Using Learning Style Theory in Remote Laboratory Applications

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ABSTRACT
Studies have shown that, while learning different concepts, people sometimes use different approaches. These different approaches define individual learning styles. Understanding learning style differences is thus an important step in improving the performance of the individuals and educational institutions. In this study, a learning style assessment tool was used to examine the relationship between students’ learning styles and their performance in engineering education programs of Atılım University. 329 students (55 female) participated in this study. At their first year in the program, students’ learning styles are measured by a learning style assessment tool developed by David Kolb. The results show that, at the Atılım University’s engineering education program, most of the students are having assimilator type of learning style (45%). Convergers (27%) and divergers (22%) follow the assimilators. The number of accommodators is very limited (5%). This information can be used to create adaptive teaching environments in distance education courses.

I. INTRODUCTION
While learning different concepts, people sometimes use different approaches. In fact, people usually develop their own preferred learning approaches [1]. These different approaches define individual learning styles. For example, some people like to learn while paying attention to the instructor and taking notes, while others prefer to study by themselves or prefer to work within groups. Some respond strongly to visual forms of information, like pictures, diagrams, and schematics; others get more from verbal forms—written and spoken explanations. Some prefer to learn actively and interactively; others function more introspectively and individually. They also preferentially focus on different types of information, tend to operate on perceived information in different ways, and achieve understanding at different rates [2,3]. Usually, the teaching style of the instructor supports only a group of learners in the class and there exist a mismatch between the teaching style and the learning styles of most of the students. This has several serious consequences [4]. In order to improve the performance of engineering classes, one must understand the learning styles of each individual in the class and provide instruction according to their preferred ways. However, usually this is not possible while teaching a group of people in a class. In that concern, distance education programs come with more alternatives for providing more support on individual expectations and preferences of the learners. In these programs, the program designers should understand their learners’ individual characteristics and preferences and prepare the program by providing alternative ways of instructions to satisfy each group of learners’ expectations.

This study aims to better understand the learning styles of engineering students. Understanding engineering students’ preferred ways of learning can help educators to design their instructional methods to better fit the expectations of the learners. Especially for the distance education programs, this might be a guide for the designers to improve the program’s effectiveness.

II. BACKGROUND
As Larkin and Bundy [5] states that learning style is composed of learner’s affective, cognitive, environmental and physiological responses. Several learning style inventories have been used in the educational field, to better understand the individual learning approaches. One of these inventories, the learning style theory of David Kolb, based on how people perceive and process information, has been successfully used in engineering education.

Learning Styles
In the literature, there are several studies which attempt to discover individual learning styles and their effects on people’s performance in their educational and work experiences [2, 6, 7, 8, 9]. One of these studies was conducted by David Kolb [2]. His model is based on two dimensions; the way individuals perceive information and the way individuals process information. He discovered four different groups of learning styles and accordingly evaluated people’s success in their work experiences. These learning styles are converger, diverger, assimilator, and accommodator. A brief summary of Kolb’s learning styles [2] is offered below.

Converger (CO): People with this learning style are best at finding practical uses for ideas and theories. They have the ability to solve problems and make decisions based on finding solutions to questions or problems. They would rather deal with technical tasks and problems than with social and interpersonal issues. These learning skills are important for effectiveness in specialist and technology careers.

Diverger (DI): People with this learning style are best at viewing concrete situations from many different points of view. Their approach to situations is to observe rather than take action. The enjoy situations that call for generating a wide range of ideas, as in brainstorming sessions. They have broad cultural interests and like to gather information. This imaginative ability and sensitivity to feelings is needed for effectiveness in the arts, entertainment, and service careers.

Assimilator (AS): People with this learning style are best at understanding a wide range of information and putting this into concise, logical forms. They are less focused on people
and more interested in abstract ideas and concepts. They find it more important that a theory have logical soundness than practical value. This learning style is important for effectiveness in information and science careers.

**Accommodator (AC):** People with this learning style have the ability to learn primarily from “hands-on” experiences. They enjoy carrying out plans and involving themselves in new and challenging experiences. Their tendency may be to act on “gut” feelings rather than on logical analysis. In solving problems, they may rely more heavily on people for information than on their on technical analysis. This learning style is important for effectiveness in action-oriented careers such as marketing or sales.

