Learning styles of medical students change in relation to time

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Submitted 23 May 2011; accepted in final form 11 July 2011

Gurpinar E, Bati H, Tetik C. Learning styles of medical students change in relation to time. Adv Physiol Educ 35: 000–000; doi:10.1152/advan.00047.2011.—The aim of the present study was to investigate if any changes exist in the learning styles of medical students over time and in relation to different curriculum models with these learning styles. This prospective cohort study was conducted in three different medical faculties, which implement problem-based learning (PBL), hybrid, and integrated curriculum models. The study instruments were Kolb’s Learning Style Inventory (LSI) and a questionnaire describing the students’ demographic characteristics. Sample selection was not done, and all first-year students (n = 547) were targeted. This study was designed in two phases. In the first year, the study instruments were delivered to the target group. The next year, the same instruments were delivered again to those who had fully completed the first questionnaire (n = 525). Of these, 455 students had completed the instruments truly and constituted the study group. The majority of the students were assimilators and convergers in both the first and second years. A change in learning style was observed between 2 yr in 46.9% of the students in the integrated curriculum, in 49.3% of the students in the hybrid curriculum, and 56.4% of the students in the PBL curriculum. The least and most changes observed between the learning style groups were in assimilators and divergers, respectively. Curriculum models and other independent variables had no significant effect on the change between learning styles. The learning styles of medical students may change over time. Further followup studies in larger groups are needed to clarify this relation.

medical education; curriculum models

Since the last quarter of the 20th century, crucial changes have been experienced in the field of medical education. A significant cause of these changes is the constant increase in and update of knowledge, which, in turn, has brought out an overwhelming burden of information. In the face of this burden, the need to help students acquire the notion of lifelong learning has arisen. In achieving this purpose, the main aim is to train students who are equipped with the skill of self-learning and are responsible for their own learning. Accordingly, medical schools have begun to use integrated, interactive, and active teaching methods more often than traditional methods (4, 19). These developments have brought out a significant change in the philosophy of learning and education. The emphasis has shifted from teacher-centered or subject-centered teaching to student-based learning. Accordingly, it has become more important to identify the learning psychology and study methods of individuals. This process has also led to the emergence of new concepts such as “learning style.” The term “learning style” was first introduced by Rita Dunn in 1960 to refer to different ways of learning. Dunn (7) defined learning styles as different and unique ways used by individuals as they prepare to learn and recall any information.

Since the 1960s, psychologists have conducted many studies and developed different inventories to identify the learning styles of individuals. As seen in the literature, among these inventories, the one that is most commonly administered to medical school students is Kolb’s Learning Style inventory (LSI) (9, 15, 18). Kolb’s model was developed on the basis of psychology, philosophy, and physiology. According to Kolb, learning styles are shaped by genetic characteristics, past experiences of the individual, and expectations of the social environment. He defined learning style as the individual’s preferred method in perceiving and processing information and classified these styles into four groups: converging, diverging, assimilating, and accommodating. Kolb argued that learning styles of individuals are not constant and may change over time (10–12). There are many descriptive studies determining the learning styles of students (14, 16, 20). However, to our knowledge, there is no study in the literature that investigates if any change exists in the learning styles of medical students and the effect of curriculum models on this change. Determining the effects of curriculum model on learning styles will contribute to medical education. Medical schools may design and arrange their curricula regarding the different learning styles of their students and create different instruction methods for them.

We hypothesized that different curriculum models affect students’ learning styles and may lead to a shift from one learning style to another over time. To test this hypothesis, the following research questions were asked:

1. What is the distribution of medical students according to their learning style?
2. Do any changes occur in learning styles of medical students over time?
3. If there is a change in the learning styles of medical students over time, is there any relation between curriculum models and this change?

METHODS

Setting

The medical school with a hybrid curriculum started to apply this model in 2002. The curriculum in each of the first 2 yr is composed of five thematic blocks structured on the basis of organ system-related themes. The first week of each block is allocated to problem-based learning (PBL) sessions. The remaining 5–7 wk in each block consist of lectures and practicals.

The medical school with an integrated curriculum in this study had restructured its curriculum between 2000 and 2003 and started to apply a vertically and horizontally integrated curriculum in the first 3 yr of medical education in 2003.
How We Teach

The medical school with a full PBL curriculum adopted this model in 1999. There are 13 PBL modules/yr during the first 3 yr. A PBL module includes learning activities such as lectures and laboratory practices in addition to discussion sessions and self-learning periods.

