

# Individual Differences in Learning with Hypermedia: Effects of Students' Cognitive Styles, Computer Competency Levels, and Prior Knowledge Levels on Learning Strategies

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**Özet:** *Hipermedya İle Öğrenmede Kişisel Farklılıklar: Bilişsel Stillerin, Bilgisayar Kullanım Yeterliği ve Ön Alan Bilgisi Düzeylerinin Öğrenme Stratejileri Üzerine Etkisi* - Bu çalışma, öğrencilerin, bilişsel stilleri, bilgisayar kullanımı yeterlik düzeyleri ve ön alan bilgilerinin eğitim amaçlı bir hipermedya programındaki öğrenme stratejileri üzerindeki etkilerini incelemektedir. Bu amaçla, Web destekli bir öğrenme ortamındaki 111 öğrenciden 16'sı bilişsel stilleri, bilgisayar kullanımı yeterlik düzeyleri ve ön alan bilgileri baz alınarak seçilmiştir. Öğrencilerin öğrenme stratejilerini ortaya çıkarmak amacıyla yüzyüze görüşme ve gözlem metodları kullanılmıştır. Bulgular, bilişsel stillerin çalışma yönetimi açısından önemli olabileceğini ve bilgisayar kullanımı yeterlik düzeyi ve ön alan bilgisi faktörlerinin de hipermedya programı kullanma örüntülerini etkileyebileceğini göstermiştir.

*Anahtar kelimeler:* bireysel farklılıklar, bilişsel stiller, hipermedya ile öğrenme.

*Abstract:* *This study examines the effects of cognitive styles, computer competency levels, and prior domain knowledge levels on students' learning strategies in an instructional hypermedia program. Sixteen students were selected out of 111 students from a Web-enhanced course, based on their cognitive style, computer competency, and prior domain knowledge test scores. In order to reveal students' learning strategies, interviews and observations were conducted. Results indicated that cognitive styles may be important in terms of study management strategies of the students, and computer competency and prior knowledge levels may affect the patterns of using the hypermedia program.*

*Keywords:* *individual differences, cognitive styles, learning with hypermedia.*

## Introduction

Today, hypermedia is an integral part of almost every computer system. Therefore, hypermedia-based learning materials have been widely used in education. One of the main advantages of using hypermedia form of educational materials in a Web-based educational system is that learners have many opportunities to learn according to their individual needs (Laurillard, 1993). Jonassen (2000) emphasized the nonsequential and nonlinear method of organization and display in hypermedia which enables the learners to access information in most meaningful ways. Gauss and Urbas (2003) also stated that the constructivist view sees the non-linearity and interactivity of hypermedia as its major advantages compared to other educational media.

Many studies were conducted to find out the effects of individual differences on learning and satisfaction in hypermedia systems. The effects of gender differences (Chen & Macredie, 2010; Felix, 2001), computer competency levels (Palmquist & Kim, 2000; Maskari & Sanderson, 2011; Montelpare & Williams, 2000), prior knowledge (Hörlscherl & Strubel, 2000; Rezende & de Souza Barros, 2008, Chen & Macredie, 2010), and cognitive styles (Chen & Liu, 2009; Dufresne & Turcotte, 1997; Mampadi, Chen, Ghinea, & Chen, 2011; Palmquist & Kim, 2000; Triantafillou, Pomportsis, Demetriadis, & Georgiadou, 2004) were found to be significant for students' learning.

Although hypermedia seems to be appropriate for active and self-regulated learning activities, some empirical studies indicated problems about the efficiency and effectiveness of learning with hypermedia (Chen, 2002; Chen & Liu, 2009; Triantafillou, Pomportsis, & Demetriadis, 2003). Although the freedom given to learner for navigation and construction of the learning path is considered an advantage, it is concluded that some learners may have problems in dealing with this non-linear structure of hypermedia systems. Generally, the structure of content and navigation in current hypermedia based programs are provided in the same way, without much considering the background knowledge, age, experiences, cultural

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backgrounds, professions, motivations and goals of the learners (Papanikolau, Grigoriadou, Magoulas & Kornilakis, 2002).

Cognitive style of field dependency is one of the most studied individual characteristics and found to be effective in terms of achievement and attitudes of the students. Although there are some other theories about cognitive style, field-dependence is one of the most researched cognitive style theory and widely used in educational problems (Tang, 2003). The cognitive style of field dependency which was introduced by Witkin (1977) is based individuals' tendency of perception of the the surroundings. According to Witkin and Goodenough (1981), field dependency covers three major constructs: (1) reliance on internal vs. external referents; (2) cognitive restructuring skills; and (3) interpersonal competencies. A field-dependent person is defined as holistic, uncertain, and dependent upon others, while a field-independent person is analytic, confident, and self-reliant.

Cognitive style is studied by many researchers who are interested in hypermedia learning. Many researchers concluded that field dependency is an important characteristic affecting computer user in hypermedia environment (Angeli, Valanides, & Kirschner, 2009; Clewley, Chen, & Liu, 2011; Dufresne & Turcotte, 1997; Ghinea & Chen, 2003; Graff, 2003; Leader & Klein, 1996; Pi-Sui-Hsu & Dwyer, 2004; Triantafillou et al., 2004). These studies indicated that field-independent people either performed better or satisfied more in hypermedia systems compared to field-dependents.

The effects of individual differences on learning and satisfaction in Web environments are studied by many researchers. In addition to cognitive style differences, computer competency (Hörlscherl & Strube, 2000; Montelpare & Williams, 2000) and domain knowledge levels (Hörlscherl & Strube, 2000; Last, O'Donnell, & Kelly, 2001; Rezender & de Souza Barros, 2008) had been the focus of the studies. These characteristics seemed to effect either users' performance or satisfaction on learning or information-seeking tasks in Web environment.

