USE OF VISUAL METAPHORS FOR NAVIGATION IN EDUCATIONAL HYPERMEDIA: EFFECTS ON THE NAVIGATIONAL PERFORMANCE

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The interactional feature of hypermedia that allows high-level student-control is considered as one of the most important advantages that hypermedia provides for learning and teaching. However, high-level student control in hypermedia might not always lead to high-level learning performance. The learner is likely to experience navigation problems such as disorientation, loss of concentration, and waste of more time in hypermedia, which has a highly dynamic structure due to the constant increase in information. It is believed that visual metaphors could be used to increase the navigation performances of learners in hypermedia. In this respect, the purpose of the present study is to determine the effects of visual metaphors - used for navigation in hypermedia - on the navigation performances of learners. For this purpose, 33 teacher candidates of Information Technologies attending Anadolu University participated in the study, and their navigation performances in two different hypermedia with the same content were evaluated. Three different performance measurements such as disorientation, time and the teacher candidates’ self-evaluation of their performances were used. According to the results obtained, it was revealed that the teacher candidates presented higher-level performance in hypermedia in which a visual metaphor was used.
INTRODUCTION

Unlike the system-controlled structure of multimedia, hypermedia systems require high-level interaction. This interactional feature of hypermedia that allows learner control is considered to be one of the most important advantages of hypermedia in terms of teaching and learning. Learner control can increase student interest and motivation, support the processes of active learning, and help students try harder to structure information (Scheiter & Gerjets, 2007). However, high-level learner control in hypermedia may not always lead to high-level learning performance. Due to constant increase in information, especially students with less experience are likely to be exposed to navigation problems such as disorientation, loss of concentration, and waste of time in highly dynamic hypermedia.

Disorientation is frequently mentioned as a navigation problem in research on hypermedia (Scheiter & Gerjets, 2007; Karadeniz, 2006; Zhu, 1999; Beasley & Waugh, 1996). In general, disorientation in hypermedia refers to the fact that the user loses his or her place in the whole environmental structure and does not know how to go to a desired place. Therefore, if a user asks questions such as “where am I”, “where was I”, and “where am I going to go” then it means that he or she has got lost in the environment (Karadeniz, 2006). Navigational performance in hypermedia is a comprehensive concept that covers easy achievement of a task, the time spent on the achievement of that task, and disorientation that means trying to find one’s way. Navigational performance is a relational property among parts of a system that include the individual, the task, the hypermedia, and the context in which learning occurs (Land & Hannafin, 1996; Barab, Bowdish & Lawless, 1997).

Hypermedia is considered to be quite a complex system, since it depends on the non-linear organization of information, (Dias & Sousa, 1997). Thus, a powerful hypermedia navigational substructure is necessary to help individuals find their way in a hypermedia environment that has a dynamic structure. In addition, in order for users to understand the structure of hypermedia and to navigate easily in these environments, the navigation tools should be familiar to and meaningful and directive for users. Appropriate metaphors can be an option to design the navigation tools according to the background knowledge of users.

Metaphors and Their Use in Computers

Until 1980s, metaphors that we use in almost every area of our daily lives were considered as a technique of using the language effectively and were defined as an art of using words without reference to their real meanings. However, in their study named “Metaphors We Live By”, two cogni-
tive scientists, Lakoff & Johnson (1980), mentioned the importance of cognitive aspects of metaphors stating “If we are right in suggesting that our conceptual system is largely metaphorical, then the way we think what we experience, and what we do every day is very much a matter of metaphor” (p. 25). The intended emphasis here is the fact that metaphors are structures that we use not only in a language but also in our thoughts and actions. This approach, later called contemporary metaphor theory (Lakoff, 1993), has taken its place as an interdisciplinary approach in different fields of study, mainly computer sciences, cognitive science, and communication sciences.

