THE EFFECT OF LEARNING STYLES ON ACHIEVEMENT IN DIFFERENT LEARNING ENVIRONMENTS

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ABSTRACT
Every learning environment may attempt to raise successful students, but will not achieve the desired results if several essential elements are not considered in the instructional design process. These elements can be classified interior and exterior conditions. Learner characteristics, items of the interior conditions such as learning style, age, maturity level, interest are essential in designing learning environments process. The purpose of this study is to investigate the effect of learning styles on students' achievement in different learning environments which were designed according to principles of Generative Theory of Multimedia Learning. Research was conducted in the framework of single group repeated measures experimental design model and three different learning environments (text based, narration based and computer mediated (narration + music + text + static picture) were planned and study group studied in these environments at different times. The two instruments were used to collect data for this study. The pre-posttest designed to identify students' achievement score and Kolb's Learning Style Inventory to measure students' learning style. As a result, it has been clarified that the type of the learning style was not significantly effective on students' achievement in different learning environments.

Keywords: Learning style; Learning environment; Generative theory of multimedia learning

INTRODUCTION

The level of learning achieved by a learner is one of the most important factors which indicate the success of a learning environment. In order to ensure the effectiveness of teaching environments, it is important to take account of characteristics, abilities and experience of learners as individuals or as a group when beginning to plan a learning environment (Kemp, Morrison, Ross, 1998).

It is important for the effectiveness of teaching environments to take account of group or individual learners' characteristics, competence and experiences (pre-learning) throughout the process of planning learning environments (Kemp, Morrison, Ross, 1998). Though all human beings have common bio-psychological and social characteristics in learning process, individual preferences concerning the ways of giving meaning and acquiring information may vary. Even identical twins who share the same environment may give meaning in different ways the phenomena and events which have common characteristics. All information which becomes the subjective life of an individual after giving meaning process may have individual-specific differences in ensuring permanence of learning and remembering. One of these individual-specific differences is the learning style which is the topic of this study.

In literature there exist numerous learning styles and learning style models. The differences among definitions and models result from the fact that learning is achieved at different dimensions and that theorists define learning styles by focusing on different aspects. Shuell (1986) explains that "different ways used by individuals to process and organize information or to respond to environmental stimuli refer to their learning styles". Jensen (1998) defines learning style as a sort of way of thinking, comprehending and processing information. To Kolb (1984), learning style is a method of personal choice to perceive and process information. In this sense, learning style is, on one hand, sensory and, on the other hand, mental.

In the context of this study, Kolb's Learning Style Model is used since it identifies with "Generative Theory of Multimedia Learning" which forms the basis of the study.

Kolb states that Experiential Learning Theory, which defends that learning is a combination of experience, cognition, perception and behavior, lays the foundation of Learning Style Model (Kolb, 1984).

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A twelve-item inventory of learning styles is administered to identify the learning styles in Kolb's model. The scores obtained from these inventories indicate the coordinates related with organization (Active Experimentation – Reflective Observation) and perception (Abstract Conceptualization – Concrete Experience); and the interaction of these two points indicate the learning style. The learning styles on this system of coordinates are Accommodator, Diverger, Assimilator and Converger.