There are several studies which state that students’ performances increase, if the student’s learning style matches with the learning environment. However, almost none of the educators take into account all learning styles when they prepare their lessons. Several researchers have explored learning style theory in their engineering education programs. For example, in the study by Dunn et al. [10], it has found that student performance increased considerably by matching teaching style with the student’s learning style. Felder and Silverman [4] have concluded that, learning styles of most engineering students and teaching styles of most engineering professors are incompatible in several dimensions. They suggest that, teaching style that is both effective for students and comfortable for the professors will potentially dramatic effect on the quality of learning that subsequently occurs [4]. McShannon and Derlin [11] also conclude that, faculty can consider the interactive learning styles of the various student groups when designing engineering programs, which will retain diverse populations. Another study shows that, with a clearer understanding of learning and teaching differences and developing support network within and outside of the university, the task of undergraduate first year engineering education has become a positive experience for all involved [12]. Arslan and Aksu [13] also believe that, awareness of the learning style would provide better engineering educational experiences for students and may help instructors to better understand their students.

According to Terry and Harb [14] engineering fields are dominated by learners having converger or assimilator type of learning styles. They report that, as students learn to traverse the learning cycle by themselves, they can become more efficient-independent thinkers and learners. They agree that, the learning style provides a practical model which engineering faculty may use as a basis for improved instruction of students [14]. Throughout a ten-year study, Sharp [15] have found that, among the 1013 engineering students 40% were convergers, 39% were assimilators, 13% were accommodators and 8% were divergers. Schipper and Krist [16] found that, converger and assimilator learners gravitate towards the technology of computer-based training more readily than do divergers and accommodators.

### III. PROCEDURE

In this study, as a descriptive case study, students’ learning styles were analyzed in two years period at the Atılım University. The authors believe that, this will help the educators to better understand their students’ expectations and preferences while designing their courses and instructional materials.

329 students (55 female) from different engineering programs of the university were voluntarily participated in this study. The participants of this study were from Computer Engineering (CENG), Electrical & Electronics Engineering (EEE), Industrial Engineering (IE), Civil Engineering (CE) and Mechatronics Engineering (MECE) departments of the university. Participants’ distribution among the departments is given in Table 1. Most of the participants are from Computer Engineering Department (37%) and industrial engineering department (28%). Civil engineering (20%) and Electrical & Electronics Engineering (11%) follows them. Only 4% of the participants were from Mechatronics Engineering.

### Table 1. Students’ Profile – Departments

<table>
<thead>
<tr>
<th>Department</th>
<th># of participants</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CENG</td>
<td>149</td>
<td>45</td>
</tr>
<tr>
<td>IE</td>
<td>80</td>
<td>24</td>
</tr>
<tr>
<td>CE</td>
<td>58</td>
<td>18</td>
</tr>
<tr>
<td>EEE</td>
<td>31</td>
<td>9</td>
</tr>
<tr>
<td>MECE</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>329</strong></td>
<td></td>
</tr>
</tbody>
</table>

### IV. RESULTS

First year students from different engineering departments were asked to fill the Kolb’s LSI with 12 questions, each having four answers. Each question was answered on a scale of 0-4 (4-best fit) related to student’s best fit. Table 2 summarizes the participants’ learning styles. As seen from the table, most of the students are assimilators. Divergers and convergers follow assimilators. Only 5% of the students are accommodators.

### Table 2. Students’ Learning Styles

<table>
<thead>
<tr>
<th>Learning Style</th>
<th># of participants</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assimilator (AS)</td>
<td>148</td>
<td>45</td>
</tr>
<tr>
<td>Converger (CO)</td>
<td>90</td>
<td>27</td>
</tr>
<tr>
<td>Diverger (DI)</td>
<td>74</td>
<td>22</td>
</tr>
<tr>
<td>Accommodator (AC)</td>
<td>17</td>
<td>5</td>
</tr>
</tbody>
</table>
V. CONCLUSION

The results of this study supports the results of Terry and Harb’s [14] and Sharp [15] studies which conclude that the engineering students are mostly assimilators and convergers. However, in our study the number of diverger students is also close to the convergers. The accommodators are only 5% of the whole group. Where as Sharp [15] reported 13% accommodators and 8% divergers. We believe that the learners’ learning style information can be helpful to prepare effective course contents in distance education programs which would provide adaptive environments to the individual’s learning styles, increasing teaching effectiveness.

REFERENCES