The concept of metaphor is defined as a way of producing a speech with reference to something in order to state a similarity that can not be explained completely (WordNet, 2001). Metaphors are used for the purpose of doing an effective transfer from the source concept to the target one so as to establish a connection between the two concepts. The essence of metaphor is understand and experience one kind of thing in terms of another (Lakoff & Johnson, 1980).

Today, metaphors are frequently used in computer sciences besides their use in a language. The language used in computer sciences is the one which is substantially formed by metaphors (Colburn & Shute, 2008). Depending on the contemporary metaphor theory, metaphors can be gathered under three headings such as conceptual metaphors, orientation metaphors and ontological metaphors (Lakoff, 1993). These three types of metaphors are frequently used in computer sciences.

Conceptual metaphors, also known as structural metaphors, are mostly related to linguistics. In conceptual metaphors, meaningful transfers are carried out from the source concept area to the target concept area. For instance, the definition of the central processing interfaces as desktop, recycle bin, and the concept of mouse in place of a data-input device that controls the actions on the computer screen can all be considered as conceptual metaphors.

Orientation metaphors are related to our physical life experiences on Earth. Since our childhood, we have learnt such concepts as gravity, balance, and symmetry, and we often use these concepts when learning a new thing. For instance, up-down, front-back, and in-out are all examples of orientation metaphors. Orientation metaphor is one of the most frequently used metaphors in the computer environment. Almost all the moving and non-moving arrows used in the computer environment, the download used for data transfer, and the proceeding that shows flow of operations are all examples of orientational metaphors.

As for ontological metaphors, a non-physical concept is explained with an existing physical thing. For instance, “Clean the memory”, “Open-Close
file” and “Divide disc”, which are all used in computer sciences are examples of ontological metaphors.

Computers are quite complex devices and are difficult to learn, yet the 21st century requires its members to use them effectively and efficiently. One common way of intuitively understanding computers is the use of metaphors (Barr, 2003). The reason is that metaphors can facilitate satisfaction and success in understanding the system by loading the first comparison - related to the system – to the memory; otherwise, it would take very long time to do the comparisons in mind (Carroll & Thomas, 1982). By using what we already know, we can clearly explain what we have not been able to comprehend completely. Therefore, in order to explain a new concept in all levels of interactions with computers, an old metaphor is used (Barr, 2003). In the simplest term, the visuals and concepts related to the computer such as window, desktop, mouse, recycle bin, file, folder, page, document, loading, download, and memory are all old metaphors for new concepts.

**Visual Metaphors and Their Use in Hypermedia**

It is important to understand that conceptual, orientation and ontological metaphors can be used in visual or verbal form. Verbal forms of metaphors are frequently used in literature and daily speech. Similar to verbal metaphors, visual metaphors can be defined as the representation of a new system with the use of visual symbols which users are familiar with, which replace the system, and which serve the same purpose. Visual metaphors, like verbal metaphors, are frequently used in computers. The desktop metaphor can be given as the best example for this.

Instead of the traditional hierarchy of directories and sub-directories on the desktop we use, visual metaphors of files and folders are used. In fact, directories and sub-directories are interconnected structures within a hierarchical structure and are technically expressed in this way. However, in information and communication technologies, this structure is called tree. The reason is that as we know the structure of the tree, by using this structure, it will be easier to understand the structure of the system of directories. In addition, most of the icons and buttons used in the computer environment are designed with the help of metaphors.

Metaphors that help users avoid using routine operations of command-writing on the black screens of computer systems are widely used with the development and spread of computer technologies. Metaphors are also used to help users get easily accustomed to these new environments of hypertext, hypermedia and multimedia. According to Erickson (1990), since metaphors enable us to obtain information from familiar and reliable objects as well as since they function like natural models, their use in hypertext and hyperme-
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dia is of great importance. Today, visual metaphors are commonly used in hypermedia. Visual metaphors can be used in web browsers, search engines, databases, and educational web pages as well as in illustrating a subject in ordinary contents and designing interfaces.

