The Role That Students’ Learning Styles Play in Complex Problem Solving Over Time while Implementing a Case-Based E-Learning Environment in a Lecture-Oriented Anesthesiology Class

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Abstract

This study explores how students’ learning styles influence students’ learning performance in solving complex problems in an Anesthesiology class over a three-week period as a case-based e-learning environment is implemented in a conventional lecture-oriented classroom in a dental school. Seventy students from an Anesthesiology class participated in this study. Five learning-outcomes tests and two course-satisfaction surveys were implemented during the case-based instruction using a blended approach (online and face-to-face). The results revealed that students’ learning styles seemed to influence their learning outcomes slightly at an earlier time during the case-based learning implementation; however, as time passed, learning styles no longer influenced their learning at all. Thus, learning styles may be considered only in the early stages of instructional implementation in order to facilitate the students’ transition to the new learning environment.
Introduction

When new instructional innovations are introduced to students, the students are implicitly or explicitly requested to adjust themselves to the new ways of teaching and learning by their instructors, who believe that the new innovations may result in better learning outcomes than the previous approaches did. Hung, Bailey, & Jonassen (2003) argue that students experience frustrations and dissatisfaction during the initial transition from a traditional approach (e.g., teacher-centered lecture) to a new approach (e.g., problem-based learning). The uncomfortable experience at an early stage of a new curriculum is an unavoidable experience for learners who face the uncertainty of their roles, their responsibilities, and the evaluation methods in their learning processes (Jost, Havard, & Smith, 1997). Students’ discomfort level, however, decreases as they adjust their learning styles and their roles to the new curriculum (Schultz-Ross & Kline, 1999).

Often we focus more on the learning outcomes after the implementation of innovations to verify the effectiveness of the innovations (e.g., Schultz-Ross & Kline, 1999). However, understanding the dynamics of students’ learning experiences in the process of their adjustment to new instructional innovations over time is very important for the design of effective instructional innovations, as well as for the appropriate implementation of the innovations in order to maximize their learning effectiveness. Thus the focus of this study is on understanding the process of the students’ transition to a new instructional innovation according to their different learning styles.

In this study, a case-based e-learning environment was introduced to a lecture-oriented, contents-heavy anesthesiology class in a dental school over a three-week period using the Internet. This environment was used to create a blended approach, incorporating both face-to-face and online activity. Lecture-oriented, teacher-centered approaches are currently the dominant educational practices in this school. The question we asked is, how do the individual students—who have different learning styles—adjust themselves to be successful in their learning?

Can Individual’s Learning Styles Be Adapted for Different Learning Environments?

Two conflicting perspectives

The possibility of changes in learning styles has been a controversial issue. Some researchers believe that learning style is a trait which is stable over time regardless of contexts and approaches, whereas others regard learning style as a state that can be changed through learning experiences (Cassidy, 2004). For example, Rakoczy and Money (1995) conducted a 3-year longitudinal study using Kolb’s Learning Style Inventory to 176 female nursing students in the first year, 138 in the second year, and 144 in the third year. There were no significant differences in learning styles over time. McParland, Noble, and Livingston (2004) examined the effectiveness of problem-based learning (PBL) compared to a traditional curriculum in psychiatry. Although the PBL approach increased deep learning and examination scores, there was no difference in learning styles between the two learning environments. Loo (1997) examined stability and change in learning styles using Kolb’s revised Learning Style Inventory (LSI-1985). The LSI-1985 was administered to 152 students twice, at the beginning and the end of a semester, separated by about 10 weeks. This study confirmed other studies indicating
stability in learning styles over time. Therefore, the perspective of learning styles as traits suggests that teachers accommodate learning styles instead of trying to change them (Murray-Harvey, 1994).

On the other hand, a number of studies show that students change or adapt their learning styles to their disciplines and subjects (Nulty & Barrett, 1996; Sutcliffe, 1993). For example, Nulty and Barrett (1996) found that there were differences in the learning styles of students among different disciplines of study, meaning that students accommodated their learning styles to the subjects over time. Cohen (1997) investigated changes in learning styles in a technology-rich environment designed based on a constructivist approach to learning. Although she could not conclude that there were changes in learning styles after one year in the technology-rich, constructivist learning environment, her results indicated that learning styles could be influenced by learning environments, such as the use of technology. Busato, Prins, Elshout, and Hamaker (1998) designed a cross-sectional and a longitudinal study, and they examined the development of the learning styles of college students based on the four different learning styles proposed by Vermunt (as cited in Busato et al., 1998): an undirected, a reproduction-directed, an application-directed, and a meaning-directed style. The longitudinal study showed that there were increases in the meaning-directed and the application-directed learning style scores, while the reproduction-directed and undirected learning style scores decreased over a one-year period. However, the cross-sectional study showed no significant differences in learning styles among students in different stages of their college careers.