### ***Purpose of the Study***

Learning strategies of the students in hypermedia environment might vary depending on their cognitive styles as stated by Jonassen and Wang (1993). However, the process of learning in these environments still needs to be discovered. As stated by Gauss and Urbas (2003), more evidence is necessary to derive general guidelines from research on individual differences in hypermedia learning, so there is a need for deeper understanding about the learning processes of different learners in hypermedia environment. The question under investigation is about how learner characteristics affect the use of an instructional hypermedia program.

In this study, learning strategies of the students with different cognitive styles in a hypermedia program were explored by considering their computer competency levels and prior domain knowledge levels. The study focused on the following questions:

- How do cognitive styles affect students' learning strategies in an instructional hypermedia environment?
- In what ways do the computer competency and prior domain knowledge levels of the students affect their learning strategies in an instructional hypermedia environment?

### **Methodology**

Since it was focused on the process rather than the product, "how" questions are tried to be answered, so case study becomes the main strategy for the research (Merriam, 1998; Yin, 1994). To explore the ways how the students with diverse characteristics use an educational hypermedia program, a qualitative case study was designed. Interpretive case studies -as explained by Merriam (1998)- are used to developed conceptual categories through the data collected, or illustrate, support, or challenge the theory that is considered before data is collected. Since the current study is based on the evidence provided by the literature and aims to expose the process by categorizing and interpreting data collected, the interpretive case study design is fitting well the aim of the research. As mentioned by Bogdan and Biklen (1998), the aim of the qualitative study is to better understand human behavior and experience. The goal of the qualitative researcher as overlapped with the aim of this study is to grasp the processes by which people construct meaning and define these meanings (Bogdan & Biklen, 1998).

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This study was conducted in two phases. For the first phase, three instruments were administered at the beginning of the semester to identify target participants with different individual characteristics. For the second phase, qualitative data were collected from selected subjects through interviews, observations, and review of Web logs.

### **Participants**

Since the qualitative inquiry focuses on small samples in depth, it is important to select information-rich cases from which one can get a great deal of information for the purpose of the research (Patton, 1990). In considering this issue, the purposeful sampling strategies were used in selecting participants. The sample within the case was selected by considering some criteria that were important for the study. Purpose of the sampling was to have a representative group with diverse characteristics which is named as *maximum variation* strategy by Patton (1990). In this study, the criteria for the maximum variation sampling were the following:

- *prior domain knowledge levels* of the students about the subject matter,
- *computer competency levels*, and
- *cognitive styles* of the students.

*Measure of Domain Knowledge.* An achievement test was administered at the beginning of the semester to measure the prior domain knowledge levels of the students on first aid subject. The test was developed and regularly used by Turkish Red Crescent to measure the domain knowledge levels of the students at the beginning and end of the semester and trainee who takes at least 85 points over 100 gains the right of having the First Aid Provider Certificate.

*Measure of Computer Competency Level.* A modified test which was originally developed by Yildirim and Dusick (1997) was used to measure the students' perceived computer competency. After conducting the reliability analysis on SPSS, the coefficient alpha was found to be .97 which indicates to a high reliability in social sciences. The content of the test was consisted of word processor, databases, spreadsheets, Internet applications, presentation software, operating systems and the maintenance of computers.

*Measure of Cognitive Style.* The cognitive styles of the students were measured through the Groups Embedded Figures Test (GEFT) which was developed by Witkin, Oltman, Raskin and Karp (1971) and translated and adapted into Turkish by Cakan (2003). The reliability analysis of the Turkish version of GEFT was conducted by Cakan (2003) and the coefficient alpha was found to be .82, so an acceptable reliability for the Turkish version of the GEFT is assured.

111 students from 124 in total have been administered three tests to determine their prior domain knowledge levels, computer competency levels, and cognitive styles. 124 students in total were enrolled to the course, however only 111 were ready in class hour when the cognitive style, and computer competency tests were administered. Therefore, only those 111 students who took all of the tests were taken as the participants of the study. Later, sixteen of them were selected after conducting some basic statistical analyses on test results. Mean scores and standard deviations were found for each measurement, then participants who scored one-half standard deviation below the mean were considered as belonging to the low-level group, and participants who scored one-half standard deviation above the mean were considered as belonging to the high-level group. Since the information-rich cases are important while selecting subjects in qualitative research, the low-level and the high-level groups were included, and represented equally in sampling (See Table 1). The middle groups were excluded, so only the participants representing specific characteristics were selected.

**Table 1:** Participant Selection Criteria According to the Test Results

	Mean	Std.Dev.	Low level group	High level group
<b>GEFT</b>	14.91	3.70	If score < 13.06	If score > 16.76
<b>C.Competency</b>	2.78	.76	If score < 2.40	If score > 3.17
<b>P. Domain knowledge</b>	15.13	3.90	If score < 13.18	If score > 17.08

However, the intended sampling strategy could not be realized exactly because there were not available subjects for each group according to the test results. Since the main consideration of the study was the cognitive styles, lack of four subjects at the field dependents column was supported by including

subjects without taking the domain knowledge or the computer competency levels into consideration. Therefore, four more subjects were selected among the field-dependents. Genders and major were also taken into consideration in terms of assuring variety. Table 2 and Table 3 show characteristics of the participants.