Various metaphors can be used in software as computer applications, yet use of metaphors in hypermedia, especially use of visual metaphors, is more appropriate (Cates, 1994). The presentation of a visual and concrete metaphor to students addressing individual differences and the natural area of informatics may facilitate students’ navigation in an environment (Vicente & Williges, 1988). Therefore, it is possible to encounter with visual metaphors used for different purposes in most hypermedia applications. However, since in these interfaces, visual metaphors are not often used as appropriate to their purpose of use, it is believed that visual metaphors are not used in a way to benefit well from their orientation potentials and navigational features.

With the spread of the Internet, the use of hypermedia in education is increasing everyday. Today, information is constantly updated, and hypermedia is intensely used in order to maintain the life-long learning of individuals. Hypermedia is a system that has complex navigational tasks besides high level of user interaction. Users who cannot cope with these tasks are most likely to experience problems such as disorientation in the system, overuse of time accessing information, and inability to locate the correct information. In order to avoid, or at least decrease, such problems, students are supposed to show high level of navigational performance by benefiting from their background knowledge. One of the most important features of visual metaphors is to introduce a new system to the learner with the help of another system that the learner is familiar with. In other words, the learner transfers new information based on his or her old knowledge. For this reason, the use of visual metaphors appropriate to the background knowledge of learners in hypermedia navigation is believed to increase the navigational performance of learners in these environments.

**Literature Review**

In their exploratory study, Dias & Sousa (1997) investigated the role of a navigation map, provided by a hypermedia prototype, as a helping tool during browsing process. They tried to establish the influence of this navigational tool in retrieval tasks. 22 students tested navigation map and some data were collected. With scores obtained in a task-test and a record of the path followed by the subjects a set of ratios, as an attempt to understand the subjects’ browsing processes, defined. The findings of the study suggested that the navigation map was not effective in the ameliorative role. Conse-
quently, it was not wise to assume that a map that helps performance in a spatial context also forms an aid in a hypermedia environment under a non-hierarchical model.

Focusing on navigational performance in hypermedia, McDonald & Stevenson (1998a) investigated the effects of content structure and background knowledge on navigational performance in hypermedia. Three different content structures such as hierarchical, non-linear and hybrid (hierarchical and hybrid connections) were tested on 30 university students (half of whom had background knowledge about the subject, and half of whom did not). The navigational performances of the participants were measured in terms of the speed and correctness of their responses to the questions and in their determining their places. Students who had background knowledge about the subject showed higher performance than those who had no background knowledge about the subject. In addition, it was revealed that the participants had higher navigational performance in the hybrid content structure than they did in the other structures.

Dabbagh (2002) researched the effects of hierarchical versus heterarchical hypermedia structures of Web-based case representations on complex problem-solving skills and knowledge assembly in problem-centered learning environments. The study was conducted with two groups of college students (n=3 and n=3). They were assigned to work through an ill-structured problem, represented hierarchically and heterarchically in a Web-based format. Students’ journeys through the hypermedia case designs tracked by a Web-based tracking program. Students were observed while interacting with the problem and were interviewed after submitting their case solutions. Results from the tracking program, observations, case solutions, and interview questions addressed case design issues, problem-solving issues, and group processes. According to the results obtained, heterarchical case designs potentially increase student collaboration in a Web-based hypermedia design of an ill-structured problem and engage students in thinking critically about case content.

In another study conducted by Hsu & Schwen (2003), the researchers tried to determine the effects of structural cues – that can be inferred from the metaphors used in hypermedia – on the search performance in hypermedia. A total of 54 university students were assigned a task of information search in the hypermedia designed. At the end of this experimental study, the metaphorical signs given were found to help students reach higher number of correct information in shorter time.

McDonald & Stevenson (1998b), in their experimental study, investigated the effects of field knowledge and navigational tools in the hypermedia learning systems on navigational performance. For this purpose, hierarchical sitemap, content list, and hypertext only condition (no navigational
aid) were used. In the study carried out with 36 university students (half of whom knew the subject well, and half of whom did not), those who knew the subject well showed better performance in sitemaps than they did in content list.