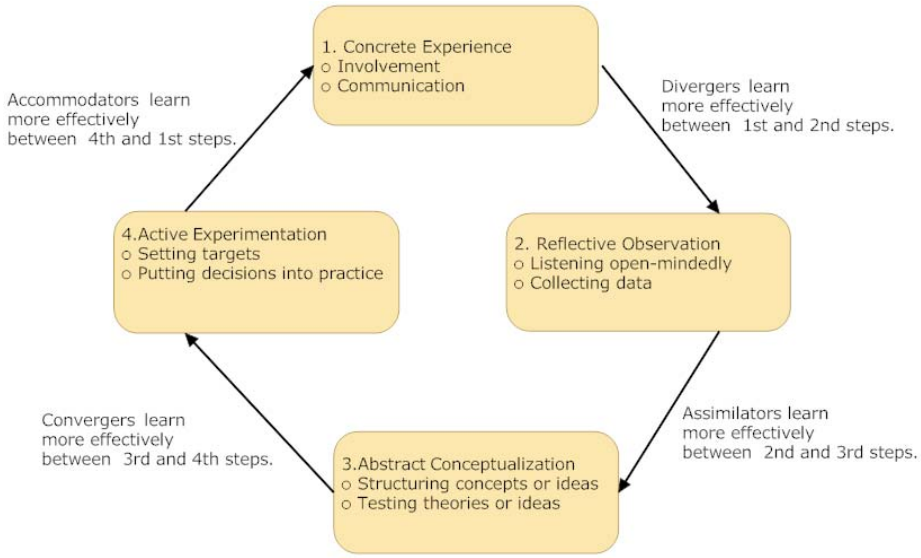

Figure 1. Learning styles in Kolb's learning cycle (Kolb, 1984)

Though learning styles are not stable and unchangeable elements, it takes some time for them to change. That is why, it seems as an easier and more effective way to select and organize methods and strategies, classroom environment and teaching materials according to learning styles rather than expecting the students to adapt to the existent organization. The literature is rich in studies focusing on learning environments which are designed with respect to the characteristics of the learner (Clariana, 1997; Stroot et al., 1998; Pimentel, 1999; Rourke and Lysynchuk, 2000). For the purpose of this study, three different environments are designed on the basis of Generative Theory of Multimedia Learning.

Generative Theory of Multimedia Learning developed by Mayer will be summarized before providing information about the research problem and the research process. In his Generative Theory of Multimedia Learning, Mayer defines multimedia as the presentation of a material by supporting it with a picture or a text or, in other words, in more than one form. In this context, a PowerPoint presentation, a film on television and a voiced animation prepared on computer are examples of multimedia.

According to this theory, multimedia, as a noun, refer to the technology by which a material is presented visually and verbally. The term, as an adjective, is a word which qualifies the messages and presentations related with learning. In this context, multimedia learning refers to learning through words and pictures; multimedia message/presentation refers to a presentation which includes words and pictures; and multimedia instructional message/presentation refers to a presentation which includes words and pictures with a view to ensure learning (Mayer, 2001).

Mayer makes use of three cognitive theories when structuring his theory: Dual Coding, Limited Capacity, Active Processing

Table 1. The cognitive theories underlying the Generative Theory of Multimedia Learning (Mayer,2001)

Name of the Theory	Definition	Developers of the Theory
Dual Coding Theory	Human beings use two different channels to process visual and auditory information.	Paivio, 1986; Baddeley, 1992
Limited Capacity Theory	Human beings are able to process limited information in each channel simultaneously.	Baddeley, 1992; Chandler & Sweller, 1991
Active Processing Theory	Human beings are active learners who perceive external information, and select relevant data and organize them into meaningful information, and then integrate this information with their prior knowledge.	Wittrock,1989; Mayer, 1999

Mayer (2001), whose theory on the design of effective multimedia learning environments is based on Dual Coding, Limited Capacity and Active Processing theories, define individuals who enter into a process of learning as active learners who use two channels to process visual and auditory information, process limited information in each channel simultaneously, perceive external information, and select relevant data and organize them into meaningful information, and integrate this information with their prior knowledge. Mayer distinguishes between auditory/verbal and visual/pictorial channels used by learners to process information. Mayer (2001) mentions that, in a presentation, verbal or nonverbal auditory elements (e.g. narration (uttered words), background music, etc.) are processed in the auditory/verbal channel and verbal or nonverbal visual elements (e.g. animation, written text, etc.) are processed in the visual/pictorial channel; and that these channels process limited amount of data in one go.