Study Design and Participants

The present prospective cohort study was conducted in three different medical faculties, which implement PBL, hybrid, and integrated curriculum models. The study was designed in two phases (years). In the first year, at the beginning of academic year 2008–2009, study instruments were delivered to first-year medical students. A sample selection was not done for the selection of a follow-up group, and all of the first-year students in the three participant faculties were targeted for the study. The numbers of students enrolled in the PBL, hybrid, and integrated curriculum models were 71, 165, and 311 students (n = 547), respectively. To determine if any change occurred in the study data, the next year, at the end of academic year 2009–2010, the same instruments were delivered again to second-year medical students who met the requirements of the study in the first phase (n = 525 students). A total of 455 students (83.1%) who met whole criteria of the study in both years constituted the study group.

The remaining 107 students were excluded from the study due to reasons such as failing in the first year, leaving the school, or incomplete study instruments.

Ethical Issues

All participants were informed about the study, and their informed consent was obtained. Since the authors were also the teachers and assessors of the participants, to assure anonymity to prevent any possible negative effect on the teacher-student relationship, an “honest broker” in each school gathered all study instruments (forms) and numbered them, hiding the names.

Thus, we analyzed numbered anonymous forms without knowing which form belonged to whom.

Ethical approval was obtained from the Ethics Committee of Akdeniz University.

Instruments

Kolb’s LSI to reveal learning styles and a questionnaire to describe the students’ demographic characteristics [demographic questionnaire (DQ)] were used.

Kolb’s LSI. Kolb’s LSI was developed by Kolb to determine the learning styles of individuals. The inventory was translated into Turkish by Askar and Akkoyunlu (2). The validity and reliability of the inventory were confirmed in a previous study (2) conducted among Turkish people. We found a Cronbach value of 0.89 for the Kolb LSI used in our study.

The LSI includes 12 items completed by 4 different statements representative of 4 elements of the learning process. The inventory scores preferences for the four constructs on two Cartesian axes between −36 and +36 to produce the dimensions of active experimentation-reflective observation and abstract conceptualization-concrete experimentation. Preference scores are plotted on the two axes and fall within the quadrants, with each representing a learning style.

The four basic learning styles can be described as follows:

• Diversers: dominant learning abilities of feeling and watching. They have imagination, understand and are interested in people, recognize problems, and use brainstorming to solve them.

• Assimilators: dominant learning abilities of thinking and watching. They are interested in abstract concepts, use logic to define problems, and then create theoretical models for planning.

• Convergers: dominant learning abilities of thinking and doing. They define problems and use deductive reasoning to solve problems and make decisions. They are relatively unemotional, preferring to deal with practical things rather than people.

• Accommodators: dominant learning abilities of feeling and doing. Their greatest interests are in doing things and being involved in new experiences. They get things done, take risks, and give leadership (9–13).

DQ. The DQ consisted of four questions asking student’s sex, high school, parents’ educational background, and living area to investigate any possible associations between learning styles and demographic characteristics.

Data Analysis

Statistical analyses were performed using SPSS (version 13.0) for the personal computer. A χ²-test was used to investigate whether any differences existed in the basal learning styles of the participants from different curriculum models in the first phase. Multiple regression analysis was used to determine if the curriculum models predicted the change in learning styles. P values of <0.05 were set for statistical significance.

RESULTS

In the first year, 525 participants (95.9%) in the study group fully completed the questionnaire. Of these, 455 participants (83.1% of the total) completed the questionnaire in the second year. The ratio of male to female students was close to each other (56.1% and 43.9%, respectively).

There were no statistically significant differences between demographic characteristics and learning styles of the students from the three participant schools in the initial phase of the study.

As the distribution of the study group according to learning style was investigated, it was found that, followed by convergers, diversers, and accommodators, a large number of the students were assimilators in both the first and second years (Table 1). The distribution of students in the learning style groups did not significantly change over time from the first year to the end of the second year, and curriculum models had no effect on this distribution (Table 2). No changes in learning style were observed in 53.1% of the students enrolled in the integrated curriculum model, 50.7% of the students in the hybrid program, and 43.6% of the students in the PBL program. As the change in learning style was evaluated according to each curriculum model, it was found that the greatest change was found in the group of diversers (Tables 3 and 4). Overall, it was found that the groups that changed the least and most in the second year were the assimilating and diverging groups, respectively. In summary, the most significant shifts among the students who changed their learning styles were observed to be the assimilating and converging learning style groups (Table 4). We also investigated whether the independent variables resulted in a change in the learning styles of the students in the second year and concluded that none of the independent variables had a significant effect on the learning styles (Table 5).