**Table 2:** Participants Selected Based on Test Results

Comp. Competency Level	Field Dependents		Field Independents		Total
	P. Domain knowledge		P. Domain knowledge		
	Low	High	Low	High	
Low	2 (Group8)	0 (Group6)	2 (Group7)	2 (Group5)	6
High	1 (Group4)	1 (Group2)	2 (Group3)	2 (Group1)	6
Total	3	1	4	4	12+4*

\* 4 Field dependent subjects were added considering their genders and majors

**Table 3:** Participants with Certain Characteristics

Participants	Gender	Major	Cognitive Style	Computer Competency	P. Domain Knowledge
S1	f	Business&Adm.	FI	competent	high
S2 (*)	m	Education	FD	competent	intermediate
S3	m	Education	FD	competent	high
S4 (*)	f	Education	FD	novice	intermediate
S5	f	Nat.Science	FI	novice	high
S6	f	Nat.Science	FI	novice	high
S7 (*)	f	Engineering	FD	intermediate	high
S8	m	Soc.Science	FD	competent	low
S9	m	Business&Adm.	FI	competent	low
S10 (*)	m	Engineering	FD	intermediate	high
S11	m	Engineering	FI	competent	high
S12	f	Education	FD	novice	low
S13	f	Nat.Science	FI	novice	low
S14	m	Nat.Science	FD	novice	low
S15	m	Engineering	FI	competent	low
S16	m	Nat.Science	FI	novice	low

\* 4 Field dependent subjects were added considering their genders and majors

### **Learning Environment**

Participants of the study were selected among a group of 111 students of a semi-online elective course given at the Middle East Technical University (METU). The course was about First Aid that is available for all of the senior students of METU.

Face to face classes were conducted during the first six weeks, and the rest of the course was conducted on the Web through the use of a Learning Management System (LMS). Asynchronous delivery methods were used in the system. Facilities provided by the LMS are the syllabus, electronic forum, course announcements part, lecture notes, and a gradebook. Lecture notes were divided into four parts including four or five chapters in each part, and subheadings in each chapter. This structure is provided by a tree type menu on the left side of the interface (Figure 1).

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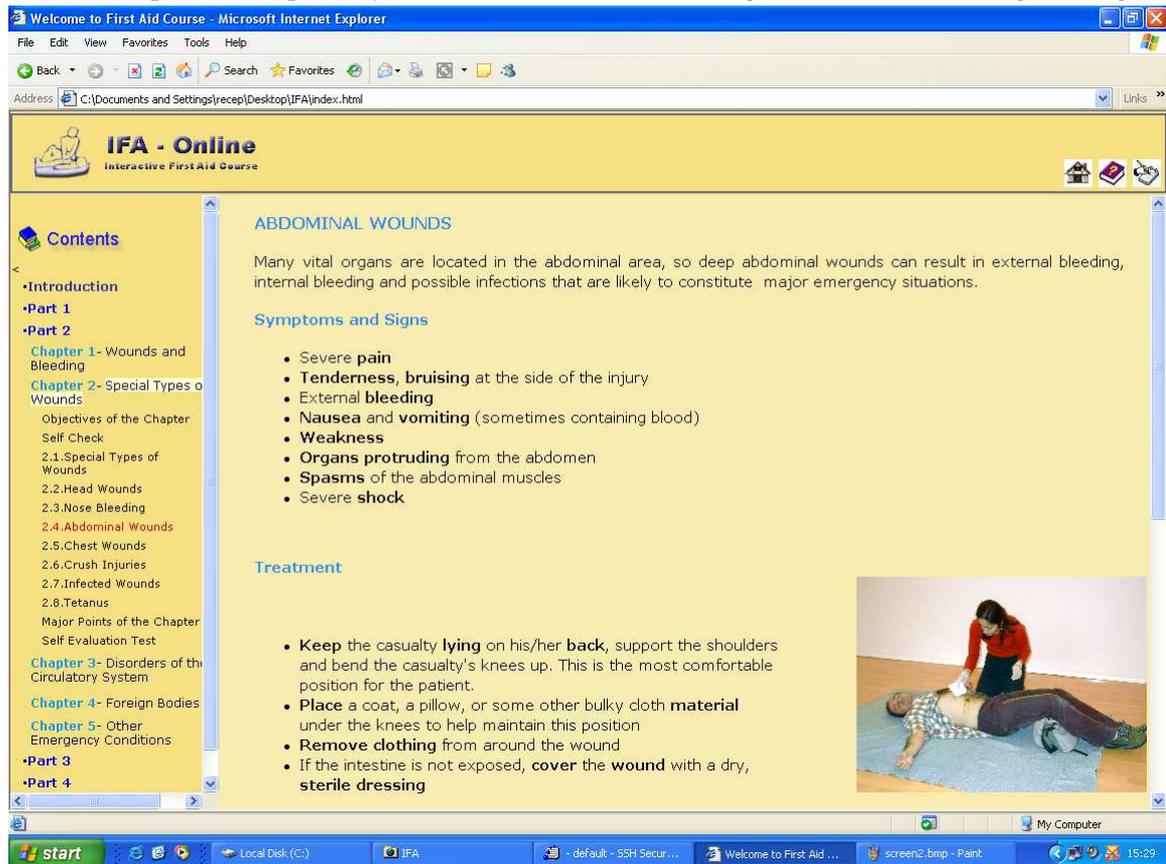


Figure 1. A screenshot from the course web site.

## Data Collection

In-depth interviews and participant observations were the primary source of data. Students' Web logs gathered by the LMS were the secondary data source. Each participant was invited to be observed during a usual study session and an interview was conducted after the observation. To minimize the researcher effect, characteristics of the participants were not known by the researcher during the whole data collection process.

*Observations.* An observation schedule was prepared to gather data on participants' navigation and interaction patterns, and favored and not favored components of the course Web site. Participants were invited individually to demonstrate a usual study session of the course. The same content was assigned to each participant and expected them to think loudly while studying. There was no time and material limitation during the observations. Participants' statements and actions were noted by the researcher.