Lee & Hsu (2004), in their experimental study conducted with 201 university students, aimed at determining the effects of cognitive styles and visual metaphoric interfaces on the learning performances of university students. The researchers found that there was a significant relationship between the cognitive styles of students and the interface format and the metaphoric interfaces increased the learning performances of the students.

When studies in the related literature are examined, it is seen that in general, navigation map (Dias & Sousa, 1997) content structures (McDonald & Stevenson, 1998a), navigational tools and background knowledge of students (McDonald & Stevenson, 1998b) were investigated regarding navigational performance in hypermedia. Moreover, the effects of visual metaphors on the learning performances (Lee & Hsu, 2004) and search performances of students (Hsu & Schwen, 2003) were investigated. However, there are relatively few research studies conducted on the effects of visual metaphors – which are quite important in cognitive field, computer sciences, and educational sciences – and fewer on the navigational performances of learners in hypermedia.

The purpose of this study is to determine the effects of visual metaphors used in hypermedia on the navigational performances of students. For this purpose, the following research questions were directed;

- Are there any significant differences between the navigational performances of students studying in visual metaphor supported and unsupported Hypermedia environments?
- What are the views of the participants on their own navigational performances?

METHODS

This study, investigating the effects of visual metaphors – used for navigational purposes in educational hypermedia – on the navigational performances of learners, was designed with post-test control group, one of the true-experimental designs. According to Campbell & Stanley (1966), a true-experimental design must include more than one group, common measured outcome(s), and random assignment.
Participants

The participants of the study were 33 students who were selected from 48 novice users taking the “Information Technologies in Education II” course in the department of Computer Education and Instructional Technologies (CEIT) at the Faculty of Education at Anadolu University. The students in this program interact with hypermedia learning environments throughout their courses in this program. The participants of the study were novice users to eliminate the possible effects of background hypermedia knowledge of the students on the research findings.

Data Collection Tools

In order to determine the ways students follow in the hypermedia structure and to identify their levels of disorientation, the history list of the Internet Explorer was used as the data collection tool of the study. For the purpose of calculating the duration of the time students spent on carrying out the tasks they were assigned at the beginning of the research application, computer logs were used. In addition, in order to identify the views of students about their own navigational performances, a data collection tool for the study was developed by the researchers. The data collection tool consisted of six questions, which were five 5-likert type questions and one open-ended question. Five likert-type questions were on visibility of the navigation tools, clarity and comprehensibility of the links, easy access to the pages, ability to reach the desired information speed and effectiveness of searching for information in hypermedia environments. The open-ended question was on student views on their navigational performance. For the validity of the data collection tool, field experts were consulted for their views. In line with these views, the questionnaire was finalized.

Data Collection Process

First, two hypermedia structure (one of which included visual metaphors in its interface, and the other did not) were prepared for the subject of “Web site design” included in the content of the Information Technologies In Education II course, which CEIT students took in the Fall Term. Following the preparation of the two hypermedia structure, the students were randomly divided into two groups as the experimental group (group A) and the control group (group B). The students in group A were given the hypermedia whose interface included visual metaphors, and those in group B were given the traditional hypermedia (whose interface did not include any metaphors).

On the first page of the hypermedia materials developed included the things to be done. Below the page was an entrance button that students would click to start the application when they were ready. When this but-
ton was clicked, the time started counting, and the student reached the main page of the hypermedia prepared for his or her group as can be seen in Figure 1.

**Figure 1.** The Home Page Screens of the Hypermedia of the Groups A (top) and B (bottom).
In order to enable the students to see the task assigned whenever they wanted, there was a button of “tasks” placed on the upper right corner of the pages. The tasks were finding information about a domain name registration and file names that can be used as the index page. Science the time that participants spend on hypermedia site was one of the main dimensions of this study, there was an “exit” button on the upper left-corner to allow students to leave the environment whenever they wanted. When the exit button was clicked, students were directed to an online questionnaire of performance evaluation. After the students completed the performance evaluation questionnaire, they saved it and left the environment. In order to decrease the difficulties that students might experience during the application and to allow healthy execution of the data collection process, the application was implemented by the researchers.