In the same line, Cassidy (2004) argues that while learning styles have constant structures, they can be changed to some degree, being “responsive to experiences and the demands of the situation (process) to allow change and to enable adaptive behaviour” (p. 421). By administering a questionnaire on learning style preferences to 1,388 students, Reid (1987) found that there were significant differences in learning style preferences between native English speakers and nonnative speakers, and such variables as gender, length of time studying English, level of education, and age were related to the differences in learning styles. However, Reid indicated that nonnative students seem to modify or change their learning styles in order to adapt themselves to the U.S. academic environment.

An alternative perspective

We considered Curry’s (1983) onion model as an alternative explanation to reconcile these two conflicting claims. Curry conceptualized learning style models and instruments into a three-level system known as the layers of an onion. According to Curry, the first and the innermost layer is cognitive personality style, which is a relatively permanent personality dimension involving adapting and assimilating information. This layer is independent of the environment, and thus it is regarded as the most stable level. The second layer of the onion is information processing style, which refers to individuals’ ways of processing information. This layer seems to be stable, but it is also viewed as changeable by instructional methods and the surrounding environment. The third and the outermost layer, instructional preference, refers to individuals’ choices of learning environments. Since this layer is directly exposed to the outside environment and can be influenced by interaction with the environment, it is considered the least stable layer.
compared with the other two inner layers. Curry’s conceptualization of learning styles was validated by Marshall (1987). Marshall conducted a study to examine the validity of Curry’s learning style topology and concluded that, “the topology can be used for classifying learning style models and instruments into a meaningful structure” (p. 427).

Defining learning styles

Therefore, in this study, the term learning styles is used to refer specifically to information processing styles in terms of Curry’s three-layer model of learning styles. Curry believes that learning styles at this level would be more stable than at the outermost level and yet less robust than the core personality style. Thus, the learning styles could be adjustable to the new learning environments. At the same time, the learning styles are stable enough to influence an individual’s learning process. The learning styles from the information processing model generally refers to an individual’s preferred ways of perceiving, processing, and assimilating information (Curry, 1983; Jonassen & Grabowski, 1993; Kolb, 1984; Felder & Soloman, 1991/1994b)

Along with this perspective, Kolb (1985) developed the Learning Style Inventory (LSI) to assess learning style preferences, specifically information processing preferences, which suggests a four-stage cycle model from concrete experience to reflective observation, abstract conceptualization, and active experimentation. Based on Kolb’s model, Felder’s recent model (2002; Felder & Silverman, 1988; Felder & Soloman, 1991/1994b) proposes four dimensions related to how students perceive, process, and organize information (sensing or intuitive, visual or verbal, active or reflective, and sequential or global). Felder’s model has been used and tested for college students. We believe that this model is relevant to the interface design of a case-based e-learning environment (Choi, Lee, & Jung, 2008). Each dimension of Felder’s model is followed (Felder & Spurlin, 2005, p. 103):

- “sensing (concrete thinker, practical, oriented toward facts and procedures) or intuitive (abstract thinker, innovative, oriented toward theories and underlying meanings);
- visual (prefer visual representations of presented material, such as pictures, diagrams and flow charts) or verbal (prefer written and spoken explanations);
- active (learn by trying things out, enjoy working in groups) or reflective (learn by thinking things through, prefer working alone or with a single familiar partner);
- sequential (linear thinking process, learn in small incremental steps) or global (holistic thinking process, learn in large leaps)”

A Case-Based E-Learning Environment Implemented

Case-based instruction is often defined as “a teaching method which requires students to actively participate in real or hypothetical problem situations, reflecting the kinds of experiences naturally encountered in the discipline under study” (Ertmer & Russell, 1995, p. 24). Case-based instruction bridges the gap between theory and practice (Christensen, 1987; Ertmer & Russell, 1995; Flynn & Klein, 2001; Shyu, 2000; Williams, 1992). These instructional methods are suited for teaching the essential skills of analysis, decision making, critical thinking, and problem solving in their professions (Merseth, 1991).
There are a variety of ways to organize learning activities around cases in case-based learning. The different learning events organized around cases may cause different learning experiences. Thus, it is important to explain the learning environment that we used in our study. The current case-based e-learning environment for Anesthesiology has been developed by the authors (Choi et al., 2006). This has been designed based on the following four main instructional decision considerations:

1) learning experiences organized around critical decision-points,
2) three types of knowledge integration,
3) belief failure facilitation and just-in-time learning support, and
4) multiple cases for cognitive flexibility and assessment.

