4MAT MODEL’S IMPACT ON THE LEARNING STYLES, SUCCESS AND ATTITUDES TOWARDS MATHEMATICS

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Abstract
Instructors seek new approaches and methods to facilitate and to achieve learning while the learning process constantly changes and develops. Individual characteristics are considered important factors to facilitate learning. An individual’s learning style (LS) is one of the important factors affecting the learning process. There is a consensus among researchers (Dunn, 1990; Claxton ve Murrell, 1987) that knowledge regarding an individual’s LS will facilitate in his/her learning process and it should be considered in the process.

First, the McCarty’s “Student Learning Preferences Survey” and Alkan’s “The Attitude towards Mathematics” were applied to subjects and individuals’ LS and attitudes were identified. The learning process with appropriate techniques for the individual’s LS was initiated and the process proceeded.

Our results indicated that depending on the learning approach applied and the method use, students’ LSs can change. Noticeable changes in the students’ academic success were observed with this approach.

Key Words: Learning style, 4MAT.

INTRODUCTION
There have been many studies done for achieving complete learning in the educational process. Particularly, the contribution of individual differences have been emphasized in education for last three decades. One of the individual differences in question is the individual learning style. The concept of style arising individual characteristics makes generalization difficult in learning due to its role in learning. Researchers have been working on defining the concept of individual learning style using different aspects. Some of them are:

i) Sternberg (1997) gives the learning style as the individual choice regarding in which way the individual will learn (Bedford, 2004).

ii) According to Keefe (1979), the learning style can be given as set of cognitive emotional, characteristic and physiological factors which are the indicators of how the learners comprehend, how the learners affect one another, and how they respond to learning environment.

iii) According to Riding–Ryner (1998), the learning style is the approach which the individual prefers in the organization and presentation of the information.

iv) Misko (1994) defines the learning style, with a more general approach, as the individual’s own way of approach in learning.
According to Garcia and Hughes (2000), the concept of learning style is a structure developed by bringing an activity-centered approach to the concept of style.

Common points of these definitions should be used as much as possible in order to simplify learning process. Therefore, student’s individual learning style must be determined. If the students’ learning styles are known, choosing possible teaching strategies, teaching procedures and techniques, and learning instruments can be facilitated (Akkoyunlu, 1995) and also appropriate opportunities can be provided for learners (Claxton and Murrell, 1987). Based on the results from different studies, providing appropriate learning opportunities to students’ learning styles can improve

i) positive development in their attitude towards the fields,

ii) indulgent behaves to those having cognitive difference,

iii) academic success,

iv) behaviour in well disciplined


The Learning Style Model developed by McCarthy, is formed of four quadrants and is called 4MAT. In addition to Kolb’s studies, McCarthy defined the system using the properties of right and left hemispheres of the brain.

Each of the four learning style quadrants was converted into a condition to cover right–mood, left–mood functions. In the second and third quadrants of the established model left–mood is dominant, on the other hand, in the first and fourth quadrants an inclination to right–mood process type is observed (McCarthy, 1990). Students need to exhibit the attitudes in all zones of the cycle in the learning process. Therefore, the completion of the whole cycle becomes more valuable than any part of it (McCarthy, 1990).

Different properties of learning types which is included in each quadrant are distinguished more dominantly. McCarthy presents the individual common characteristics and the differences among them in Figure 2.

As shown in Figure 2, the types that the model defines have very different properties. Hence, if 4MAT model is adjusted for education, a new learning environment for the model, learning activities and learning tools may be needed, because the purpose is not to eliminate these differences but to get benefit from all of them, which requires different approaches.
### Type 4 Dynamic Learners
- They perceive the information concretely and process actively.
- Combine their experiences with practice and learn by trial and error.
- Enthusiastic about new things.
- Like differences and easily adapted.
- Good at situations requiring flexibility.
- Often reach entire results where they don’t have reasonable causes.
- Get on well with people, and can take risks, sometimes can be seen as directive and insistent.
- Search for affecting.
- School is very often boring and quite regular because they tend to perform what they are interested in different ways.