*Interviews.* After each observation session, the researcher conducted semi-structured interviews with each student to gather information about their general thoughts, problems, appreciations, expectations, and suggestions of the hypermedia program specifically and online courses in general. Each interview session lasted 20 to 60 minutes and provided data about the invisible dimensions of the learning process. Interview sessions were especially helpful in terms of getting information about participants' learning strategies.

*Student Logs.* Frequencies of 111 students' use of the Web site were taken from the log files of Learning Management System. Students' visits of the Web site were kept by the LMS by counting the visited pages.

## Data Analysis and Coding

Analysis of data included ordering, structuring, and interpreting the mass of collected data, as explained by Marshall and Rossman (1999). The six steps while analyzing the data were followed: 1) Organizing the data; 2) generating categories, and themes; 3) coding the data; 4) testing the emergent

understandings as considering students' individual differences; 5) searching for alternative explanations; and 6) writing the report.

Interviews were transcribed, read twice, and coded by the researcher. Later, they were scanned by the researcher again and the main categories were determined in accordance with the codes. Four main categories were emerged including students' characteristics, subject matter characteristics, learning strategies, and patterns to use the hypermedia program with subcategories. In order to verify the categories, the researcher decided to scan all of the interviews again for each main category, and coded them again by focusing just on specific categories.

In terms of validating the research findings, codes and categories were reviewed by another researcher who was not involved in the study. Coded data were discussed and changes were done if necessary. Transcribed data were also sent to the participants to take their approvals about the interviews and give them an opportunity to make changes if they want to.

Since the study is based on comparison of the students according to their certain characteristics, data was grouped based on the characteristics which the students belong. Namely, the same data were divided into two columns for cognitive style, groups, two columns for computer competency level groups, and two columns for domain knowledge level groups.

After organizing the data, researcher first looked at the similarities and then the differences in the data within the same group. Observational data was also analyzed by considering the characteristics of the students.

## **Results**

The data have shown that the common learning strategies used by the learners were study management, reading, note-taking, simple examination, and use of visuals. Although almost all of the participants followed these strategies, some differences emerged among the learners with different characteristics. Results are presented through three perspectives including cognitive style, computer competency, and prior knowledge levels as proposed in research questions. The differences rather than similarities among the groups were presented. Table 4 represents the main differences among the groups in terms of learning strategies and hypermedia using patterns of the participants.

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**Table 4:** Participants' common patterns of learning strategies, and use of the HM program with data sources.

Learning Strategies	Cognitive Styles		Data Source		
	FD	FI	Interview	Observ.	S. Logs
<b>Aim of Studying</b>	Considering others' expectations	Considering their own decisions	✓	✓	
<b>Aim of Reading</b>	Influenced by external forces	Influenced by internal forces	✓	✓	
<b>Sequence to Study</b>	Confused about inconsistency with syllabus	Like the current sequence	✓		
<b>Dealing with unknown terms</b>	Need to use dictionary	Reading explanations& reasoning	✓	✓	
<b>Use of Visuals</b>	Interest in figures on images	No special interest	✓		
<b>Computer Competency</b>					
Learning Strategies	Non-competent	Competent	Interview	Observ.	S. Logs
<b>Content Segmentation</b>	Prefer long-page presentation	Prefer short page presentation	✓		
<b>Visiting Frequency</b>	No difference	No difference			✓
<b>Materials to Study</b>	Print-out	HM program	✓		
<b>Navigation within the content</b>	Usually using <i>Back&amp;Next</i>	Using menu for turn backs within content		✓	
<b>Using the menu</b>	Having difficulty	No difficulty	✓	✓	
<b>Prior Knowledge</b>					
Learning Strategies	Low-level	High-level	Interview	Observ.	S. Logs
<b>Depth of Studying</b>	Reading more than once, Taking notes, Turning back to previous topics.	Reading once, Skim&Scan No detail in studying	✓	✓	
<b>Navigation Tools</b>	No special need	Need a design to skip easily	✓		

### **Cognitive Style Differences**

Participant interviews revealed some differences among the statements and experiences of cognitive style groups on a general manner in terms of learning and interaction with hypermedia. Analysis of the participant interviews, and observations strongly exposed the difference on self-regulation between the field-dependent and field-independent learner groups. Their self-regulation abilities were important in terms of their general approach to study and using learning strategies.

The findings were in accordance with the definition of field dependence which was supposed to be related to a person's dependence on internal or external factors by Witkin and Goodenough (1981) and Saracho (1997). Actually field-independent participants of the current study usually tended to be self-regulated in general, and their overall approach to learning is based on their own points of view and own decisions.

*Aim of Studying/Reading.* During both the interviews and observations, most of the learners (11 of 16) stated that they prefer to focus on specific parts within the reading material rather than reading the whole content equally. Six of the eight field-independent learners in total stated that they especially focus on things which they found to be important according to their personal beliefs and feelings. Similarly, most of the field-independent participants established their own goals for studying special points within the whole content according to their personal beliefs.

About determining the goal of the learning, four of the eight field-dependent learners tend to consider the demands of exams or the instructor. They usually stated that they focused on parts which were emphasized by the instructor during the face-to-face classes or were assumed as possible exam questions by the students. Results indicated that field-dependent learners usually don't set their own goals, and look at external sources to determine the importance and priority of the subjects within the content.

*Organization of the content.* In terms of the content organization of the hypermedia program, learners usually appreciated the order and segmentation of the whole content into topics and subtopics. However, there was a problem for some learners about the order of the chapters which do not follow the sequence of face-to-face classes. Although the researcher was not aware about the content of the face-to-face classes during the observations and interviews, it was revealed after analysis that five of the eight field-dependent learners claimed about studying without following the sequence of the hypermedia program. S7 mentioned this issue and stated; "I felt disturbed about skipping chapter3 for instance... Did we purposely skip that chapter? Why do we postpone it?" Inconsistency between the sequences of hypermedia program and the face-to-face course was a problem for field-dependent students, while field-independents didn't mention this issue during the interviews and observations.