Data Analysis

The students’ scores regarding the time were calculated by dividing the total time by the number of tasks. The disorientation scores were calculated by dividing the number of correct visited pages that stand on the shortest path by the total number of visited pages (Laberge & Scialfa, 2005). In this way, the scores obtained for the first two measurements of navigational performance were saved. The third performance measurement was related to the students’ perceptions on their own navigational performances. For this purpose, the data obtained from the questionnaire of navigational performance were used.

In order to compare the navigational performances of students in hypermedia, one group was compared with the other for each performance measurement. For the purpose of determining whether there was a significant difference between the groups A and B in terms of such three features of students’ navigational performance as time, disorientation and perceptions about their own performance, Independent Samples t-test was applied at the significance level of p<.05.

FINDINGS

In the application executed in two different hypermedia groups with the same content, initially, the time scores and the disorientation scores as the first two measurements of navigational performance for the students in the experimental group (A) and for those in the control group (B) were calculated. Table 1 below presents the descriptive statistics regarding the time scores and the disorientation scores for both groups.
As can be seen in Table 1, while the time scores of the 16 students in group A were lower than the time scores of the 17 students in group B, the disorientation scores of the students in the former group were higher than those of the students in the latter. Since the disorientation scores were calculated dividing the number of the correct visited pages by the total number of the visited pages, the higher disorientation scores meant less disorientation for a student.

**Time Scores**

In order to determine the time the students in both groups spent on carrying out the tasks assigned, computer logs were examined. For this purpose, the time the students got connected to the Html site prepared for the Information Technologies in Education II course and the time the students left the environment were saved. Following this, by dividing the total time spent by each student by the number of tasks assigned, the time scores were obtained. Independent Samples t-test was applied to compare the mean time scores of the two groups.

As can be seen in Table 2, the time scores of the teacher candidates of Information Technologies revealed a significant difference between the groups \[t(31) = 2.27, p < .05\]. This finding shows that there was a significant relationship between the navigational hypermedia and the time spent on accessing
and locating the information. In addition, it is seen that the mean time (\(\bar{x}=2.5\)) spent on each task by the students in group A who used the hypermedia - supported by visual metaphors - in order to carry out the tasks assigned was lower than the mean time (\(\bar{x}=1.9\)) spent by those in group B.

**Disorientation Scores**

For the purpose of calculating the disorientation scores of the students, all the pages in which the students in both groups navigated were recorded by benefitting from the history lists of the Web browser. The disorientation scores of the students were calculated by dividing the number of the correct visited pages by the total number of all pages visited. The results of the Independent Samples t-test applied to compare the mean disorientation scores of the students can be seen in Table 3.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>(\bar{x})</th>
<th>Sd</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group B</td>
<td>17</td>
<td>.163</td>
<td>.063</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As can be seen in Table 2, the disorientation scores of the teacher candidates of Information Technologies differed significantly with respect to the hypermedia in which they navigated \([t(31)=3.39, p<.05]\). The mean disorientation scores (\(\bar{x}=.231\)) obtained from the pages in which the students in group A, who used the hypermedia supported by visual metaphors, navigated to carry out each task assigned were higher than the disorientation scores (\(\bar{x}=.163\)) of the students in group B. This finding shows that there was a significant relationship between the hypermedia the students navigated and the disorientation and that the disorientation of the students in group A was lower than that of the students in group B.

**Perceptions of the Students about Their Own Navigational Performances**

The third measurement carried out to determine whether the navigational performances of the students were related to the perception of the students about their own navigational performances. For this purpose, *the web site navigational performance evaluation questionnaire*, which was developed by the researchers and made up of two parts with 6 items, was used.

