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Effects of different metaphor usage on hypertext learning

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There are many studies that offer different opinions on the effects of hypertext usage as an educational tool. Given the differences of opinion, it is useful to research the effects of metaphor usage in hypertext education and the use of hypertext as an educational tool. In this study, the effects of metaphors' uses in constructing the characteristics of the hypertext teaching have been approved. A between-group design experiment was conducted to study the effects of four metaphors on four different groups. Survey results emphasise the importance of metaphor usage and the manner in which metaphor is used. It was also discovered that metaphor usage in the hypertext teaching affects the construction duration of the hypertext but does not have any effects on the acquisition of knowledge.

Keywords: metaphor; hypertext; teaching/learning strategies; media in education; knowledge acquisition

1. Introduction

Educational tools and methods used in teaching are affected by fast-improving technology, and, correspondingly, hypertexts are used as an educational tool today with the common utilisation of the Internet in education. One of the first to use the term *hypertext*, Ted Nelson in 1961, named non-linear information organisations as hypertext. The usage of hypertexts, which have spread all around the world at a fast pace via the World Wide Web, has been the subject of experimental studies among psychologists, cognitive scientists and education researchers (McKnight *et al*. 1990, Mohageg 1992, Barnes 1994, Jacobson and Spiro 1995, Khalifa 1998, Bromme and Stahl 1999, 2002, 2005, Sun 1999, Ford and Chen 2000, Miall and Dobson 2001, Crandall and Phillips 2002, Koçoğlu and Köymen 2003).

There are several research studies and opinions stating that the use of hypertexts and hypertext constructions as an educational tool has a positive effect on learning (Jacobson and Spiro 1995, Turner and Handler 1997, Crandall and Phillips 2002, Wang 2003, Dünser and Jirasko 2005). These studies and opinions argue that hypertext environments can be used as cognitive tools to help students to perceive the semantic relations within a context and to develop ideas on information structures. In particular, Crandall and Phillips (2002) stated that the student-generated hyperlinks are more effective compared to the instructor-generated hyperlinks.

On the other hand, there are those who argue that hypertexts are effective only for students who are successful at information organisation, and, therefore, the use of hypertexts as an educational tool is limited (Laurillard 1993). Additionally, some researchers claim that certain characteristics of hypertexts may have negative effects on learning (Jonassen 1989, Bromme and Stahl 2002, 2005, Wang 2003). Likewise, Conklin (1987) identified two problems that may ultimately limit the usefulness of hypertexts as an educational tool: disorientation and cognitive overhead. Haake *et al*. (1994) confirm that these problems are still with us.

While there are different opinions as to its benefits, hypertext education increasingly gains more prominence due to its common use as a tool. Using metaphors in hypertext teaching is very common (Bromme and Stahl 1999, 2005, Wang 2003, Keranen 2005). Because metaphors relate new information to current information and convert abstract knowledge to concrete knowledge, they are one of the significant strategies used to introduce new information to students (Kuhn and Blumenthal 1996, Guss 2003, Senemoğlu 2004). However, if the necessary attention is not given, a strategy which can facilitate learning may fail. It may cause mis-learning of the new information, or learning only that part of it emphasised by the metaphor (Lakoff and Johnson 1980).

The most common metaphors used in hypertext teaching are as follows: book, map, village, house, classroom and travel (May *et al*. 1997, Bromme and Stahl 1999, 2005, Guss 2003, Keranen 2005). Bromme and Stahl (2005) discovered in their studies that when the hypertext concept is explained with a book

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metaphor, students perceive the hypertext structure as texts on successively ordered pages. Keranen (2005) states that the book is a good metaphor for a learning environment, and hypertext can be used in comparison as a new type of traditional book, as it is commonly known by everybody. Bromme and Stahl (2005), claimed that the space metaphor is the one most appropriate for the perception of hypertext structure. According to May *et al*. (1997), when the travel metaphor, which is similar to the space metaphor, is applied to hypermedia, learners utilise their energy trying to determine the directions to follow in the hypermedia rather than understanding the information.

As Lakoff and Johnson (1980) have stated, it is in the nature of metaphor to emphasise some aspects of the target and to hide others. Therefore, using a metaphor that emphasises the organisation of a book encourages students to perceive hypertext structure as linear. In this context, it would be useful to research the effects of different metaphors used in hypertext education and their usage manners on hypertext learning. Both the type of metaphor and the way the metaphor is used affect the way the students perceive the hypertext structure. Another problem that requires research is the difference in knowledge acquisition among students who form differently structured hypertexts.