*Approach to unclear points.* Although the interviews and the observational data revealed that many learners faced with problems related to unknown terms while reading the course material, half of the field-dependent learners needed to use a dictionary while the field-independents usually tend to elicit the meanings of the terms by reasoning, reading the material in detail, or examine the images. This finding may be consistent with the idea that field-dependent people tend to use external sources of information for self definition as stated by Saracho (1997).

*Use of visuals.* The images and movies within the hypermedia were among the most appreciated features of the material. Almost all of the students stated that they sometimes preferred to look at the images on the page instead of reading the texts. Moreover, the images were found to be helpful to understand the unknown terms. Although all of the participants stated positive comments on visuals of the hypermedia program, it was notable that only the field-dependent students emphasized details on the visuals which helped them to remember the procedural knowledge on the content. While talking about the images and movies on the hypermedia program, five of the eight field-dependent participants stated that they were very beneficial to them, and helped them in remembering the face-to-face classes, since the instructor was a part of the images and movies on the hypermedia program. On the other hand, field-independent students didn't mention this detail. Therefore, clues reminding previous learning experiences might be a motivational factor for field-dependent learners, while field-independents do not show any interest.

### ***Computer Competency Level Differences***

Both the interviews and observations revealed that computer competency levels of the students may be important in terms of their hypermedia using patterns. Especially, there would be problems in using hypermedia program for novice computer users.

*Frequency of visiting the Web site.* Web logs revealed that the course web site was visited 47048 times in total, which means that average view for a participant was 423.86 for the whole semester. Almost all of the students noted that they were visiting the Web site once or twice a week to access assignments and announcements of the instructor. Main aim of visiting the Web site was usually to get the announcements, most of the participants did not look at the lecture notes on the Web site until the examination week.

Participants usually emphasized that there should be some encouraging factors to make them visit the Web site. They complained about not being forced to study for online courses in general until the exam date is close. However, homework and announcements were found to be useful in terms of forcing them to visit the Web site.

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Most of the novice computer users stated that they didn't like to use the hypermedia for studying. The relationship between the perceived computer competency scores and frequency of visiting the Web site was examined via Pearson correlation coefficient. Analysis indicated that the correlation between computer competency score and frequency of using the Web site was not statistically significant ( $r(111) = .0114, p = 0,05$ ).

*Preferred medium for reading.* The choice of the medium for reading varied among the participants. While nine of the sixteen participants stated that they read from the hypermedia program, others either preferred to read on printed material or used to read on both printed material and hypermedia program.

After grouping the participants according to their certain characteristics, it was revealed that novice computer users tend to print out the content, and read through the printed material. They stated that it was not comfortable to study in front of a computer all the time.

*Navigation within the content and using the menu.* Random access to the content through the menu on the hypermedia program was appreciated by almost all of the students. However, six of the nine novice computer users had difficulties in using the menu, since the content on the right side was not changing, despite a chapter name is clicked on the menu. Actually the menu consisted of four main items with many subtitles under each. If a main item is clicked by the user, only the subtitles were opening without any change on the right side of the page, and it was a problem for novice computer users since they expected to see a change on the content presentation page after clicking on any item. Interviews and especially the observations revealed that novice computer users didn't prefer to use the menu for navigation as much as competent users.

Although most of the participants appreciated the random access opportunity provided by the menu, observations didn't exactly support the interview findings for some cases. Observations revealed that novice computer users didn't prefer to use the menu for turning back to any topic. Instead, they preferred to click on the *back* buttons to go back within the chapter even it was four pages away. It was observed that it was a bit complicated for them to come to the last studied part again with *next* buttons after looking at the previous pages.

*Segmentation of the reading material.* The short-page presentation of the content in hypermedia program was appreciated by seven of the participants. Although it was not asked during the interviews, ten of the participants from which the seven were field-dependents mentioned this issue. They stated that they liked this kind of presentation either since they can control the flow of the content or since their motivation increased while reading short pages. Instead of having many things on the screen, they preferred to have small chunks of information on each page.

On the other hand, three of these ten participants stated that they prefer to read long page presentations. All of them were at low level of computer competency, and belong to different groups in terms of their cognitive styles. They mentioned that it disturbed them to click always on next buttons. Although short page presentation was appreciated by many participants, it required to cope with more pages in total compared to long-page presentation. So, it was a problem for novice computer users.

### ***Prior Domain Knowledge Level Differences***

Prior domain knowledge level groups indicated some differences in terms of studying course material. depth of studying varied among the different prior-domain knowledge levels, as well as the preferences for navigation tools.

*Depth of Studying.* All of the participants with high level of prior domain knowledge usually preferred to scan the texts rather than reading in detail. Moreover, the analysis of interviews and observations indicated that students with high level of prior domain knowledge usually took small and less-detailed notes, while students with low level of prior domain knowledge tended to take more detailed notes including the titles and main structure of the subject studied.

*Navigation Tools.* Although the random access opportunity provided by the menu was widely appreciated by almost all of the learners, participants with high level of prior domain knowledge especially appreciated this feature, since the menu structure allowed them to skip some chapters without studying. Two of the participants with high level of prior domain knowledge suggested a different design for navigational tools, so that they could easily skip the known parts without reading. According to Rezende &

de Souza Barros (2008), navigation patterns in an instructional hypermedia environment might be associated with prior knowledge levels of the users. In their study, knowledgeable students either used organized or conceptual navigation in which they preferred random access to topics and used the index more than the non-knowledgeable students. Prior knowledge levels of the students might be a factor to be considered in designing hypermedia environments for instructional aims.

