Learning Styles in Relation to Academic Performance in Middle School Mathematics

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ABSTRACT

Research was conducted with middle-school Kuwaiti children to assess the effectiveness of student learning styles in predicting students' academic performance in Mathematics. A group of middle school students who had received first quarter grades and enrolled in an after-school tutoring program were studied, with half of the students in a traditional tutoring program and the other half in a Markova learning style-tutoring program. Results show that the students in the experimental group (mean = 45.91), whose learning styles were accommodated for, performed better than the students in the control group who studied using the traditional method (mean = 43.80) of teaching. Gender, type of school attended, and area in which the students lived were all analyzed within the experimental group. The experimental group results show that the highest-grade improvement in Mathematics was found to be predominately male students attending private institutions, and living in the urban areas of Kuwait.

Students learn in a variety of ways, and their ability to attain this information also varies. A student's capacity to learn is impacted by the teacher's style of conveying information. Unfortunately, little attention has been given to how children think (Markova, 1992). Often, it is assumed that students' minds operate in the same way as the teacher's does. So much of student failure in school comes directly out of the larger failure to stimulate all those areas in the children's brains, stimulation which could open up their minds in so many ways (Markova, 1992).

Student's academic performance is a matter of concern to educators, parents, and students themselves. The ways in which an individual characteristically acquires, retains, and retrieves information are collectively referred to as his or her learning style (Felder and Henriques, 1995). Unfortunately, the manner in which children acquire the information to perform well academically is too often ignored.

Considerable research has examined the relationship between students' learning styles and their academic performance (Witkin, 1973; Gregorc, 1979; Claxton and Murrell, 1987; Brunner and Majewski, 1990; Schroeder, 1993; Klavas, 1993). These studies have consistently found that when learning styles were considered in the teaching process, academic performance increased. Schroeder states that accommodating the variations in learning styles could improve curricula and the teaching process (1993). The results of a study by Dunn et al. (1995) suggested that students whose learning styles are accommodated would be expected to achieve 75% of a standard deviation higher than students for whose learning style had not been accommodated. Many researchers have reported that students often classified as poor achievers, learning disabled, at-risk youth, or dropouts were able to improve their academic performance when instruction was redesigned to respond to their particular learning style preferences (Stone, 1992; Perrin, 1990; Elliot, 1991; Andrews, 1990).

Children suffer deeply when their natural way of thinking, of absorbing and processing information, of creating and expressing is criticized, mocked, or ignored (Markova, 1992). However, learning efficiently empowers children to gain confidence since many believe they have learned a skill only after they can perform it easily.

Markova acknowledges that many approaches to understanding individual differences include something about the fact that most of us have one sense we are most comfortable using in the learning process. Understanding these patterns of processing information is crucial to finding the most effective ways to educate our children. Markova has identified six patterns of personal thinking, which are different combinations of the perceptual kinesthetic (K), auditory (A), and visual (V) channels. He posits that information is first received by the conscious mind, sorted by the unconscious mind and finally integrated by the subconscious mind (Markova, 1992). The six different combinations (KAV, KVA, AVK, AKV, VKA, and VAK) are referred to as personal thinking patterns and determine the most comfortable and effective way for each learner to learn.

Purpose and Research Question

The purpose of this study was to determine how accommodating students' learning styles affected middle-school student academic performance in mathematics. The specific objectives of the study were to answer the following questions:

1. Is there a significant difference between the

traditional method and Markova style of teaching mathematics?
2. Is there a significant difference between male and female students within the experimental group?
3. Is there a significant difference between those students studying at private and government institutions within the experimental group?
4. Is there a significant difference between those students who live in the urban and suburban areas of Kuwait within the experimental group?

Methods and Procedures

Population and Sample: The population for this study were middle school students who were referred to a learning and developmental institute (Early Learning Institute) due to difficulties learning mathematics.

Experimental Group

Table Three gives a description of the experimental study sample. There are 87 male students and 48 female students (N=135). From the government schools, there are 39 students, and from the private schools, there are 96 students. Eighty-four are urban district students' and 51 are suburban district students. The secondary school comprises four grade levels; there are 18 first-year students, 39 second-year students, 51 third-year students, and 27 fourth-year students.