Kolb introduces the abovementioned learning styles, asserting that individuals differentiate in organizing and perceiving information. Accordingly, accommodators make use of Concrete Experience in perceiving and Active Experimentation in organizing. They learn by doing and feeling (Aşkar and Akkoyunlu, 1993; Ergür, 1998). They like new experiences and planned working. They prefer acting on the basis of their feelings rather than mental analyses and acquiring information through dialogues with people rather than technical analyses. The most outstanding strengths of the people having this learning style are practicality, leadership and courage to take risks (Kolb, 1993).

Divergers make use of Concrete Experience in perceiving and Reflective Observation in organizing. Individuals having this learning style are able to see concrete situations from different perspectives. Their approach to events is limited to observing rather than taking action. They enjoy producing various ideas on an ample scope through methods such as brainstorming. They have vast cultural knowledge and like collecting information. Among the remarkable strengths of divergers are creativity, understanding others, being aware of problems and developing a large perspective about an event by brainstorming (Kolb, 1993).

Assimilators make use of Abstract Conceptualization in perceiving and Reflective Observation in organizing. Individuals having this learning style are able to comprehend and transform comprehensive information in a large interval into a meaningful whole. They prefer dealing with abstract concepts and topics rather than tackling people. They generally attach more importance to logical validity of theories than their practical value. They are good at planning, creating models, defining problems and developing theories. It will be useful to develop their skills through exercises on organizing information, creating conceptual models, testing theories and ideas, designing experiments and carrying out quantitative data analysis (Kolb, 1993).

Covergers make use of Abstract Conceptualization in perceiving and Active Experimentation in organizing. They are quite good at taking practical advantage of ideas and theories. They prefer dealing with technical works or problems to social relations. Among their strengths are skills of problem-solving, decision-making, deductive reasoning and problem-detecting (Kolb, 1993).

This study discusses the effect of learning styles on the success of individuals in various learning environments, within the framework of Mayer's information processing and Kolb's perception and organization ideas.

In this study the effect of learning environments on achievement in different learning environments are examined; and the responses to following questions are sought for in this context:

- What is the effect of learning styles on success in a text-based learning environment?
- What is the effect of learning styles on success in a narration-based learning environment?
- What is the effect of learning styles on success in a computer-mediated (narration + music + text + static picture) learning environment?

METHOD

The method of the study is pre-post test experimental method. In this study, achievement is the dependent variable whereas different learning environments and learning styles are independent variables.

Participants

The research group of the study is composed of 39 from the Department of Computer Education and Instructional Technology, Faculty of Education, Hacettepe University.

Instruments

In this study pre-posttests including 30 items concerning the behaviors to be gained in three different learning environments and Kolb's Learning Style Inventory are used to collect data.

Pre and Post-Tests

A pre and post test was designed consists of 30 multiple choices questions to define effectiveness of the learning environments. The alpha reliability coefficient of the test was found as .54, validity of the test was found as .53.

Kolb's Learning Style Inventory

David A. Kolb's Learning Style Inventory consists of 12 questions about the ways in which one learns best. Each question has four answers, which are ranked by an individual in terms of best fit on a scale of 1 – 4 (being best). Responses are organized into two bipolar concepts: Concrete Experience vs. Reflective Observation and Abstract Conceptualization vs. Active Experimentation. The numbers are summed to give scores for CE, AC, RO and AE. Then (AE – RO) and (AC – CE) are calculated and used abscissa and ordinate, respectively, on a graph that determines one's ultimate learning styles.

Kolb's Learning Style Inventory (LSI, 1976), revised in 1985, purports to categorize individuals on the basis of their self-reported preferred learning style. LSI adapted into Turkish by Aşkar and Akkoyunlu (1993) and its validation and the alpha reliability coefficient of the scale were calculated.