Furthermore, the hypermedia system used in this study was found to be quite simple to navigate by almost all of the participants. Actually the medium could be important in terms of disorientation problems of the users related to their domain knowledge. McDonald and Stevenson (1998) concluded that there are differences in terms of navigation efficiency between knowledgeable and non-knowledgeable participants on different hypermedia designs. The non-linear and hierarchical designs suggested superior performance for knowledgeable users, while the mixed design was resulted in no difference between the knowledgeable and non-knowledgeable participants. Actually the hypermedia program used in this study could be regarded as having mixed design, since a hierarchical menu is provided besides the linear flow with navigation buttons. So, there is no difference emerged in terms of interaction patterns of the participants, or disorientation problems.

### **Discussion and Implications**

Laurillard (1993) emphasized the importance of self-pace opportunity given to users so that they can develop their cognitive structure in hypermedia environment. According to the findings of the current study, it seems to be easy for field-independent learners to control the pace and sequence of learning, while the field dependents might fail in doing the same thing.

Since field-dependent learners usually need for guidance (Jonassen & Grabowski, 1993), non-structured hypermedia environments usually disturbs field-dependent learners, while field-independents like self-pacing opportunity provided by this environment. Findings of the current study revealed that field-dependent participants were not satisfied with studying by following the self-determined sequence of the content. It is difficult for field dependent learners to learn the materials that require higher order thinking when cues are not provided (Witkin, 1977). It is obvious from the findings that field-dependent learners may have difficulties in determining the importance of the content parts, so they may have difficulties in determining their own priorities within the whole content.

In self-regulated learning which is necessary in hypermedia environments, learners usually set some goals and plan timing to organize learning according to their priorities (Whipp & Chiarelli, 2004). Time management seemed to be dependent on students' general approach to study and to the specific course. Findings of this study suggest that cognitive styles might be important in terms of establishing goals for learning either based on individuals' personal beliefs and thoughts or demands of external factors like an instructor or the assessment criteria. Then it becomes necessary to emphasize the importance of subjects within the content to notify especially the field-dependent learners, since they usually need for external sources about what to learn. On the other hand, a non-structured presentation would be better for field independent learners in terms of supporting their self-regulation and reasoning activities as stated by Triantafillou et al. (2004).

Visuals are seemed to be indispensable components of instructional hypermedia systems for the current study. Although the characteristics of the specific subject matter should be taken into account, it is emphasized that learners prefer to use visuals in understanding concepts and procedures rather than reading texts. As proposed by Witkin and Goodenough (1981), Morgan (1997) and Saracho (1997), field-dependent people are usually motivated extrinsically, so the potential of visuals in increasing the motivation might be appreciated by instructional designers in designing hypermedia systems.

In addition to the cognitive style differences of learners in hypermedia learning, perceived computer competency levels also revealed as an important characteristic affecting the process. Different levels of computer literacy among students and lack of confidence in using computers were concluded by Montelpare and Williams (2000) as the common challenges in using Internet in higher education. Another study conducted by Maskari and Sanderson (2011) similarly concluded that users with more searching experience were able to find significantly more relevant documents compared to less-experienced users in a search task, while spending equal times. For the current study, students who consider themselves as novice computer users usually tended to use the hypermedia program less, so they preferred to print out the

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material rather than visiting the Web site and reading on site. Providing a printable version of the whole content on the Web site might be considered by instructional designers of hypermedia environments.

The study indicates some other problems of novice computer users about using the hypermedia program. An instructional hypermedia system should be prepared as simple as possible (Palloff & Pratt, 2001) in terms of accommodating the needs of novice computer users. For instance, short page presentation of the hypermedia program was disliked by some novice computer users, since it meant more Web pages in total and more navigation. Although there are some research concluding that field-dependent people are performing better in short-page presentation, while the field-independents are more successful with large-page presentation (Gauss & Urbas, 2003), there might be some other factors affecting participants' performance. Findings of the current study indicated that effects of computer competency levels are very important in hypermedia learning and might be misinterpreted as effects of cognitive styles. A study conducted by Palmquist and Kim (2000) concluded that cognitive styles of novice users influence their search performance in Web, while experienced internet users didn't indicate any difference in terms of their cognitive style category. It could be suggested that computer competency levels of the users should be taken into consideration in cognitive style research on hypermedia environments.

Another important factor to affect hypermedia usage patterns is the prior domain knowledge levels of the users. Consisted with the findings of the current study, the interaction patterns with hypermedia may differ based on the knowledge levels of the students (Chen & Macredie, 2010; Rezender & de Souza Barros, 2008). Therefore, users' knowledge levels become an important factor in designing instructional online systems.

Although the current study examined a single case, so the results cannot be widely generalized, there are some suggestions exposed for instructional designers and researchers;

- Learners' dependence on external or internal factors while regulating the learning is revealed as an important issue. Actually learners who are dependent on external factors – field dependents – usually faced with problems related to being alone while learning with hypermedia. It would be better, if hypermedia programs are designed in a more structured way for field dependent learners to provide them guidance. Emphases on important points, relation to real life situations, and motivational elements should be used extensively in instructional hypermedia to make them engage in learning.
- Field-dependent learners might need external sources to verify any information, while the field-independents used reasoning. The information on hypermedia program should be provided so detailed that the field-dependent learners could find everything they need. On the other hand, it could be better for field-independents to provide opportunities to allow them reasoning.
- Considering the differences among the people, and the potential of the hypermedia systems, it would be suggested that hypermedia systems would provide different designs for different learners. Adaptive Educational Hypermedia Systems (AEHSs) are one of the innovations that may help the instructional designers in designing learning environments accommodating learner characteristics.
- More research regarding different individual characteristics should be conducted in different contexts to reveal the effects of differences on using hypermedia.
- The current study suggested that the computer competency level of the learners is a very important factor affecting their use of instructional hypermedia. Any research which aims to investigate the role of cognitive styles in hypermedia learning should definitely consider the computer competency levels of the participants besides the cognitive style preference.
- Participants' achievements and overall situation in terms of academic success were not the considerations of this study. However, students' self-expectations and academic accomplishment are usually suggested as important factors in predicting current approach to learning. Further research investigating learning in hypermedia environment should take these factors into consideration.

