AN INVESTIGATION ON THE LEARNING STYLES AND THE STUDENTS’ ACCESS TO BLOOM’S COGNITIVE LEVELS IN MATHEMATICS

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ABSTRACT
This study tends to investigate the relationship between learning styles and the student’s access to Bloom’s cognitive levels in Mathematics. The method is descriptive-survey and of correlational type. The statistical population in this study is 180 students of the third grade in high school studying Humanities in Delgan 60 of which were selected through random sampling. The measuring was done by Kolb’s learning styles questionnaire and educational progress test. The data gathered were analyzed using statistical indexes such as average, Pierson’s correlation coefficient and regression. The results showed that there is a significant relationship between the learning styles and the levels of knowledge, understanding, function, analysis, combination and evaluation so that there was seen a direct and significant relationship between the concrete experience learning style and the level of achieving cognitive levels, understanding and function by the students. However, there was found no significant relationship between the concrete experience learning style and analysis levels, combination and evaluation.

Keywords: Teaching Mathematics, Learning Style, Abstract Conceptualization, Active Experimentation, Concrete Experience, Cognitive Levels

INTRODUCTION
Due to the its importance in the process of planning schedules in schools and universities, being admitted in universities, attending advanced Mathematical courses, getting technological and technical jobs, etc., Mathematics has always been of researchers’ interest. In spite of allocating a considerable share in the financial and human resources of The Ministry of Education to the teaching of these courses, every years there is seen a decline in the educational progress. Learning styles are considered a part of learners’ input features. Based on this, when dealing with different learners, teachers need to accept that each of them may be doing their exercises and learning with a learning style of their own. Although one can teach different students the more effective learning approaches and techniques, every learning style is a personal characteristic that may be the most suitable for the learner. Therefore, teachers have to adjust their teaching and communication methods to the students’ learning styles as much as possible (Seif, 2006).

Learning is the important process of adjusting and adapting by the individual and undoubtedly all the outstanding progresses made in the new world are a result of learning. Learning includes the process of receiving and processing information different from person to person. In fact, learning speed and the level of progress made by the learners are not always the same (Demirkan and Demirbas, 2010). Numerous factors effect educational progress one of which is the learning style that can affect the learning process. Learning style is defined as a habitual and distinctive behavior to obtain knowledge, skills and feedback gained through studies or experiences, or as a method that the learners choose over the other ones when learning (Smith and Dalton, 2005).

The studied have shown that the learners’ efficiency is formed by teaching method or learning style or both of them. In fact, the teaching method alone or combined with the learning style can make in some cases a big difference but it cannot measures all the satisfaction, progress and efficiency aspects (Tanwir et al., 2010). It is necessary for the learners and the teachers to understand the learning style. In fact, a reliable tool to measure the learning style can lead a more precise recognition of the learning style based on which one can help the learners improve their learning and strengthen their abilities. As defined, the
learners are the beliefs, preferences and behaviors used by the learners when learning in a specific situation. These styles are formed based on individual differences on one hand, and by the impact of the environment on the other (Homayouni and Kadivar, 2006). Individual learning styles are a direct reflection of different psychological and cognitive factors and they determine the attitude of the individual to respond to the learning stimulus (Christou and Dinov, 2010). Kolb learning style is one kind of the many. Kolb provided the most useful descriptive model of the adults learning process in 1984 inspired by Kurt Lewin’s works referred to as experimental learning style (Atherton, 2005). In this model, learning happens in a four-step cycle: 1. concrete experience 2. observing and thinking about the experience 3. developing a hypothesis or a kind of theory about it 4. testing the hypothesis. Combining the above-mentioned learning styles, Kolb and Fry developed the convergent, divergent, assimilating and accommodating learning styles (Smith and Dalton, 2005). On the other hand, there is a hierarchical relationship between the elements of every learning unit according to the classification of the educational purposes, in that, in the learning process, the elements not going beyond knowledge and information are learnt considerably more easily than the elements related to understanding and perception and the elements most difficult to learn are the ones mixed with function and analysis. In the cognitive domain, the levels of 1) knowledge, 2) understanding and 3) function in the low level, and the levels of 4) analysis, 5) combination and 6) evaluation lead to learning in the high level. Here, the trainer needs to direct the learner to the higher levels step by step (Seif, 2003).