Procedure

Three different learning environments are designed within the scope of this study. The characteristics of learning styles and the details concerning the data collection process are as follows:

Text-based learning environment: Mayer's (2001) principles of multimedia instructional design are taken into consideration to prepare the text to be used in this environment. The text including directions and questions was distributed among students; and the students were asked to progress at their own pace.
Narration-based learning environment: The topic used in this environment was prepared and narrated by the course instructor, Ms. Akkoyunlu.

Computer-mediated (narration + music + text + static picture) learning environment: The topic used in this environment was devised by the researcher through an authoring tool in PC environment in view of Mayer's principles of multimedia instructional design.

Analysis of the Data

The data collected in this study were analyzed through repeated measures of one way ANOVA test.

FINDINGS

The findings of the study are presented in the order of aforementioned research questions:

What is the effect of learning styles on success in a text-based learning environment?

Table 2. Pretest-posttest achievement score means and ANOVA results of learners who have different learning styles in a text-based learning environment

	Pretest			Posttest		
	N	$\bar{x}$	**sd**	**N**	$\bar{x}$	**sd**
Assimilator	19	4.16	1.8	19	5.47	1.7
Converger	20	4.25	1.5	20	5.55	1.5
Source of the Variance Within Subjects	**Sum Squares**	**(df) Sd**	**Mean Squares**		**F**	**p**
Achievement score (pre-posttest)	33,34	1	33,34		22,78	.00
*Learning style * Achievement score*	,001	1	.001		,001	.98
Error	54,15	37	1,46			

Table 2 shows the pretest-posttest achievement scores of assimilator and converger learners in a text-based learning environment. As seen in Table 2, it is identified that, of 39 students in the research group who filled in Kolb's Learning Style Inventory, 19 students have an assimilator learning style and 20 students have a converger learning style.

The pretest and posttest score means of students having assimilator and converger learning styles differentiate in favor of posttest. As seen in Table 2, the achievement of learners who have different learning styles in text-based learning environment does not show a statistically significant change (p = .98). The absence of a significant difference among the scores of students having different learning styles though the achievement increases may be due to the fact that students having assimilator and convergent learning styles have common ability to organize and use the information they acquire from the text.

Rasmussen and Davidson-Shivers (1998) state that converger and assimilator individuals are successful in similar learning environments. Bostrom, Olfman and Sein (1990) found out in their study that assimilator and converger students were more successful in comprehension test compared to students having the other learning styles. Wu, Dale and Bethel (1998) point out that converger and assimilator students have comparable success. Furthermore, students' opportunity in text-based learning environment to study at their own pace, make use of their own studying strategies (highlighting, note-taking, etc.), re-read the points they have missed and be involved in the process actively with the help of questions and directions about the text may also contribute to this result.

What is the effect of learning styles on success in a narration-based learning environment?
Table 3 shows the pretest-posttest achievement scores of assimilator and converger learners in a narration-based learning environment.

Table 3. Pretest-posttest achievement score means and ANOVA results of learners who have different learning styles in a narration-based learning environment

	Pretest			Posttest		
	N	$\bar{x}$	**sd**	**N**	$\bar{x}$	**sd**
Assimilator	19	4.42	1.35	19	5.42	1.57
Converger	20	4.15	1.09	20	5.45	1.23
Source of the Variance Within Subjects	**Sum Squares**		**(df) sd**	**Mean Squares**	**F**	**p**
Achievement score (pre-posttest)	25.77		1	25.77	23.78	.00

*Learning style * Achievement score*	.44	1	.44	.41	.53
Error	40.1	37	1.08		

As seen in Table 3, the pretest and posttest score means of students having assimilator and converger learning styles differentiate in favor of posttest. The achievement of learners who have different learning styles in narration-based learning environment does not show a statistically significant change (p = .53). The absence of a significant difference among the scores of students having different learning styles though the achievement increases may be due to the fact that students having assimilator and convergent learning styles have the opportunity in narration-based learning environment to make use of their own studying strategies (note-taking, etc.) and ask the points they have not understood and due to the style of communication between the course instructor and students through the methods and techniques used in the course. Currie (1995) indicates that assimilator and converger students are more successful in classroom environments where narration and discussion methods are used. Furthermore, Sein and Robey (1991) observed that assimilator and converger students had comparable successes in comparable learning environments.