Control Group

Table Eight describes the control study sample. There are 72 male students and 45 female students (N=117). From the government schools there are 30 students and from the private schools there are 87 students. Thirty-three are suburban district students' and 84 are urban district students. The secondary school comprises four grade levels; there are 18 first-year students, 45 second-year students, 42 third-year students, and 12 fourth-year students.

Instrumentation

Markova's Thinking Patterns Inventory (1992) was administered to assess the preferred learning style of each student. Through a list of eight characteristic behaviors and qualities children encounter through their perceptual channels and states of mind (conscious, subconscious, unconscious). The eight characteristics are:

1. language
2. visual
3. physical
4. learning strengths and challenges
5. "spaces out"
6. typical trouble
7. frustrations
8. natural gifts

After which they fall into one of the six categories: KAV, KVA, AVK, AKV, VKA, and VAK. K = kinesthetic; A = auditory; and V = visual. The total possible range of scores on Markova's Thinking Patterns Inventory is 0 to 15. Individuals scoring the highest in an individual category were considered to be that type of learner/ thinker. The traditional method of teaching was based on information from the textbook and the teacher's basic background knowledge.

Data Collection and Analysis

The Markova Thinking Pattern Inventory was distributed to students in the experimental group when they arrived at the Institute after receiving their first quarter grades. Academic performance in mathematics was measured by their grade after each quarter until the end of the school year.

The teachers were trained in Markova's style of teaching for a 2-week training period for all levels of middle school. Students were then placed in either the traditional method of a mathematics teaching program (control group) and the other students were put in the Markova Style of Learning program (experimental group).

Descriptive statistics were generated on mathematics scores and teaching methods as well as student variables (gender, type of school, and area in which they live) within the experimental group. A correlation between the test-retest was calculated using the students' scores across the academic school year between the traditional method and the Markova Style of Learning method. T-tests were used to explain differences within the experimental group for grades according to gender, type of institution, and living area.

Results

Experimental and Control Groups

The purpose of this study was to determine whether students demonstrate higher levels of achievement when they received mathematics instruction through a teaching style designed to

match their temperament-based learning styles in an after school tutoring program compared to traditional social studies instruction. A T-test was performed to investigate between the two variables of experimental and control group. The type of instructional strategy used by the teachers significantly affected achievement between the means of experimental and control for total add with the experimental (45.91) being higher than the control (43.8). The total difference gives the experimental group a higher mean of 5.51 compared to the control group mean of 4.67. (See Table One).

Table One also shows a significant difference with the mean being higher for the experimental group in the second (e = 10.67, c = 10.28); third (e = 12.31, c = 11.67); and fourth (e = 14.22, c = 13.26) grading periods.

As Wyer (1974) stated there are both state (emotional arousal) and trait (ability) differences in the ability to process information. These aspects must be considered when we examine how learners learn in given contexts.

Experimental Group

The system used is the quarter system and the mean of the four grading periods are 45.91, and the total difference from the first quarter to the fourth quarter is a mean of 5.51. The four grading periods give the mean differences of first grading period = 8.71; second grading period = 10.67; third grading period = 12.31; fourth grading period = 14.22. (See Table Two).

T-tests were performed to investigate the two variables of male and female, attending private schools or government schools, and living in urban or suburban areas of Kuwait.

By using the T-test (Table Three) there is a significant difference between the mean of male and female for total add being the mean of male (47.38) is higher than the mean of female (43.25). The total difference shows significant difference ($p < .05$) between the mean of male (6.28) being higher than the mean of female (4.13).

Table Four shows a significant difference ($p < .05$) with the mean of male being higher than the female in the second grading period (Male = 11.10, Female = 9.88); third grading period (Male = 12.76, Female = 11.50); and fourth grading period (Male = 14.90, Female = 13.00).

In Table Five a T-test indicated significant differences ($p < .05$) were found between the mean of private (5.75) higher than the mean of government (4.92) schools in the total difference.

Significant differences ($p < .05$) were also found between the mean of private being higher than the government schools for the

second grading period: private (10.84), government (10.23); and the fourth grading period: private (14.47), government (13.62).

In Table Six, a T-test was run and a significant difference was found with the mean of urban being higher than the suburban areas of Kuwait for the third grading period (u = 12.54, s =11.94); fourth grading period (u = 14.61, s = 13.6); and the total difference (u = 5.9, s = 4.9).