### Type 1 Imaginative Learners
- They perceive the information concretely and process through reflective observations.
- Combine their experiences with themselves.
- Listen to the thoughts and share their thoughts to learn.
- Thinkers with high imagination relying on their experiences.
- Work in harmony and need to take part in work.
- Take responsibility, interested in culture and people.
- Sometimes have difficulty deciding since they have a wide viewpoint.
- Try to obtain the meaning and understanding of events.
- Think school is separate from personal hobbies in which they are interested.
- Have difficulty relating what they need to what they learn in school to understand their development and lives.

### Type 3 Common Sense Learners
- They perceive the information abstractly and process actively.
- Combine theory with practice.
- Learn by testing the theories and using their forethought.
- Pragmatists; use something if they believe it is of use.
- Solve valid problems of life, do not like ready-made answers.
- Value strategical thinking.
- Talent-focused people enjoying making trials and repairs as they need to know how objects work.
- Place reality to the very center of events.
- Regard school time as waste time since they need to work on life problems.
- Want what they have learned to be practiced.

### Type 2 Analytic Learners
- Perceive information concretely and process it reflective observations.
- Combine their observations with what they know and produce theories.
- Learn by thinking through ideas.
- Need to know what experts think.
- Value systematical thinking.
- Need details, perfectionists, diligent.
- Enjoy traditional class environments and find the ideas effective.
- Sometimes ideas are more appealing to them, and they sometimes can be isolated people living on their own.
- Look for intellectual competence and personal productivity.
- Have verbal ability and are ambitious readers.
- Regard schools as proper places for their need.

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Figure 2: The main characteristics of 4 Major Learning Styles According to 4MAT Learning Style Model (McCarthy, 1990)

### METHODOLOGY

This study is a quasi-experimental study depending on pre-test / post-test model with control group. In the intervention of the study, the learning activities have been developed with the principles and main bases of 4MAT Learning Model.

The experiment class is formed of a total of 30 pre-service teachers, 17 females and 13 males, who take Calculus Course, Faculty of Education, in the study year of 2006-2007. The control class at the same grade with 35 students has been used.
2002 version of Learning Styles Measure (LSM), developed by McCarthy, has been used in order to determine the learning styles of students. The measure in question was translated into Turkish and made useable by researchers (Alkan, Elçi, 2002). In the learning environment group work has been preferred. An approach based on activity has been exhibited to make learning easy. However, it has been paid attention for activities to be appropriate to each LS while they were being formed. Before and after the intervention process, LSM measure has been implemented to subject Therefore, the LS of the students were measured and the effects of implementation on the LS of students were tried to be revealed.

During the intervention, the prepared work sheets, the periodical homework, written examinations are used to determine the academic successes of the students.

The collected quantitative data have been analyzed and tried to be interpreted using proper statistical package programs.

**FINDINGS**

In the experiment group before the intervention, the distribution of learning styles of students can be found in Table 1.

<table>
<thead>
<tr>
<th>Learning Styles</th>
<th>Experiment Group (n= 30)</th>
<th>Control Group (n= 35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>10 (33.3)</td>
<td>20 (57.1)</td>
</tr>
<tr>
<td>Type 2</td>
<td>9 (30.0)</td>
<td>3 (8.6)</td>
</tr>
<tr>
<td>Type 3</td>
<td>9 (30.0)</td>
<td>10 (28.6)</td>
</tr>
<tr>
<td>Type 4</td>
<td>2 (0.7)</td>
<td>2 (5.7)</td>
</tr>
</tbody>
</table>

Students are not equally distributed by learning styles. The numbers of students are equally distributed among the Type 1 (Imaginative Learners), Type 2 (Analytic Learners), and Type 3 (Common Sense Learners) while those in Type 4 (Dynamic Learners) are low compared to the other types in the experiment group. However, the Dynamic Learners can utilize what they have learned and acquired in solving real life problems. The Dynamic Learners can utilize their experiences to solve the real life problems. This shows that our educational system has difficulty in preparing the students to life.