Therefore, the current study aims to investigate the relationship between learning styles and the student’s access to Bloom’s cognitive levels in Mathematics.

MATERIALS AND METHODS

Methodology

In this section, the research method, the sampling method, sample volume estimation, research instruments, reliability and validity of the test and the statistical methods used are discussed.

Research Method

Considering the importance of the subject and purpose of the study, i.e. the relationship between learning styles and the student’s access to Bloom’s cognitive levels in Mathematics, the research method was chosen to be descriptive and correlational.

Population and Sampling

The statistical population in this study is 180 students of the third grade in high school studying Humanities in Delgan 60 of which were selected through random sampling.

Questionnaire

The measuring devices in this research are Kolb’s learning styles questionnaire and the educational progress test. Kolb developed a questionnaire with 12 multiple-choice questions called the learning style inventory and the testes need to answer the questions from 1 to 4 according to their interest, 4 showing they are most interested and 1 showing they are least interested. To obtain the learning style of the testes, the first choices of all the 12 questions were added up and this was done for the other questions too; this way, there were obtained four different marks for four different styles: the first total mark is the concrete experience learning style, the second total mark is reflective observation learning style, the third total mark is the abstract conceptualization learning style, and the fourth total mark is the active experimentation learning style.

Validity and Stability

The inventory has a good content validity and is suitable for the measurement of learning styles. Yazdi (2009) reports the reliability of the questionnaire to be 0.73 under the current circumstances within the country making it acceptable. After being translated, the questionnaire was given to the Rural Development Department experts and an English language teaching expert to determine the level of validity, reliability and credibility (formal reliability). Additionally, to determine the confidence (internal stability) of the questionnaire, Cronbach Alpha Coefficient was used and it was calculated to be 0.72. Also, for the purpose of supporting the stability of the questionnaire in this study, 25 copies were
distributing among the students and after gathering them the Cronbach Alpha Coefficient was calculated 0.84. The stability coefficient of each of the learning styles in the questionnaire is shown in Table 1. Finally, the stability of the questionnaire was confirmed.

Table 1: The stability coefficient of each of the learning styles in the questionnaire

<table>
<thead>
<tr>
<th>Learning Styles</th>
<th>Concrete Experience</th>
<th>Reflective Observation</th>
<th>Abstract Conceptualization</th>
<th>Active Experimentation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stability</td>
<td>0.85</td>
<td>0.78</td>
<td>0.79</td>
<td>0.80</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Data Collection
The educational progress test that has 8 questions and 6 components (knowledge, understanding, function, analysis, combination and evaluation) was gathered in essay form from the contents in the second chapter of Mathematics textbook of the third grade of high school in Humanities based on the different Bloom’s cognitive levels. The stability coefficient of the test was 0.79 using the Cronbach Alpha method. Consequently, the stability of the test was confirmed, too.

RESULTS AND DISCUSSION
Data Analysis
The analysis of the data was, according to the nature of the data and the measurement scale, done in two levels: descriptive statistics (including determining the frequency, adjusting the tables, graphs, percentages, average and standard deviation) and inferential statistics (using Pierson correlation coefficient and regression to recognize the relationship between the variables and their various aspects).

Research Questions Investigation
To do a research plan in a scientific method, the researcher gathers enough information and evidence to be measured and evaluated using proper instruments and summarizes, adjusts and classifies the data using certain methods and represents them in tables and statistical samples. In this chapter, based on the research questions, the obtained information were analyzed step by step using Pierson correlation coefficient and regression.

The first question: Is there a significant relationship between the learning styles and the student’s access to Bloom’s cognitive levels in Mathematics?
To investigate the relationship between the learning styles and the student’s access to Bloom’s cognitive levels, Pierson correlation coefficient test was used and the results are shown in Table 2.