DISCUSSION

A medical course is a long and challenging educational program. Over the course, in addition to professional knowledge, the student must also be adequately furnished with professional skills. Generally, medical students have to attend courses in crowded lecture halls. To increase the learning motivation of these students and the level and quality of education, it would be beneficial to identify the students’
learning styles and to regulate and arrange the educational programs accordingly. Aims of medical schools can be better achieved by allowing students realize their own learning styles and their strong and weak points in learning, instructing them about how to improve their weak points, and raising awareness of the students’ learning styles among tutors and teachers (6, 17).

In recent years, there has been a particular increase in the number of studies aimed at identifying the learning styles of medical students. However, most of these studies are descriptive. The present study, which was aimed at identifying the learning styles of medical students and determining the effect of curriculum models on these students, showed that the great majority of medical students included in the study were assimilators and convergers. The results of this study are consistent with those of the similar studies using Kolb’s LSI (1, 3, 5, 14, 16, 20, 21). Taken together, the rate of assimilators and convergers was ~87% in the first year and 88% in the second year. The fact that the students in our study group predominantly adopted the converging and assimilating learning styles may be explained by the profession preferences of the different learning style groups. As suggested by the literature, convergers generally prefer professional fields such as medicine, economics, and computer sciences, whereas assimilators generally prefer physics, mathematics, biology, education, law, and social sciences. On the other hand, accommodators generally study the fine arts, history, political sciences, foreign languages, psychology, and literature, whereas divergers mostly prefer the educational sciences, communication, public management, or education management (11, 12).

Table 1. Demographic characteristics and learning styles

<table>
<thead>
<tr>
<th>Demographic characteristics</th>
<th>Assimilator</th>
<th>Converger</th>
<th>Diverger</th>
<th>Accomodator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First year, %</td>
<td>Second year, %</td>
<td>First year, %</td>
<td>Second year, %</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>292</td>
<td>54</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>231</td>
<td>54</td>
<td>51</td>
</tr>
<tr>
<td>Father’s educational background</td>
<td>Higher than university</td>
<td>265</td>
<td>53</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>University</td>
<td>272</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td>Mother’s educational background</td>
<td>Higher than university</td>
<td>342</td>
<td>53</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>University</td>
<td>180</td>
<td>55</td>
<td>49</td>
</tr>
<tr>
<td>Living area</td>
<td>Home</td>
<td>306</td>
<td>53</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>Shared accommodation</td>
<td>215</td>
<td>55</td>
<td>53</td>
</tr>
<tr>
<td>Curriculum model</td>
<td>Integrated</td>
<td>295</td>
<td>58</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>Hybrid</td>
<td>143</td>
<td>44</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>PBL</td>
<td>66</td>
<td>58</td>
<td>51</td>
</tr>
</tbody>
</table>

Values were rounded to the nearest whole number; n, number of students. PBL, problem-based learning.

Table 2. First- and second-year students’ learning styles

<table>
<thead>
<tr>
<th>Learning Style in the First Year</th>
<th>Learning Style in the Second Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assimilator, %</td>
<td>Converger, %</td>
</tr>
<tr>
<td>Diverger, %</td>
<td>Accomodator, %</td>
</tr>
<tr>
<td>Integrated curriculum model</td>
<td>64</td>
</tr>
<tr>
<td>Hybrid curriculum model</td>
<td>39</td>
</tr>
<tr>
<td>PBL curriculum model</td>
<td>65</td>
</tr>
<tr>
<td>Accomodator model</td>
<td>19</td>
</tr>
<tr>
<td>Hybrid curriculum model</td>
<td>68</td>
</tr>
<tr>
<td>PBL curriculum model</td>
<td>46</td>
</tr>
<tr>
<td>Accomodator model</td>
<td>55</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
</tr>
</tbody>
</table>

Values were rounded to the nearest whole number.

Table 3. Learning styles during the first and second years

<table>
<thead>
<tr>
<th>Learning Style in the First Year</th>
<th>Learning Style in the Second Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated curriculum model</td>
<td>Assimilator, %</td>
</tr>
<tr>
<td>Assimilator model</td>
<td>64</td>
</tr>
<tr>
<td>Hybrid curriculum model</td>
<td>39</td>
</tr>
<tr>
<td>PBL curriculum model</td>
<td>65</td>
</tr>
<tr>
<td>Accomodator model</td>
<td>19</td>
</tr>
<tr>
<td>Hybrid curriculum model</td>
<td>68</td>
</tr>
<tr>
<td>PBL curriculum model</td>
<td>46</td>
</tr>
<tr>
<td>Accomodator model</td>
<td>55</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
</tr>
</tbody>
</table>

