) which was an experimental study to find out the impact of learning styles on academic achievement among middle school students in Kuwait, his results showed the superiority of the group who received education according to their preferred learning styles. Likewise, Dasari (2006) and Abu Ghazal (2008) showed a positive impact of teaching when the impact of learning styles on achievement and the attitude confirmed that teaching methods matching learning styles increased the chances of academic success.

Conclusion

Learning styles vary from student to student within the same class, hence the teacher must take into account the following points so that the preferences of all students are considered as much as possible in the regular class. This has also been emphasized by Mckeachie (2003), Ghoneim and Bodhi (2012) who stressed that teaching students according to the preferred learning styles contributes to achieving academic excellence and increasing achievement and personal enhancement, and that consideration of learning style in curriculum design and evaluation of teaching is equally important. This implies that the role of the teacher must be focused on awareness of integrating the learning styles while heading to the task of teaching and learning. Accordingly, it can be said that the teacher's consideration of students' preferred learning styles increases their academic achievement. However, it is not necessary to take into account the student's learning style throughout the class, but simply to distribute the class time so that each part of it takes into account a certain learning style. The teacher should help the student to address learning tasks that suit their learning style. The success of the teacher depends on his/ her ability to recognize the students' most preferred learning style during the lesson and addressing them through it. The methods of teaching and directing them towards teaching students in the light of these findings can help achieve the desired objectives.

Recommendations

Many international institutions and bodies interested in quality standards in education call for the importance and necessity of taking into account the conditions of learners and their learning styles, and their right to enable them to learn in the way they can learn (NCATE. (2008)), which is consistent with what many studies also indicated. Based on the results and conclusions of this study, the researcher recommends the following: The need to take into account learning styles according to the VARK model when reviewing and developing the curriculum.

1. Holding training programs for teachers to help them discover students' preferred learning styles and how to deal with them.
2. Emphasizing the importance of diversifying learning activities and methods of presenting information and facts to students in line with their preferred learning styles.

Limitations

The researcher feels that qualitative data would have added a new dimension to this study, and hopes that future studies will take this fact into account.

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