Table 2: Relationship between the learning styles and the student’s access to Bloom’s cognitive levels

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Bloom’s cognitive levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>r</td>
<td>0.41</td>
<td>0.42</td>
<td>0.69</td>
<td>0.43</td>
<td>0.32</td>
<td>0.28</td>
</tr>
<tr>
<td>sig</td>
<td></td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Table 2 indicates a significant relationship between the learning styles and the student’s access to Bloom’s cognitive levels at the level of 99% (r=0.60, p<0.01). Also, there is shown a significant relationship between the learning styles and knowledge (r= 0.41), understanding (r=0.42), function (r=0.69), analysis (r=0.43), combination (r=0.32) and evaluation (r=0.28).

The second question: Is there a significant relationship between the concrete experience learning style and the student’s access to Bloom’s cognitive levels in Mathematics?
For the purpose of answering this question, Pierson correlation coefficient test was used and the results are shown in Table 3.
The results in Table 3 indicate a significant relationship between the concrete experience learning style and the student’s access to Bloom’s cognitive levels at the level of 99% ($r=0.35$, $p<0.01$). There was seen a significant relationship between the concrete experience learning style and knowledge ($r=0.33$) and understanding ($r=0.22$) at the level of 99% ($p<0.01$). Additionally, there was seen a significant relationship between the concrete experience learning style and function ($r=0.17$) at the level of 95% ($p<0.05$). However, there was seen no significant relationship between the concrete experience learning style and analysis, combination and evaluation at the level of 95% ($p<0.05$).

The third question: Is there a significant relationship between the reflective observation learning style and the student’s access to Bloom’s cognitive levels in Mathematics?

To answer this question, Pierson correlation coefficient test was used and the results are shown in Table 4.

The results in Table 4 indicate a significant relationship between reflective observation and the student’s access to Bloom’s cognitive levels at the level of 99% ($r=0.40$, $p<0.01$). There was seen a significant relationship between reflective observation learning style and knowledge ($r=0.38$) and understanding ($r=0.32$) and function ($r=0.28$) at the level of 99% ($p<0.01$). Additionally, there was seen a significant relationship between the reflective observation learning style and analysis ($r=0.17$) at the level of 95% ($p<0.05$). However, there was seen no significant relationship between the reflective observation learning style and combination and evaluation at the level of 95% ($p<0.05$).

The fourth question: Is there a significant relationship between the abstract conceptualization learning style and the student’s access to Bloom’s cognitive levels in Mathematics?

To answer this question, Pierson correlation coefficient test was used and the results are shown in Table 5.

The results in Table 5 indicate a significant relationship between abstract conceptualization and the student’s access to Bloom’s cognitive levels at the level of 99% ($r=0.44$, $p<0.01$). There was seen a significant relationship between abstract conceptualization learning style and knowledge ($r=0.41$) and understanding ($r=0.39$) and function ($r=0.30$) and analysis ($r=0.27$) at the level of 99% ($p<0.01$). Additionally, there was seen a significant relationship between the abstract conceptualization learning style and combination ($r=0.14$) at the level of 95% ($p<0.05$). However, there was seen no significant relationship between the abstract conceptualization learning style and evaluation at the level of 95% ($p<0.05$).
The fifth question: Is there a significant relationship between the active experimentation learning style and the student’s access to Bloom’s cognitive levels in Mathematics?

To answer this question, Pierson correlation coefficient test was used and the results are shown in Table 6.

Table 6: Relationship between the active experimentation learning style and the student’s access to Bloom’s cognitive levels

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Bloom’s cognitive levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active experimentation</td>
<td>r</td>
<td>0.45</td>
<td>0.41</td>
<td>0.37</td>
<td>0.35</td>
<td>0.24</td>
<td>0.21</td>
</tr>
<tr>
<td>sig</td>
<td>0.01</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
</tr>
</tbody>
</table>

The results in Table 6 indicate a significant relationship between active experimentation learning style and the student’s access to Bloom’s cognitive levels at the level of 99% (r=0.51, p<0.01). There was seen a significant relationship between the active experimentation learning style and knowledge (r=0.45) and understanding (r=0.41), function (r=0.37), analysis (r=0.35), combination(r=0.24), and evaluation (r=0.21) at the level of 99% (p<0.01).