On the other hand, the numbers of students by learning styles are more evenly distributed.
Table 2: The Distribution of Experiment Group Before The Intervention and After The Intervention

<table>
<thead>
<tr>
<th>Learning Styles n (%)</th>
<th>Before Intervention (n= 30)</th>
<th>After Intervention (n= 35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>10 (33.3)</td>
<td>11 (36.7)</td>
</tr>
<tr>
<td>Type 2</td>
<td>9 (30.0)</td>
<td>7 (23.3)</td>
</tr>
<tr>
<td>Type 3</td>
<td>9 (30.0)</td>
<td>7 (23.3)</td>
</tr>
<tr>
<td>Type 4</td>
<td>2 (0.70)</td>
<td>5 (16.7)</td>
</tr>
</tbody>
</table>

The number of Dynamic Learners has increased during the intervention (Table 2). While the students’ dominant learning styles have developed in the course of the intervention, they have helped students to form their own learning styles when the students have forced them in the learning style in which they are weak.

Kolmogorov–Smirnov test was applied to test the students' academic success are normally distributed in the experiment and the control groups at the end of the intervention. The results of the test are shown in Table 3. The distribution of the academic success are given in Figure 3.

Table 3: Kolmogorov – Smirnov Results According to Normal Distribution of the Academic Success of Experiment Group

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Mean</th>
<th>Standard Deviation (SD)</th>
<th>Test Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>30</td>
<td>62.20</td>
<td>4.95</td>
<td>0.808</td>
<td>0.531</td>
</tr>
<tr>
<td>Control</td>
<td>35</td>
<td>43.89</td>
<td>8.93</td>
<td>0.627</td>
<td>0.826</td>
</tr>
</tbody>
</table>

Figure 3: Academic Successes of Experiment and Control Groups of Second Term

As shown in Figure 3 and Table 3, it can be said that the academic successes of experiment and control groups are comparable. Two simple t-test was used to compare academic success grades between experiment and control groups before intervention in order to provide comparison.
Table 4: the t–test results of Experiment and Control Groups according to Academic Success

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Mean</th>
<th>Standard Deviation (SD)</th>
<th>Test Statistic</th>
<th>p–value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>30</td>
<td>45.40</td>
<td>14.45</td>
<td>−1.48</td>
<td>0.142</td>
</tr>
<tr>
<td>Control</td>
<td>35</td>
<td>41.20</td>
<td>7.78</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4: Academic Success of Experiment and Control Groups in 1st Term

The results indicate that there is no statistically significant difference between the experiment and the control groups in academic success before the intervention (p=0.142).

Results comparing the two groups in Academic Success after the intervention are given in Table 5. and Figure 5 shows the grades by two groups.

Table 5: t–test results of Experiment and Control Groups According to Academic Success After Intervention

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Mean</th>
<th>Standard Deviation (SD)</th>
<th>Test Statistic</th>
<th>p–value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>30</td>
<td>62.20</td>
<td>4.95</td>
<td>−9.98</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Control</td>
<td>35</td>
<td>43.89</td>
<td>8.93</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results showed that academic success was statistically significantly higher in the experiment group (mean=62.20, SD=4.95) than the control group (mean=43.89, SD=8.93) with p–value of < 0.0001. The intervention increased the success of experiment group.

The academic success of experiment group before and after the intervention is given in Figure 6.
Moreover, the average grades of students in the experiment group increased and amplitude narrowed and it indicates, the academic success of students at the end of intervention process. In other words, the students who seem unsuccessful developed more rapidly and got closer to the successful ones.

Kolmogorov-Smirnov test was used to test normality of the distribution of attitudes towards mathematics in the experimental group. Results of the test were presented in the Table 3.

Table 3: Kolmogorov-Smirnov Test: Attitudes towards Mathematics in the Experimental Group

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Kolmogorov – Smirnov Value</th>
<th>p – value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>30</td>
<td>173.70</td>
<td>14.14</td>
<td>0.486</td>
<td>0.972</td>
</tr>
</tbody>
</table>

Pearson correlation was used to determine the relationship between the attitude scores towards mathematics before and after the intervention (Table 4).