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## Genişletilmiş Özet

Günümüzde hipermedya, bilgisayar sistemlerinin vazgeçilmez bir parçası ve bu ortam üzerinde hazırlanan öğrenme ortamları da eğitim sisteminin önemli bir bileşeni haline gelmiştir. Hipermedya, aktif ve öğrenci tarafından yönlendirilebilen öğrenme etkinlikleri açısından uygun bir ortam olarak görülmesine rağmen kimi araştırmalar bu ortamda öğrenmenin etkililiği ve verimliliği açısından bazı sorunlar bulunduğunu göstermiştir (Chen, 2002; Chen & Liu, 2009; Triantafillou, Pomportsis, & Demetriadis, 2003). Öğrenciye gezinme ve öğrenme pathinin oluşturulması konusunda tanınmış olan özgürlük bir avantaj olarak görülmesine karşın bazı öğrencilerin hipermedyanın bu sıralı olmayan yapısıyla başa çıkmada sorunlar yaşayabildikleri belirtilmiştir.

Öğrencilerin bireysel farklılıklarının hipermedya ortamdaki performansları ve memnuniyetlerine etkisini ortaya çıkarmak amacıyla birçok çalışma yapılmıştır. Bu araştırmalar genellikle bilişsel stil farklılıkları (Chen & Liu, 2009; Dufresne & Turcotte, 1997; Palmquist & Kim, 2000; Triantafillou, Pomportsis, Demetriadis, & Georgiadou, 2004), bilgisayar kullanımı yeterlik düzeyleri (Hörlscherl & Strube, 2000; Montelpare & Williams, 2000) ve ön alan bilgisi yeterlikleri (Hörlscherl & Strube, 2000; Last, O'Donnell, & Kelly, 2001; Rezender & de Souza Barros, 2008) üzerine yoğunlaşmıştır. Sonuç olarak bu faktörlerin, kullanıcıların Web ortamında öğrenme veya bilgi arama gibi işlemlerdeki performansını yada memnuniyetini etkileyebildiği sonucuna varılmıştır.

Bilişsel stil, bireylerin psikoloji temelli niteliklerinden biri ve kişiliğin değişmez bir bileşeni olarak görülmesi nedeniyle birçok araştırmacı tarafından incelenen bir bireysel farklılık olarak karşımıza çıkmaktadır. Jonassen ve Wang (1993)'a göre, öğrencilerin Web ortamlarındaki öğrenme stratejileri, bilişsel stillerine bağlı olarak farklılık gösterebilmektedir. Ancak bu ortamlardaki öğrenme sürecini aydınlatacak daha çok çalışmaya ihtiyaç vardır. Gauss ve Urbas (2003), Web ortamında öğrenme ve bireysel farklılıklar konusunda genel çıkarımlarda bulunabilmek için daha fazla bulguya ihtiyacımız olduğunu belirtmiştir, dolayısıyla farklı niteliklere sahip öğrencilerin bu ortamlardaki öğrenme süreçlerine ilişkin daha derin bir bilgiye sahip olmamız gerektiği söylenebilir.

Bu araştırmanın amacı da, bireysel farklılıkların eğitim amaçlı bir hipermedya sisteminin kullanımını ne şekilde etkilediğini ortaya çıkarmaktır. Çalışmada farklı bilişsel stillere sahip öğrencilerin hipermedya bir sistemdeki öğrenme stratejileri, bilgisayar kullanımı yeterlik düzeyi ve ön alan bilgisi farklılıkları da gözönüne alınarak ortaya çıkarılmaya çalışılmıştır.

Araştırmanın çalışma grubunu Orta Doğu Teknik Üniversitesinde seçmeli olarak tüm lisans öğrencilerine açık olan İlk Yardım dersinin öğrencileri oluşturmuştur. Ders harmanlanmış öğretim formatında, Web-destekli olarak verilmiştir. Dersi almakta olan 124 öğrenciden 111'ine bilişsel stilleri, bilgisayar kullanımı yeterlik düzeyleri ve İlk Yardım konusundaki ön bilgilerini ortaya çıkarmak üzere 3 farklı test uygulanmış, belirgin karakteristikler gösteren onaltı öğrenci maksimum çeşitlilik örnekleme yoluyla çalışmaya katılmaları amacıyla belirlenmiştir. Katılımcı öğrencilerin belirlenmesinde, uygulanan ölçek sonuçlarının yanısıra cinsiyet ve bölüm çeşitliliği de gözönüne alınmaya çalışılmıştır.

Çalışmanın birincil veri kaynakları yarı yapılandırılmış görüşmeler ve gözlemdir. Ek olarak, çevrimiçi öğrenme ortamı tarafından kaydedilmiş olan loglar kullanılmıştır. Araştırmacı, belirlenmiş olan katılımcılarla iletişim kurarak Web sitesi kullanımlarının bir demosunu gerçekleştirmelerini, bunu yaparken de sesli düşüncelerini istemiştir. Bu sırada katılımcıların davranışları ve açıklamaları araştırmacı tarafından not edilmiştir. Demo gösterimi sonrası katılımcılarla birebir yüzyüze görüşmeler yapılarak Web sitesi hakkındaki görüşleri, yaşadıkları sorunlar, beğendikleri özellikler, beklentileri ve önerileri konusunda bilgi alınmıştır.