The sixth question: Which of the learning styles predicts more of student’s access to Bloom’s cognitive levels in Mathematics?

To answer this question, stepwise regression was used and the results are shown in Table 7.

Table 7: A summary of the regression of the learning styles predicting more of student’s access to Bloom’s cognitive levels in Mathematics

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>R</th>
<th>R2</th>
<th>F</th>
<th>B</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Active experimentation</td>
<td>0.51</td>
<td>0.36</td>
<td>79.45**</td>
<td>0.51</td>
<td>8.91</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>Active experimentation + Abstract conceptualization</td>
<td>0.65</td>
<td>0.43</td>
<td>52.60**</td>
<td>0.41</td>
<td>6.50</td>
<td>0.00</td>
</tr>
</tbody>
</table>

P≤0.05*  P≤0.01**

As Table 7 shows, in the first step, active experimentation has the most prediction of the student’s access to Bloom’s cognitive levels in Mathematics. This variable alone predicts 0.51 of the changes in the student’s access to Bloom’s cognitive levels in Mathematics. This prediction is significant at the level of 99%. This coefficient is significant at the level of 0.01%.

In the second step, abstract conceptualization enters the prediction pattern and the two variables predict 0.43 of changes in the student’s access to Bloom’s cognitive levels in Mathematics. Abstract conceptualization alone has predicted 0.07 of the changes in the student’s access to Bloom’s cognitive levels in Mathematics. This prediction is significant at the level of 99%. This coefficient is significant at the level of 0.01%.

Discussion and Conclusion

The results are provided here based on the order of the research hypotheses:

The first question: Is there a significant relationship between the learning styles and the student’s access to Bloom’s cognitive levels in Mathematics?

The results reveal that there is a significant relationship between the learning styles and the student’s access to Bloom’s cognitive levels. Also, there is a significant relationship between the learning styles and knowledge, understand, analysis, combination and evaluation. One may infer that most teachers would agree that not all the learners learn with the same style or have a similar approach. This may true especially to the adult learners. The adult learners, due to the age and having more experiences, are more varied and have very different views compared to any other group. If the learning situation complies with the preferred learning style of the learner, it is possible that he learn more compared to the time the learning style is ignored. This is consistent with the results developed by Homayouni & Kadivar (2003), Kadivar et al., (2010), Rezayi (1999), Yazdi (2009), Mansouri (2000), Tanwir et al., (2010), Lynch et al.,
Research Article

(1998), and Cronwell and Manferdo (1994) that showed a relationship between the learning styles and educational performance.

The second question: Is there a significant relationship between the concrete experience learning style and the student’s access to Bloom’s cognitive levels in Mathematics?
The results reveal that there is a significant relationship between the concrete experience learning style and the student’s access to Bloom’s cognitive levels. There is a significant relationship between the concrete experience learning styles and knowledge, understand and function but there no significant relationship between the concrete experience learning style and analysis, combination and evaluation. One may that as in this learning style the learner learns from specific experiences, communicates with others and is sensitive to their own feelings and others’, remembering or recognizing pieces of evidence and using abstract subjects in specific and objective situations is effective. This is consistent with the results developed by Homayouni & Kadivar (2003), Kadivar et al., (2010), Rezayi (1999), Yazdi (2009), Mansouri (2000), Tanwir et al., (2010), Lynch et al., (1998), and Cronwell and Manferdo (1994) that showed a relationship between the learning styles and educational performance.