Values were rounded to the nearest whole number.
With regard to the change in learning styles and the effect of different curriculum models on this change, the following results were obtained: the learning styles of 51% of the students in the study group remained the same in the second year, the greatest shift in learning styles took place in the group of students enrolled in the PBL education program, and more than half of the students enrolled in the hybrid and integrated curriculum models did not experience a change in their learning styles. As the change that occurred over time was investigated according to the four learning styles, it was determined that the greatest change took place in the group of divergers, and a great majority of these students shifted to the assimilating (58.6%) and converging (27.6%) learning styles. In contrast, the smallest change was observed among the assimilators and convergers. The rate of the assimilators and convergers who shifted to the diverging learning style was 5.4% and 6.0%, respectively. This finding supports the assumption that medical students mostly prefer assimilating and converging learning styles. It seems that these students had chosen a faculty in accordance with their learning styles and, consequently, did not change their learning style preferences.

The data obtained in the second year of the study suggest that ~93% of the divergers may have changed their learning style because of the weak points of this learning style mentioned by Kolb. Kolb argues that divergers are weak in decision making, scientific thinking, actualization of ideas, data collection (accessing knowledge), deciding what to learn, reaching conclusions through information, and putting the information into practice. The same data also indicate that, among all four learning styles, students shifted to the accommodating learning style the least. It is known that accommodators have weak points that include not being able to execute tasks timely, lacking target orientation, not relying on their own analysis skills, lacking scientific competency, inadequate problem-solving abilities, depending more on feelings than logic, impatience, and inconsistent planning. It is obvious that these weak points may complicate medical education. Additionally, it has been mentioned in the literature that divergers generally prefer art, history, political sciences, foreign languages, psychology, and literature, whereas accommodators generally prefer the educational sciences, communication, and public and educational administration (12, 13). These findings suggest that a smaller number of divergers and accommodators prefer medical education, and those who prefer it tend to change their learning style over time.

Since the findings obtained at the end of the study showed that the great majority of the students were assimilators and convergers, focusing on the educational methods that favor these two educational styles may facilitate learning and consequently increase student success. In this respect, it is important to take the methods that are preferred by these two learning style groups into consideration. As mentioned by Kolb, assimilators...
Clinical models in medical education. As also mentioned by Kolb, convergers learn through experimentation and contemplation and prefer methods including brainstorming, practical applications, and case analysis. In one study (8), which was aimed at determining which educational methods are commonly preferred by medical students and increase their success the most, it was found that assimilators were more content with traditional education, whereas convergers were more content with PBL. Accordingly, the study (8) also showed that assimilators were more successful in the courses based on traditional education and convergers were more successful in the courses based on PBL. According to Kolb, the cooperation of convergers and divergers and assimilators and accommodators compensate for their deficiencies and weak points and, consequently, contribute positively to their learning (13). Since a small number of medical students adopt the accommodating and diverging learning styles, to boost their learning potential, these students can be grouped together during applications such as PBL, which are carried out in small groups. We believe that further studies need to be conducted to show that the satisfaction and success of assimilators and accommodators and divergers and convergers are increased when they are grouped together.

The result of the present study showed that the curriculum models did not have a significant effect on learning styles over a period of 2 yr. However, 2 yr might be not enough to observe such a change. Thus, we plan to continue our study on the same student groups. It was also determined that the independent variables included in the study did not have any significant effects on the students’ learning styles. However, the learning styles of about half of the students changed in the 2 yr. These results, as a whole, indicate that medical education, in general, affects learning styles and incites their change.

The present study has three major limitations. First, 55 PBL students may not be sufficient to compare with other students. This study was carried out in three schools. It is not a general study including all medical schools in Turkey. Second, 2 yr as a study period might not be enough to change learning styles. The study group may change their learning style until graduation. We need to continue following their learning styles. The final limitation is that the present study and others in the relevant literature are unable to deal with errors in categorization into learning styles and thus establish confidence limits for their claimed changes in learning styles.

Conclusions

The present study showed that the different curriculum models at medical schools did not significantly affect students’ learning styles within 2 yr, although the students did change their learning styles in this short term. Studies planned for a longer term are necessary to reveal whether there is an effect of curriculum models in medical education.

ACKNOWLEDGMENTS

The authors are thankful to Dr. M. Kemal Alimoglu for constructive comments on an early draft of this article.

GRANTS

This work was supported by the Akdeniz University Research Fund (Project 2008.01.0103.005).

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

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