To investigate group differences in those statistically significant grades for each quarter grading period, post hoc multiple comparison of mean tests were performed for the independent variable of age. The results show no significant difference between or within groups by age for total add and total difference.

In Table Seven.two, a significant difference ($p < .05$) was found in the first grading period between 10 and 12 year olds. By contrast, in Table 7.1 we see that the 10 year olds' mean (9.67) is higher than the 12 year olds' mean (8.41). However in Table 7.2, a significant difference between age groups was found for the final grading period between 12 and 13 year olds.

Control Group

The four grading periods give the mean differences of first grading period = 8.59; second grading period = 10.28; third grading period = 11.67; fourth grading period = 13.26. The total add mean = 43.79 and the total difference mean = 4.67 (See Table 8).

Discussion and Findings

Students in the experimental group performed better overall in mathematics than the control group. Statistically significant differences were found for the second, third, and fourth grading periods with the experimental group achieving higher levels each time (refer to Table 1). This coincides with research that reports associations between learning styles and academic performance. A doctoral investigation conducted by Spires (1983) revealed that implementation of a learning styles program resulted in significant gains in reading and mathematics achievement on standardized achievement tests. Analyses of the data conducted by Dunn, Dunn, and Price (1976) indicated that teaching students through their individual learning styles resulted in significantly higher reading and mathematics achievement, particularly on those subtests requiring higher level cognitive abilities, such as reading concepts.

Learning styles have been found to have a positive relationship with academic performance, as measured by grade point average, performance in courses, and overall success in education (Torres, 1993; Garton, Dauve, and Thompson, 1999; Cano, 1999).

It was also found that students in the experimental group who attended private institutions, lived in urban areas of Kuwait, and predominantly male students exhibited statistically significant higher achievement level differences in Math overall when their Markova learning styles were adapted to their study habits during the school year as measured by each quarter's grading period.

In this study findings show that male students in the experimental group exhibited higher success rates at improving their grades in Math for all grading periods (2, 3, and 4) after the initial first quarter grades were taken and their learning styles were applied to their learning (see Table 4). This study confirmed previous research findings by Guild and Grager (1984) and Claxton and Murrell, (1987) which conclude that when learning styles were considered in the teacher-learning process, student achievement improved.

This study also showed that overall students in the experimental group attending private schools achieved higher grades for the second and fourth grading periods (see Table 5). Therefore, students in private schools benefit most when their learning style is applied to their schoolwork in Math. The first and third grading periods showed no significant differences either for male or female or for students living in either urban or suburban areas. This coincides with Schroeder's (1993) acknowledgement that accommodating the variations in learning styles could improve not only the teaching-learning process, but ultimately retain students in private higher education institutions.

Also, students living in urban areas of Kuwait achieved higher grades for the third and fourth quarter grading periods (see Table 6). Thus children living in urban areas benefited most from the learning style adjustment.

Conclusions

The results of this study shed important light on the best possible method to assist students in their study habits in the middle school years; and have greater implications for teachers, educators, and curriculum developers.

This study demonstrated that knowledge of student learning styles and appropriate teaching methods improve overall mathematics performance in the experimental group when compared to the traditional method of teaching in the control group. Middle school male math students in the experimental group exhibited higher grades over the course of the year when study habits were adjusted according to their Markova learning

style. Thus, a significant difference was found between the traditional method of teaching and the Markova learning style method for mathematical achievement. These findings are consistent with research concerned with identifying the relationship(s) between academic achievement and individual learning style has provided consistent support for the following: a) students do learn differently from each other; b) student performance in different subject areas is related to how individuals do, in fact, learn; c) when students are taught with approaches and resources that complement their unique learning styles, their achievement is significantly increased (DeBello, 1985; Dunn, Dunn, Primavera, Sinatra, & Virostko, 1987; Dunn, Krimsky, Murray and Quinn, 1985; Hill, 1987; Jarsonbeck, 1984; Lemmon, 1985; Lynch, 1981; Martini, 1986; Miles, 1987). A significant difference between male and female students was found when using the learning style adjustment in the experimental group. In addition, students in the experimental group who used the Markova learning style and attended private institutions and lived in urban areas of Kuwait showed more improvement in their grades than did their government school and suburban counterparts.