Figure 1 shows the primary interface and the main components of the case-based e-learning lessons. This section provides a brief overview of how learners explore this learning environment.

Once individuals have logged on the site with their ID and their passwords, they can review what they have studied so far and decide where they can start (see K in Figure 1). The learners can click one of the suggested decision point lessons, and then they are directed to the lesson chosen. For example, if they click “Case 1 > DP 9,” then they will see the DP 9 event in Case 1 through the main interface, as shown in Figure 1 (center).

Once learners enter this main page, they can watch one of the representative cases (link A in Figure 1) through the video screen (link B in Figure 1). For example, Figure 1 shows that learners are watching a representative case titled “Case1: Extraction of Wisdom Teeth with Conscious Sedation.” The ninth of the ten segments of decision problems for this case is labeled DP 9 (Decision Point 9) and is titled “Solving Respiratory Depression” (links B & C). At each decision point, the video stops. Then, the learners play the expert’s reasoning video about the decision problem by clicking the Expert’s Reasoning video screen (link H). Learners can watch the expert’s reasoning video for each of the six steps of the decision-making process, which are (1) identifying problem cues, (2) assessing situations, (3) setting goals, (4) generating solutions, (5) executing the solutions, and (6) evaluating the solutions (link G). Then, learners open a reasoning and decision report page by clicking the link (D) and summarize what they have observed according to the guiding format provided in the reasoning and decision report Web form. While watching representative case videos or expert reasoning videos, or while writing reports, learners can access various information resources such as patient records (link F) and textbook-like information through the database (link E). All of learning resources are updated according to the current decision problem.

Once they have finished the current critical decision point, before moving on to the next decision problem, learners choose one to three additional real-life stories (link J), which present actual problems similar to the situation just experienced. For each real-life story, learners write their own reasoning and decision reports. Upon submitting the reports, they review an expert reasoning and decision video along with an additional comparison table where they can easily compare their answer and the expert’s answer.
Next, still under the same decision point theme, learners click on the challenge case (link I). As with the real-life story, the challenge case requires learners to submit their reasoning and decision reports to the instructor, which indicates the end of one decision point under a representative case.

Learners then move to the next decision problem segment. Learners typically finish one decision problem, one to three real-life stories, and one challenge case under each decision point. The particular representative case that we used in this study has ten decision points.

Research Questions

This study explores how students’ learning styles influence students’ learning performance in solving complex problems and students’ satisfaction with the new instructional method in an Anesthesiology class over a three-week period as an innovative case-based e-learning environment is implemented in a conventional lecture-oriented classroom in a dental school.

1. How do the four dimensions of the learning styles of individual students (active-reflective, sensing-intuitive, visual-verbal, and sequential-global learning styles) influence their learning outcomes in solving complex problems differently over time?
2. How do the four dimensions of the learning styles of individual students (active-reflective, sensing-intuitive, visual-verbal, and sequential-global learning styles) influence the degree of their perceived learning experiences differently over time?

Method

Participants

This study was implemented at one of the dental schools located in Seoul, South Korea. Among 72 third-year full-time students enrolled in a course titled “Introduction to Anesthesiology,” 70 students agreed to participate in this study. Among the 70 students, 59 students completed the learning style survey and all five learning-outcome measures, and 45 students completed the two course-satisfactions surveys.