The third question: Is there a significant relationship between the reflective observation learning style and the student’s access to Bloom’s cognitive levels in Mathematics?
The results reveal that there is a significant relationship between the reflective observation learning style and the student’s access to Bloom’s cognitive levels. There is a significant relationship between the reflective observation learning styles and knowledge, understand and function and analysis but there no significant relationship between the reflective observation learning styles and combination and evaluation. One may that individuals with reflective observation learning styles observe precisely before forming any judgments, look at things from different aspects, and look for meanings before doing anything. In addition, they remember or recognize the pieces of evidence into components so that the hierarchy of the ideas and the relationship between the unstated thoughts is clearly observable. This is consistent with the results developed by Homayouni & Kadivar (2003), Kadivar et al., (2010), Rezayi (1999), Yazdi (2009), Mansouri (2000), Tanwir et al., (2010), Lynch et al., (1998), and Cronwell and Manferdo (1994) that showed a relationship between the learning styles and educational performance.

The fourth question: Is there a significant relationship between the abstract conceptualization learning style and the student’s access to Bloom’s cognitive levels in Mathematics?
The results reveal that there is a significant relationship between the abstract conceptualization learning style and the student’s access to Bloom’s cognitive levels. There is a significant relationship between the abstract conceptualization learning style and knowledge, understand, function, analysis and combination but there no significant relationship between the abstract conceptualization learning style and evaluation. One may that as the individual with the abstract conceptualization learning style emphasizes on analyzing the ideas logically, uses systematic planning and acts according to the experts and therefore combining the components together and creating new knowledge and addition to remembering the cases and consequently having a successful educational performance. This is consistent with the results developed by Homayouni & Kadivar (2003), Kadivar et al., (2010), Rezayi (1999), Yazdi (2009), Mansouri (2000), Tanwir et al., (2010), Lynch et al., (1998), and Cronwell and Manferdo (1994) that showed a relationship between the learning styles and educational performance.

The fifth question: Is there a significant relationship between the active experimentation learning style and the student’s access to Bloom’s cognitive levels in Mathematics?
The results reveal that there is a significant relationship between the active experimentation learning style and the student’s access to Bloom’s cognitive levels. There is a significant relationship between the active experimentation learning style and knowledge, understand, function, analysis, combination and evaluation. One may that as in this kind of learning style the student is able to take risks, they can judge the value of the material and subjects for special purposes in addition to remembering them. This is consistent with the results developed by Homayouni & Kadivar (2003), Kadivar et al., (2010), Rezayi (1999), Yazdi (2009), Mansouri (2000), Tanwir et al., (2010), Lynch et al., (1998), and Cronwell and Manferdo (1994) that showed a relationship between the learning styles and educational performance.
The sixth question: Which of the learning styles predicts more of student’s access to Bloom’s cognitive levels in Mathematics?

The results reveal that in the first and second steps, active experimentation and abstract conceptualization have entered the prediction pattern respectively and the two variables are can predict the changes in student’s access to Bloom’s cognitive levels in Mathematics.

General Conclusion

Based on the results obtained, there is a significant relationship between the learning styles and knowledge, understand, function, analysis, combination and evaluation. There is a significant relationship between the concrete experience learning styles and knowledge, understand and function but there is no significant relationship between the concrete experience learning style and analysis, combination and evaluation. There is a significant relationship between the reflective observation learning styles and knowledge, understand and function and analysis but there is no significant relationship between the reflective observation learning styles and combination and evaluation. There is a significant relationship between the abstract conceptualization learning style and knowledge, understand, function, analysis and combination but there is no significant relationship between the abstract conceptualization learning style and evaluation. There is a significant relationship between the active experimentation learning style and knowledge, understand, function, analysis, combination and evaluation. The results reveal that in the first and second steps, active experimentation and abstract conceptualization have entered the prediction pattern respectively and the two variables are can predict the changes in student’s access to Bloom’s cognitive levels in Mathematics.

Consequently, based on the results, one of the factors heavily influential on the learning of the individuals and not related to intelligence is the learning style or cognitive style. In case the educational context and the teaching method is in consistence with the preferred method of the learner desirable results will be obtained.

Managers, directors and teachers can determine the learning style of the learners before going to the classes and make the teaching method compatible. In fact, the teachers should make their teaching methods compatible with the learners’ learning styles. As students have different learning styles and these learning styles have different effects on their learning and educational progress, it seems necessary for the teachers to know the compatible teaching methods to help learners use the learning styles better.

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