Implications

The match or mismatch between the way that teachers teach and the way that students learn has important ramifications for levels of student satisfaction in schools. Students whose learning styles are compatible with the teaching styles of an instructor tend to retain information longer, apply it more effectively, learn more, and have a more positive attitude toward school in general.

Educators are encouraged to provide effective instruction according to the students' individual learning style. Using objects that are visual, auditory, or kinesthetic would be helpful to these children.

Traditional study methods should be improved to meet the needs of middle school students. Educators need to develop mathematical curricular activities such as Markova's that involve the senses and whole body providing interactive learning for students so they can learn more effectively.

Markova recommends the following strategies for learning mathematics with the six styles of learning. A hands-on approach, showing rather than telling will work best for VKA and KVAs, for whom words get in the way. AKVs and AVKs need to see and discuss the whole of mathematical models. KAVs need to have concrete

experiences to talk about. VAKs do well when working in teams and teaching concepts to other children.

Finally, in order to provide a viable educational environment for all students, male and female, educators must understand their own teaching styles and adjust their teaching methods to accommodate the diverse learning styles of their students. Discovering the type of learners they are allows students to understand themselves better and make the most of their learning experience. Students will then be able to alter their learning approach to maximize their study habits and absorb information in the classroom (Griggs and Dunn, 1984).

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Experimental & Control Group

Table One: ***Means and Standard Deviations for Experimental & Control Group***

	Group	N	Mean	SD	Std. Error Mean	T	Signi-ficant (2-tailed)	Mean difference
Total Add	Experimental	135	45.91	5.76	.49	2.9	.004*	2.12
	Control	117	43.8	5.65	.52	3		
Total Difference	Experimental	135	5.51	1.55	.13	3.8	.000*	.84
	Control	117	4.67	1.91	.18	8		
1st quarter grading period	Experimental	135	8.71	1.60	.137	.60	.548	.12
	Control	117	8.59	1.60	.148			
2nd quarter grading period	Experimental	135	10.67	1.58	.136	2.1	.039*	.38
	Control	117	10.28	1.33	.123			
3rd quarter grading period	Experimental	135	12.31	1.52	.131	3.4	.001*	.64
	Control	117	11.67	1.46	.135			
4th quarter grading period	Experimental	135	14.22	1.81	.155	4.0	.000*	.97
	Control	117	13.26	1.99	.184			

*p <.05.

Table Two:
Means and Standard Deviations for Experimental Group

	Age	Total Add	Total Diff	1st quarter grades	2nd quarter grades	3rd quarter grades	4th quarter grades	Type
Mean	11.64	45.91	5.51	8.71	10.67	12.31	14.22	1.00
Median	12.00	46.00	5.00	9.00	11.00	13.00	14.00	1.00
Standard deviation	.950	5.76	1.55	1.592	1.583	1.523	1.807	.000
Minimum	10	35	3	6	8	9	10	1
Maximum	13	59	8	13	14	15	18	1

Table Three:
Sample of Students for Experimental Group

	Frequency	Percent
Female	48	35.6
Male	87	64.4
Government	39	28.9
Private	96	71.1
Suburban areas	51	37.8
Urban areas	84	62.2
10 year olds	18	13.3
11 year olds	39	28.9
12 year olds	51	37.8
13 year olds	27	20.0

Table Four: *T-test for experimental group with sex variable*

	Sex	N	Mean	Std. Deviation	Std. Error Mean	t	Significant difference (2-tailed)	Mean difference
Total add	Male	87	47.38	5.97	.640	4.23	.000*	4.13
	Female	48	43.25	4.28	.618			
Total difference	Male	87	6.28	1.32	.141	10.32	.000*	2.15
	Female	48	4.13	.789	.114	-.888	.376	-.25
1st quarter grading period	Male	87	8.62	1.78	.191			
	Female	48	8.88	1.18	.170			
2nd quarter grading period	Male	87	11.10	1.64	.175	4.63	.000*	1.23
	Female	48	9.88	1.12	.162			
3rd quarter grading period	Male	87	12.76	1.46	.157			1.26
	Female	48	11.50	1.29	.186			
4th quarter grading period	Male	87	14.90	1.72	.184	6.74	.000*□	1.90
	Female	48	13.0	1.24	.179			

*p <.05.