Measurements

Learning styles measure. The Index of Learning Styles© questionnaire (ILS), developed by Felder and Soloman (1991/1994a) was used to measure the students’ learning styles. This instrument consists of 44 items measuring the four different dimensions of a learning style (see also Felder & Silverman, 1988; Felder & Spurlin, 2005). Based on a learner’s different preferences during information reception and processing, the four dimensions of learning styles were identified: sensing or intuitive, visual or verbal, active or reflective, and sequential-global. This instrument is easily accessible through the Internet (http://www.ncsu.edu/felder-public/ILSpage.html) and has been used in other studies (e.g., Baldwin & Sabry, 2003) with acceptable reliability scores. Felder and Spurlin’s meta-analysis on the reliability and validity of the ILS (2005) indicated that most Cronbach alpha values of the ILS in four different studies were greater than 0.5, which is an acceptable criterion value for instruments measuring attitude (Tuckman, 1999). Also, the test-retest reliability coefficients obtained by Seery et al.
(2003, as cited in Felder & Spurlin, 2005) in 4-week interval provided high correlations ranging between 0.725 and 0.870 for the four dimensions. This instrument was translated into Korean by the authors. The internal consistency reliability scores (Cronbach alphas) of the Korean version of the ILS were 0.73 for the sensing-intuitive dimension, 0.76 for the visual-verbal dimension, 0.47 for the active-reflective dimension, and 0.51 for the sequential-global dimension, which exceed the acceptable criterion value of 0.5 suggested by Tuckman (1999).

**Learning outcomes measure.** The authors developed five complex case problems for five different learning modules and also developed rubrics (0-3 scale) based on the problem solving processes (cue identification, situation assessment, set goals, solution decision and reflection). The students’ written responses initially were evaluated by the third author (who is the instructor of this course). About 12 weeks later, 20% of the same students’ written responses were randomly selected and the same person evaluated them again. The consistency (Pearson r) between the two independent reviews by the third author for all five problems ranged between .94 and .99.

**Learning experience survey.** The authors modified a learning experience survey questionnaire that was developed for an earlier study (Choi, Lee, & Jung, 2008). This questionnaire consists of nine questions with a 1-5 Likert scale asking about aspects of the learning experience, such as perceived learning effects, motivation, and opinions on their preference between the given case-based instruction and a traditional lecture. The internal consistency reliability scores (Cronbach alphas) of this survey were .93 for the first survey and .90 for the second survey, respectively. Figure 2 shows a screen capture of the online survey on learning experiences.

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**Context and Procedures**

We implemented our study in a 16-week introductory course (one credit hour) about anesthesiology offered in a dental school. The students met once a week for an hour to take the lecture. This class had been delivered using the traditional teacher-centered, lecture-oriented method. In the fall of 2006, the first half of the semester in this class was delivered in the traditional, lecture-oriented way.

At the beginning of the second half of this course, the case-based e-learning environment, shown in Figure 1, was introduced to the students. During the regular class time, the instructor provided them with an orientation about how to access and navigate the system and the assignments for their case-based learning activities with this new system. Then the Internet address for the online survey was distributed to the students. During that week, the students accessed the online survey site at a convenient time for them and completed their informed consent form for the research and the learning styles survey. The survey site directed them to the case-based e-learning Website.

For the following three weeks, all the students who registered in this class completed nine modules that were assigned to them concerning a surgery case according to a suggested schedule. Table 1 provides the lesson schedule and data collection schedule. Among the nine modules, there were five modules in which the students were required to submit their written responses to a given problem at the end of the module.
After they completed the fifth module, the learning experiences survey appeared automatically and the students were asked to complete the survey before they moved to the sixth module. Likewise, after the ninth module, the same learning experiences survey was implemented through the Internet.

While implementing the case-based e-learning through the Internet, the instructor still had regular face-to-face class meetings. However, the main class activities during the three weeks were to answer questions raised by students about the systems, the assignments and the content delivered through the Internet.

The students’ written responses to the given case problems and their responses to the surveys were saved in the database system. Only the data submitted from those who submitted their informed consent form were used for our further analysis.

Results

The participants’ learning styles profile

The descriptive statistics for the participants’ learning styles are presented in Table 2. In the active-reflective (M = 1.86, SD = 4.73) and the sequential-global (M = -.27, SD = 4.65) dimensions, students’ average scores were between +3 and -3. This indicates that the students seemed to have well-balanced learning styles in these two dimensions. In contrast, the average students seemed to have a moderate preference for the sensing dimension (M = -4.55, SD = 4.30) over the intuitive dimension, and to have a moderate preference for the visual dimension (M = -3.27, SD = 5.31) over the verbal dimension.