Table 4: Pearson Correlation: Attitude Scores Towards Mathematics Before and After the Intervention

<table>
<thead>
<tr>
<th>Attitude Scores Towards Mathematics Before the Intervention</th>
<th>Attitude Scores Towards Mathematics After the Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>r = 0.501</td>
<td>Positive Relationship</td>
</tr>
</tbody>
</table>

Attitude scores towards mathematics of the subject group before and after the intervention are given in Figure 7 and the relationship between these scores was given in Figure 8.
Pearson correlation was used to measure the correlation between attitude scores towards mathematics of students and their academic success (Table 5). Figure 9 displays the relationships between these two scores.

Table 5: Pearson Correlation: Relationship Between Attitude Scores Towards Mathematics and Academic Success

<table>
<thead>
<tr>
<th></th>
<th>Academic Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude Scores Towards Mathematics</td>
<td>r = 0.501</td>
</tr>
</tbody>
</table>
There is no strong relationship between attitude scores towards mathematics and academic successes. As attitude changes over time, these results are not surprising. Since there is no negative effect of intervention on attitudes, results should be regarded.

CONCLUSIONS

The LSM results obtained from the subjects at the end of the intervention, as shown in the previous studies (Silver et., al. 1997; Tullos, 2000; De Bello, 1990), demonstrated changes in LS of some students. It is important that the learning style does not remain same and it may change by appropriate learning program, the method employed, the measuring tool preferred and the selected learning activities. As known, the individual’s non-dominant LS contributes to the formation of his/her dominant LS. Therefore, it cannot be said that student has a single learning style, but it can be said s/he has a dominant learning style. Then, it is necessary that the activities to include all kinds of LS during the learning process be considered. The fact that each student is different from one another can be explained by their learning styles’ difference. While the learning activities are being planned, the regulations in a way that will be suitable for each student’s learning style force the students to make contribution to the event.
During the learning process, knowing the student's learning style provides conveniences to the teacher towards increasing the student's success (Watson, 2003). On the other hand, the fact that the students explain the reasons of their approaches to the events, facts and concepts also contribute. On the contrary, the learning environment's being organized suitable for LS takes the teacher's much more time. In summary, it is clear that when taking LS's direct contribution to learning into consideration, the learning activities carried out in an appropriate way for LS cannot be ignored in the planning of education. Therefore, it is inevitable that the teachers and administrators designing teaching have sufficient knowledge in this field.

The studies carried out show that the LS's being taken into account during the learning process positively contribute to the academic success of the student (Appell, 1991; Ursin, 1995). In our study too, it was observed that there is statistically significant difference in favor of the subject group. That's to say, the learning process performed through the activities suitable for every LS increased the student's academic success. According to another result reached, the fact that students with every kind of LS are pulled into the learning process in the course of learning process may contribute to students' positive attitude towards mathematics, while increasing their academic successes (Dunn & Dunn, 1978; Felder & Silverman; Williams, Turner, 2004; quotation on p.7). In brief, the fact that LS have to be included in the process for increasing the academic success in education is an important and undeniable discovery. A result which is among our findings and which we can consider important is the decrease of amplitude of academic success among the students, in other words, the increase of success substratum. This shows us that the practice can be considered as an important step in trying standardization in education. One of the most important results of the study is that our education system makes less contribution to the dynamic learners. The individuals have difficulty in getting prepared for life. In order to be able to overcome this problem, the arrangements/regulations in which individual differences are driven forward must be performed.

Long-termed trial are required for attitude to change. There are a number of researches as regards the fact that the conducted studies suitable for the learning styles have an effect on attitude development towards the discipline (Ursin, 1995; Wilkerson, 1986; Klenetsky, 1997; Buchanan, 1992). In our study, no statistically meaningful difference was observed. However, wigglings were observed in a positive way. More importantly, no decline in attitude points was encountered in the students. This result, which was obtained in return for a different approach, was positively interpreted. If the trial had been more long-termed, a concrete and positive result would have been reached in the attitude development, as was the case in the academic success, according to the indicators.

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