In the first part of the questionnaire, in order to determine the perceptions of the students about their navigational performance in the Web site, the students were asked for their perceptions about the visibility of the navigation
tools on the page, the clarity and comprehensibility of the links on the page, easy access to pages, easy access to the desired information in the site, and about the speed and effectiveness of searching for information. Within the scope of the likert-type questionnaire items, a score of 1 was assigned for very good, 2 for good, 3 for average, 4 for bad, and 5 for very bad. Following this, the mean scores of the responses given to all the questions for each group were calculated. Table 4 presents the results of t-test applied to compare the perceptions about the navigational performances of the groups.

**Table 4**
T-Test Results of the Navigational Performance Questionnaire for the Groups A and B

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Sd</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>16</td>
<td>4.05</td>
<td>.044</td>
<td>31</td>
<td>2.42</td>
</tr>
<tr>
<td>Group B</td>
<td>17</td>
<td>3.54</td>
<td>.071</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As can be seen in Table 4, the perceptions of the teacher candidates of Information Technologies about their own navigational performances revealed a significant difference in terms of the hypermedia in which the teacher candidates navigated $[t(31)=2.42, p<.05]$. In addition, the mean scores of the responses given to each item by the teacher candidates in both groups are presented in Table 5.

**Table 5**
The Item Means of the Groups for the Navigational Performance Questionnaire

<table>
<thead>
<tr>
<th>Items</th>
<th>Group A (X)</th>
<th>Group B (X)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The visibility of the navigation tools on the pages</td>
<td>4.06</td>
<td>3.24</td>
</tr>
<tr>
<td>The clarity and comprehensibility of the links on the pages</td>
<td>3.88</td>
<td>3.47</td>
</tr>
<tr>
<td>Easy Access to Pages</td>
<td>4.44</td>
<td>3.59</td>
</tr>
<tr>
<td>The ability to reach the desired information in the site</td>
<td>3.81</td>
<td>3.52</td>
</tr>
<tr>
<td>The speed and effectiveness of searching for information</td>
<td>4.06</td>
<td>3.89</td>
</tr>
<tr>
<td><strong>Total (X)</strong></td>
<td><strong>4.05</strong></td>
<td><strong>3.54</strong></td>
</tr>
</tbody>
</table>

When the means of the responses to the items developed to determine the perceptions of the students about their own navigational performances are examined, it is seen that the mean scores ($\bar{X}=4.05$) of the students in
group A – students who navigated in the hypermedia that included visual metaphors - were higher than the mean scores (3.54) of the students in group B – students who navigated in the hypermedia that did not include any visual metaphors. Moreover, it is seen that the students in group A assigned the highest score (4.44) to the feature of “easy access to pages” of the hypermedia in which they navigated.

In the second part of the questionnaire, the students were asked for their perceptions about how they evaluated their own navigational performances during the completion of the tasks assigned in the site. When the responses given by the students to this question were examined, it was seen that the students emphasized certain important points besides short answers such as “good”, “beautiful”, and “bad”. It was revealed that the metaphor of “home” used regarding the development of Web site drew the attention of especially the students in group A. One of the students stated:

*Navigation was easy, at least it had a fast structure. But the visuals were bad, and the font could have been different. But it was sense to explain with the use of “home”... (The base of the home, home address, the structure of the home etc.)*

The perceptions of the students in group A about their own navigational performances revealed that besides the metaphor of home, the students found navigation fast and easy, parallel to the likert-type item means. Regarding this point, two students stated:

“...The site is quite fast and easy to use ...“

“...In this site, navigation was easy. Also, instructions were easy and comprehensible, too ...”

Since metaphors, by their nature, are structures that try to explain hard-to-comprehend complex systems by benefitting from a well-known concept, it can be stated that the students considered the hypermedia system – in which a visual metaphor of home was used - as an easy and fast system (it was sense to explain with the use of “home”... The base of the home, home address, the structure of the home etc.)