Veriler, içerik analizi yapıldıktan ve kodlar ve kategoriler oluşturulduktan sonra katılımcıların dahil olduğu bireysel farklılıklar bağlamında gruplandırılmış, aynı grup içindeki verilerin benzerlik ve farklılıkları ortaya çıkarılmaya çalışılmıştır. Daha sonra farklı gruplar birbirleriyle kıyaslanarak benzerlik ve farklılıklar üzerinden genellemelere gidilmiştir.

Bulgular, en fazla kullanılan öğrenme stratejilerinin çalışma yönetimi, okuma, not alma, basit egzersizler ve görsellerin kullanılması olduğunu göstermiştir. Bununla birlikte farklı karakteristiklere sahip öğrenciler arasında bazı farklılıklar ortaya çıkmıştır. Çalışmanın bulguları, literatürde belirlenmiş olan üç bireysel farklılık kapsamında değerlendirilmiş ve sunulmuştur.

Bilişsel stil farklılıkları açısından, öğrencilerin genel çalışma yaklaşımlarının gruplar arasında farklılık gösterebileceği görülmüştür. Witkin ve Goodenough (1981) ve Saracho'nun (1997) görüşlerini destekler şekilde, alandan bağımsız (field-independent) öğrencilerin Web ortamında da kendi kendini yönlendirmeye (self-regulated) eğilimli oldukları ve genel öğrenme yaklaşımının dış

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etkenlere değil kendi bakış açıları ve kararlarına dayandığı görülmüştür. Çalışmanın amaçlarını belirleme, çevrimiçi içeriğin organizasyonu, net olmayan noktalara yaklaşım ve görsellerin kullanımı gibi konularda alandan bağımsız (field-independent) öğrencilerin genelde bir yönlendirmeye ihtiyaç duymaksızın kendi davranışlarını yönlendirdikleri, buna karşın alana bağımlı (field-dependent) öğrencilerin başka kaynaklar yada dersi veren öğretim elemanının görüşlerine ihtiyaç duydukları gözlemlenmiştir.

Öğrencilerin bilgisayar kullanımı yeterli düzeylerinin de çalışma stratejilerinden ziyade, çevrimiçi bir öğrenme ortamının kullanımını etkileyebildiği görülmüştür. Özellikle bilgisayar kullanımı konusunda yetersiz olduklarını düşünen öğrenciler genel olarak bilgisayardan çalışmak yerine çıktı almayı tercih ettiklerini belirtmiş, yeterli olduğunu düşünenlere kıyasla Web sitesinde daha fazla sorun yaşadıklarını söylemişlerdir. Ayrıca bilgisayar kullanımı konusunda kendisini yetersiz bulan öğrenciler, içeriğe rastgele erişim imkanı veren “menü” bileşenini kullanırken zorlandıklarını belirtmiş, “ileri” ve “geri” butonlarıyla gezinmeyi tercih etmişlerdir. Son olarak, Web sitesinde kullanılmış olan “kısa sayfa sunumu” bilgisayar kullanımı açısından yetersiz olduğunu düşünen katılımcıların küçük bir kısmı tarafından beğenilmemiş ne kadar kısa sunum, ne kadar çok sayıda sayfa olursa o kadar çok sorun yaşama ihtimali olduğu şeklinde yorumlanmıştır.

Çalışmada incelenen son bireysel farklılık kategorisi olan ön alan bilgisi konusunda da, ders materyalinin kullanımı açısından bazı farklılıklar olabileceği ortaya çıkmıştır. İçerik hakkındaki ön bilgisi yüksek olan öğrencilerin az bilgili öğrencilere kıyasla detaylı bir okuma yerine yüzeysel bir taramayı tercih ettiği, ayrıca çalışırken daha küçük ve az detaylı notlar aldıkları görülmüştür. İçeriğe rastgele erişim imkanı sunan “menü” bileşeni, ön alan bilgisi yüksek öğrenciler tarafından özellikle iyi bildikleri konuları kolaylıkla atlayabildikleri için beğenilmiş ve kullanılmıştır. Bu çalışmada, Rezende ve de Souza Barros (2008) ve McDonald ve Stevenson'ın (1998) da vurguladığı gibi, konu hakkında bilgi sahibi olmak, kullanıcıların bir Web sitesindeki gezinmelerini etkileyen faktörlerden birisi olarak ortaya çıkmıştır.

Hipermedya sistemler, sundukları avantajlarla öğretim amaçlı kullanımı gittikçe yaygınlaşan uygulamalardır. Ancak bu ortamların tasarlanmasında kullanıcıların bazı niteliklerinin önemli olduğu görülmektedir. Bilişsel stiller üzerine yürütülen birçok çalışma da göstermiştir ki bu ortamlardan tüm öğrenciler aynı şekilde faydalanamamaktadır. Ayrıca kullanıcıların bilgisayar kullanımı konusundaki yeterlikleri ve içerik hakkındaki ön bilgileri de bu ortamdaki öğrenme süreçlerini ve gezinme davranışlarını etkilemektedir. Bireysel farklılıklar, tasarımcılar tarafından gözönüne alınarak tüm kullanıcıların faydalanacakları şekilde esnek uygulamalar geliştirmek faydalı olacaktır. Ayrıca hipermedya kullanımında bilişsel stil farklılıklarını inceleyen araştırmacıların, çalışmalarında bilgisayar kullanımı yeterliği ve alan bilgisi faktörlerini de gözönüne alması önerilmektedir.