Learning outcomes (problem solving) according to learning styles over time

For each learning style dimension, the students were divided into three different groups according to their learning style results. For example, based on the active-reflective learning style result, the students whose scores ranged between -11 and -4 were grouped into the active learner group. Likewise, the students whose scores ranged between +4 and +11 were grouped into the reflective learner group. Finally, the students whose scores were between -3 and +3 were classified as the neutral group. Using the same method, the students were also divided into three groups for the sensing-intuitive, the visual-verbal, and the sequential-global dimensions respectively. The descriptive statistics for the participants’ learning outcomes (Anesthesiology problem solving performance) organized by the three groups for four different learning style dimensions are presented in Table 3.
In order to test how the students’ learning styles influenced their learning outcomes during the case-based e-learning implementation over time, a two-way ANOVA with repeated measures (3 groups x 5 times) for each dimension of the learning styles was conducted. The learning outcomes were the students’ problem solving performance observed during the case-based learning. The Group x Time interaction effect was tested using the multivariate criterion of Wilks’s lambda ($\Lambda$) and multivariate eta-squared ($\eta^2$) effect size. In order to increase the statistical power of this study in which we had five repeated observations, we evaluated this ANOVA result at the $\alpha$ level of .25 ($\alpha = .05 \times 5$).

**Active-Reflective style.** The results revealed that the Active-Reflective dimension showed the Group X Time interaction effect at a marginal level, $\Lambda = .78$, $F(8, 106) = 1.72, p = .10, \eta^2 = .12$. To compare the difference among the three groups (active, neutral, & reflective style), a one-way ANOVA was conducted for each observation as a follow-up test. To control an inflated Type I error rate by using the Bonferroni method (Keppel & Wickens, 2004), each one-way ANOVA was evaluated at the $\alpha$ level of .05 ($\alpha = .25 / 5$). The results revealed that there was a significant difference among the groups at the first observation, $F(2, 61) = 3.62, p = .033$, and the second observations, $F(2, 56) = 4.65, p = .014$. For the post-hoc pairwise comparisons, the Tukey HSD was used because the assumption of equal variances among the group was met. The results indicated that the reflective group outperformed the active group at the first observation while the neutral group outperformed the active group in the second observation. However, there were no significant differences among the groups (reflective, neutral, and active) in the third, fourth, and fifth observations. The graph A in Figure 3 depicts this pattern of each group’s problem solving performance over the five observations. This graph indicates that there are differences in problem solving performances among the groups at the first two observations during the case-based e-learning implementation but, as time passed, the differences among the group disappeared.

**Other learning styles.** For the other learning styles, the same method was employed. However, the other learning styles didn’t show any influence on the students’ problem solving performance over time (Group X Time interaction effects): Sensing-Intuitive dimension [$A = .91, F(8, 106) = .68, p = .71, \eta^2 = .05$], Visual-Verbal style [$A = .92, F(8, 106) = .52, p = .82, \eta^2 = .04$], and Sequential-Global style [$A = .86, F(8, 106) = 1.01, p = .43, \eta^2 = .07$]. Figure 3 captures the patterns of students’ problem solving performances according to their learning styles over time. All groups’ performances were very similar. Thus, sensing-intuitive, visual-verbal, and sequential-global styles did not influence their learning and performance while the new case-based e-learning was implemented.

**Learning satisfaction according to learning styles over time**

In order to test how the students’ learning styles influenced their perceived learning experience during the case-based e-learning over time, a two-way ANOVA with repeated measures (3 groups x 2 times) for each dimension of the learning styles was conducted. The Group x Time interaction effect was tested using the multivariate...
criterion of Wilks’s lambda (Λ) and multivariate eta-squared (η²) effect size. In order to increase the statistical power of this study in which we had two repeated observations, we evaluated this ANOVA result at the α level of .10 (α = .05 X 2).

The results revealed that there were no significant differences among the groups in each of the dimensions. Thus, a further analysis was not conducted. The results indicated that the students’ learning styles did not influence their perceived experience with the case-based e-learning over time.

Discussion

The current results indicated that at the beginning of the implementation of the case-based e-learning, reflective students seems to outperform active students. However, the influence of the students’ learning style on their learning became weaker as time passed. This means that the students adjust themselves to the new learning environments in a relatively short period of time. In our case, the students adjusted their learning at the beginning of the second week of the implementation. Assuming that the students might spend about one or two hours for each module, we suspect that the students adjusted themselves to the new learning environment in between four and eight hours. However, the other learning styles did not influence their learning at all.