Table Five: *T-test for experimental group with school type variable*

	School	N	Mean	Std. Dev.	Std. Error Mean	t	Significant diff. (2-tailed)	Mean Diff.
Total add	Private	96	46.47	5.83	.595	1.78	.075	1.93
	Govmnt.	39	44.54	5.41	.867			
Total difference	Private	96	5.75	1.61	.164	2.87	.005*	.83
	Govmnt.	39	4.92	1.22	.196			
1st quarter grading period	Private	96	8.72	1.55	.159	.087	.931	.03
	Govmnt.	39	8.69	1.70	.273			
2nd quarter grading period	Private	96	10.84	1.61	.164	2.06	.041*	.61
	Govmnt.	39	10.23	1.44	.231			
3rd quarter grading period	Private	96	12.44	1.46	.149	1.52	.131	.44
	Govmnt.	39	12.0	1.64	.262			
4th quarter grading period	Private	96	14.47	1.91	.195	2.53	.012*	.85
	Govmnt.	39	13.62	1.35	.216			

*p < .05.

Table Six: ***T-test for experimental group with area variable***

	Area	N	Mean	Std. Dev.	Std. Error Mean	t	Signifi-cant Diff. (2-tailed)	Mean Diff.
Total add	Urban	84	46.64	5.4	.589	1.91	.058	1.94
	Sub-urban	51	44.71	6.2	.867			
Total Diff.	Urban	84	5.9	1.46	.159	3.86	.000*	1.01
	Sub-urban	51	4.9	1.51	.211			
1st Quarter grading period	Urban	84	8.71	1.31	.143	.03	.98	.01
	Sub-urban	51	8.71	1.98	.278			
2nd quarter grading period	Urban	84	10.79	1.67	.182	1.12	.26	.32
	Sub-urban	51	10.47	1.43	.201			
3rd quarter grading period	Urban	84	12.54	1.36	.148	2.23	.027*	.59
	Sub-urban	51	11.94	1.71	.240			
4th quarter grading period	Urban	84	14.61	1.75	.191	3.3	.001*	1.02
	Sub-urban	51	13.6	1.73	.243			

*$p < .05$.

Table Seven. One:
Means and Standard Deviation of the Four Grading Periods for Experimental Group by Student Age (N = 135)

	Age	N	Mean	Std. Dev.
Total add	10	18	46.67	6.36
	11	39	46.08	6.70
	12	51	44.35	4.38
	13	27	46.78	5.6
	Total	135	45.91	5.76
Total Dif.	10	18	5.16	1.38
	11	39	5.92	1.71
	12	51	5.12	1.38
	13	27	5.89	1.55
	Total	135	5.51	1.55
1st quarter grading period	10	18	9.67	1.85
	11	39	8.54	1.76
	12	51	8.41	1.34
	13	27	8.89	1.4
	Total	135	8.71	1.6
2nd quarter grading period	10	18	11.17	2.01
	11	39	10.54	1.71
	12	51	10.41	1.1
	13	27	11.00	1.8
	Total	135	10.67	1.58
3rd quarter grading period	10	18	13.00	1.57
	11	39	12.54	1.62
	12	51	12.00	1.43
	13	27	12.11	1.4
	Total	135	12.31	1.52
4th quarter grading period	10	18	14.83	1.38
	11	39	14.46	2.23
	12	51	13.53	1.43
	13	27	14.78	1.65
	Total	135	14.22	1.81

Table Seven. Two:
Scale means and standard deviations for students age 10 through 12 years, for the four grading periods of the school year (experimental group)

Grading period	Pairs of groups by age that differ significantly at .05	Significant difference	Mean difference
1st quarter	(10, 12)	.038*	1.25
4th quarter	(12,13)	.031*	-1.25

*$p < .05$.

Table Eight:
Means and Standard Deviations for Control Group (N = 117)

	Age	Total Add	Total Diff	1st qtr grades	2nd qtr grades	3rd qtr grades	4th qtr grades	Type
Mean	11.41	43.79	4.67	8.59	10.28	11.67	13.26	2.00
Median	11.00	45.00	5.00	9.00	10.00	12.00	14.00	2.00
Std dev	.87	5.65	1.91	1.60	1.33	1.46	1.99	.000
Min.	10	32	1	5	8	9	10	2
Max.	13	55	9	11	13	15	17	2