**CONCLUSION AND DISCUSSION**

This study aimed at determining the effects of the visual metaphors used in hypermedia navigation on the navigational performances of students. For this purpose, two hypermedia structures were developed with the same con-
tent. One of the hypermedia included visual metaphors in its navigation, and the other did not. Following this, 33 novice students were asked to carry out the tasks assigned in these environments. The study was limited to 33 novice students taking the Information Technologies in Education II course in CEIT at Anadolu University. For the first question directed in the study, the navigational performances of the students were examined. The results of the three performance measurements carried out during the completion of the tasks were analyzed, and the first research question was answered.

Navigational performance in hypermedia is a comprehensive concept that covers disorientation the user’s inability to find his or her way, the time spent for the achievement of a task, and the easy and correct completion of a task. Therefore, in this study, which investigated the effects of visual metaphors used in hypermedia for navigational purposes on the navigational performances of learners, three different measurements were used. For the first two measurements, which were time and disorientation, quantitative data were used, and for the third measurement, students’ perceptions about their own navigational performances were used.

In order to be able to interpret the findings of the present study, the results obtained in each phase should be analyzed well. When the time scores of the visual metaphor included (experimental group) and traditional hypermedia group (control group) are compared, it is seen that there is a significant difference between the scores of the two groups. The students in group A carried out the tasks in 1.9 minute in average, while the students in group B carried out the same tasks in 2.5 minutes in average. Depending on this result within the limitations of the study, it was concluded that in terms of time, which was the first of the three performance measurements, the group who used visual metaphors in hypermedia showed higher performance. This finding of the study is also consistent with Hsu & Schwen’s (2003) conclusion that “metaphorical signs given were found to help students reach more correct information in shorter time”.

Regarding disorientation in hypermedia, which was the second measurement of the navigational performance of the experimental and control groups, there was a significant difference between the disorientation scores of the two groups. The students in the experimental group, who used visual metaphor in hypermedia, reported lower disorientation than the students in group B who did not use any visual metaphors in hypermedia. In conjunction with the limitations of the study, this shows that the disorientation levels of learners decrease when navigational visual metaphors are used in hypermedia. This finding is also parallel to Lee & Hsu’s (2004) claim that the metaphoric interfaces can increase the learning performances of the students.
When the students’ evaluations of their own performances, which constituted the third measurement of the navigational performance in hypermedia, are examined, it is seen that the students considered their navigational performance - in hypermedia in which visual metaphors were used – to be higher especially in terms of speed and easiness. This finding is parallel to the results of time and disorientation, which were the first two measurements of navigational performance. In other words, the views of the students in the experimental group – whose navigation included visual metaphors - about the hypermedia in which they navigated support the result that they carried out the tasks assigned faster and with less disorientation than the students in the control group did.

With the spread of Web, the use of hypermedia for educational purposes has gained importance. Especially, in today’s world, in which information is constantly updated, it is quite important to effectively benefit from hypermedia - which has a dynamic structure - in order to meet the learning needs of individuals. According to Morganti (2002), educational hypermedia tools are among the most promising tools to meet the educational needs of lifelong learners. However, the hypermedia, which has become a complex network due to the increasingly intense information, has also led to navigational problems such as disorientation and overuse of time. Therefore, hypermedia now requires users to show high navigational performance besides high level of interaction.

As a result of the present study, it was revealed that teacher candidates of Information Technologies experience less disorientation problems while carrying out tasks in hypermedia, in which visual metaphors are used. They carry out tasks in a shorter time and they evaluate their own navigational performances higher. Therefore, within the limitations of the study it is thought that visual metaphors could be used to facilitate navigation in hypermedia for educational purposes. Use of visual metaphors by educators in educational hypermedia could be offered as a practical result of the study.

In further research, same subjects of this study can be investigated with more participants and different age groups. Furthermore, the affects of different metaphor types on learners’ hypermedia navigation performance and affects of visual metaphors on disorientation and cognitive overload in hypermedia can be studied.

References
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