Interestingly, all of the learning styles did not influence the students’ perceived learning experience with the case-based e-learning in the current study. This result could be interpreted with our earlier study (Choi, Lee, & Jung, 2008), in which we found that sensing-intuitive, sequential-global, and active-reflective learning styles influence students’ perceived learning experiences during the one hour implementation. In the current study, our first learning experiences survey was administered in the module 5, which is one week after the initial implementation. Thus, students might already spend about five to ten hours with the new case-based e-learning environment. Therefore, by combining these two studies, it is possible to conclude that learning styles influence students’ perceived satisfaction with the new learning environment at the early stage (the first few hours); however, the influence becomes weaker as time passed (within five to ten hours).

One of the immediate and pragmatic goals we tried to achieve with this study was to understand how to revise our current design of the case-based e-learning environment in ways that would embrace diverse learners and that would maximize their learning. The target audience was medical and dental school students. The current study could be generalized to medical and dental school students. However, it is important to note that most dental schools in Korea accept students whose high school SAT scores in the nationwide test are in the top 10%. Thus, the current participants were successful and skillful learners who were able to adjust themselves more effectively to be successful in the new learning environment. Thus, this result has a limitation that may not be able to be generalized as well to lower SAT groups.

As mentioned earlier, the issue of the flexibility of the learning styles and its interactions with learning performance has been controversial. For example, Sadler-Smith and Riding (1999) argued that cognitive styles are related to students’ instructional preferences and may influence learning performance. However, Loo (2004) argues that learning styles do not affect learning preferences strongly and thus recommends that,
instead of trying to match learning methods to individual learning styles, teachers should encourage students to adapt to different learning methods. Although learning styles are considered relatively stable and consistent over time, some changes are also expected as “the result of the temporal interplay between personal and contextual influences” (Vermunt, 1996).

While focusing on the second layer of the learning styles (the information processing model) in Curry’s model (1983), the current study tested the interactions between learning style and learning performance and satisfaction. The current study suggests that learning styles interact with students’ learning experience and learning outcomes only at the early stage of implementing a new instructional innovation, such as case-based e-learning, in the traditional classroom. Therefore, it is important to consider learning style factors during the early stage of a new instructional implementation in order to facilitate the students’ transition to new learning environments and to maximize their learning from the new approaches. Considering the fact that the students adjusted themselves within a few hours, aligning with Loo’s (2004) suggestion, it is a more efficient approach to find ways that encourage students to adapt to different learning environments than to design adaptive systems to embrace different learners.

References


Table 1.  
*Observation Schedule*

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Table 2.
Participants’ Learning Styles Profiles
(N=66)

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<td>Active(-) – Reflective(+)</td>
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<td>1.86</td>
<td>4.73</td>
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<td>11</td>
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<td>-4.55</td>
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<td>11</td>
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<td>11</td>
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<td>4.65</td>
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Table 3.
*Problem Solving Performances Over Time by Learning Styles*

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<td>Active</td>
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<td>28</td>
<td>1.87 (0.43)</td>
<td>1.71 (0.40)</td>
<td>2.01 (0.39)</td>
<td>2.12 (0.42)</td>
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<td>Reflective</td>
<td>20</td>
<td>1.95 (0.43)</td>
<td>1.45 (0.30)</td>
<td>2.11 (0.47)</td>
<td>2.03 (0.51)</td>
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<td>59</td>
<td>1.84 (0.45)</td>
<td>1.58 (0.37)</td>
<td>2.05 (0.42)</td>
<td>2.07 (0.50)</td>
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<td>1.88 (0.44)</td>
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</table>
Figure 1. The Interface of the Case-Based E-Learning for Anesthesiology.
Directions:
Please indicate how strongly you agree or disagree with each of the statements listed below. Please choose the answer that best corresponds to the strength of your belief.
When you are finished selecting answers to each question, please select the submit button at the end of the form.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
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<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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</tbody>
</table>

1. This program is effective in attaining the overall instructional objectives of the Anesthesiology class.
2. This program increases students' interest in Anesthesiology.
3. This program increases students' knowledge of Anesthesiology.
4. This program improves students' clinical problem-solving skills of Anesthesiology.
5. This program improves students' general motivation to learn.
6. This program improves students' general clinical problem-solving skills.
7. This program provides meaningful learning experiences.
8. This program is more effective than traditional lecture-style instruction in studying Anesthesiology.
9. This kind of program (or these methods) should be applied to other courses in Dental School.

Submit Survey

Figure 2. An online survey on learning experiences.
Figure 3. Problem solving performances over time according different learning styles.