What is the effect of learning styles on success in a computer-mediated (narration + music + text + static picture) learning environment?
Table 4 shows the pretest-posttest achievement scores of assimilator and converger learners in a computer-mediated (narration + music + text + static picture) learning environment.

Table 4. Pretest-posttest achievement score means and ANOVA results of learners who have different learning styles in a computer-mediated (narration + music + text + static picture)

	Pretest			**Posttest**		
	N	$\bar{x}$	**sd**	**N**	$\bar{x}$	**sd**
Assimilator	19	3.84	1.26	19	5.26	1.28
Converger	20	4.10	1.77	20	5.90	1.48
Source of the Variance Within Subjects	**Sum Squares**		**(df) sd**	**Mean Squares**	**F**	**p**
Achievement score (pre-posttest)	50.55		1	50.55	24.64	.00
*Learning style * Achievement score*	.70		1	.70	.34	.56
Error	75.91		37	2.05		

As seen in Table 4, the mean pretest and posttest scores of students having assimilator and converger learning styles differentiate in favor of posttest. The achievement of learners who have different learning styles learners in a computer-mediated (narration + music + text + static picture) does not show a statistically significant change (p = .56).

There are similar findings in the literature. Melara (1996) designed two computerized learning environments and found out that success of students did not vary according to learning styles. Dalkir (1998) also states that learning acquired in computer-assisted learning environments do not vary according to learning styles.

McWilliams (2001) observed student performances in computer-assisted learning environments and did not find a significant difference in terms of learning styles. In a similar study, Corman (1986) did not find a significant difference between learning styles and performance.

The lack of a significant difference among the scores of students having different learning styles learners in a computer-mediated (narration + music + text + static picture) may be explained due to the fact that students progress at their own pace and make use of their own studying strategies. Furthermore, students having both learning styles prefer individual study because they have concrete conceptualization and learn through thinking and logical thought analysis, which may have resulted in a differentiation of achievement in this environment.

DISCUSSION AND CONCLUSIONS

Consequently, it seems that learning styles do not have effects on the achievement of students in different learning environments.

Studies on various learning environments in the literature also support this finding. Rouke and Lysynchuk (2000) studied the effect of learning styles on success in web-based learning environments. Students whose learning styles were determined by Kolb Learning Styles Inventory were divided into two groups and took place in two different learning environments. The first group studied in a web-based learning environment, and the other group studied in a learning environment composed of printed materials. Then, both groups took an exam. The exam results showed that diverger students received high scores in both learning environments and assimilator students received low scores in both environments. These results indicate that web-based learning environments affect the success of learners having different learning styles.

Daniel, Price and Merrifield (2002) studied the effect of learning styles and learning environments on the distance education of students in the department of physiotherapy. They made use of synchronous (interactive TV) and asynchronous (computer-assisted teaching) learning environments as well as Kolb's Learning Styles Inventory. The data show that neither of these variables affected the success of students.

Werner (2003) studies the effect of self-awareness about learning styles on the selection of learning strategies and the development of comprehension process. Kolb Learning Styles Inventory was used to identify the learning styles of forty-one adult learners who were observed for six months. The subjects tackled strategies and techniques on the basis of time, keeping in the memory, reading, note-taking and decision-making. The data concerning the learning preferences of subjects were collected through the compositions they wrote. The findings of the study show that the learning types (strategies) preferred according to the learning styles of the subjects were not the appropriate strategies.

This finding demonstrates that audiovisual materials used in well-designed learning environments do not affect the achievement of students who have different learning styles. This result shows that the time and place of using a certain type of media is more important than the type of media used for the design of learning environments.

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