The effects of hypertext structures on hypertext construction and reading processes have been studied previously (Miall and Dobson 2001, Bromme and Stahl 2005). Results show that different hypertext structures constructed by students (linear/non-linear) affected their hypertext reading and construction processes differently. For example, Bromme and Stahl (2005) found that those students who construct hypertext structures in non-linear ways experience more halts during the construction. Miall and Dobson (2001) compared the reading durations per node of the two groups who read linear and non-linear hypertexts and have found that the average duration of the group that reads the non-linear hypertexts is higher.

The aim of this study was to determine the effects of different metaphors used in hypertext teaching on the characteristics of hypertext construction (linear/non-linear, meaningful/meaningless link), specifically construction durations (halting period) and knowledge acquisition (content, relation and transfer knowledge). In this context, the following hypotheses were tested.

(1) Different metaphors used in hypertext education affect the hypertext structures constructed by students (i.e. whether the metaphor is linear or non-linear).
(2) Different metaphors used in hypertext education affect the links students make in hypertext construction (i.e. whether the link is meaningful or meaningless).
(3) Students who construct hypertexts in linear structures experience more halts during hypertext construction (students will experience more halts while constructing linear hypertext structures because of not to have a command on specific subjects).
(4) When hypertext construction is used as an educational tool, students who use non-linear hypertext structure do better in terms of content knowledge than those who use linear structure (students using non-linear hypertext structure will have to read the contents more carefully and comprehensibly to understand the relation among the concepts they will correlate).
(5) When hypertext construction is used as an educational tool, students who use non-linear hypertext structure do better in terms of relational knowledge than those who use linear structure (students using non-linear hypertext structure will be more successful in terms of relevant knowledge, because they conceive the relationship between the concepts).
(6) When hypertext construction is used as an educational tool, students who use non-linear hypertext structure do better in terms of transfer knowledge than those who use linear structure (students using non-linear hypertext structure will be able to use the knowledge in many areas because they read, understand and learn the relation of the subject better).

2. Method

In the study, pre-experimental design (the static-group comparison) has been applied, and qualitative and quantitative research techniques have been used. The hypertext construction application was implemented in the computer lessons of the seventh-grade students, using the software and hardware required to use the Internet as a tool for communication and accessing information. Four study groups of students were organised to compare the effects of different metaphors on hypertext education. There are total of four classes on the seventh-grade level at the school where the study was conducted, and the number of metaphors to be compared was limited to four. Students were given a pre-knowledge test, and their grade point averages in the first-term computer course for the 2005–2006 academic years were taken into consideration in order to determine whether the groups were equal. First, the percentages of the structures constructed by each

student were examined in categorisation of the link structures constructed by students in case of requiring 70% conformity. It was determined that there would be no losses on the part of students, and structures constructed by each student could be categorised as linear or non-linear. Then, the hypertext structures constructed by students were examined, and categorisation (linear/non-linear) was performed based on the structure, to which the link structure conforms at a rate of 70%.

To test the first three hypotheses, after the given hypertext education, a hypertext construction exam was followed by discovering the effects of different metaphors used in hypertext education, on behalf of looking at the characteristics and duration of constructed hypertexts. For the Hypotheses 4, 5 and 6, additional achievement tests were given to determine the effects of hypertext construction as an educational tool on knowledge acquisition.

2.1. Participants

The study group for the research consisted of 127 seventh-grade students who did not have any pre-knowledge of hypertexts and the subject dealt with within the scope of the application. Furthermore, the students did not have any hypertext construction experience. Four groups of students were drafted on which type of metaphor-based training.

2.2. Materials

2.2.1. Pre-knowledge test

The test was applied to determine both the prior knowledge of subjects dealing with the scope of hypertext construction and the equivalence of the study groups involved in the test. Some of the items from the questionnaire, which included 12 multiple-choice questions, are cited in Appendix 1.

In order to determine the content validity of the test, the list containing the targeted behaviors desired to be measured by questions was handed out to six teachers. According to the entered information on specific questions, teachers themselves could measure the specific behavioural outcomes. Consistency between results of the evaluation carried out by six teachers has been determined to be 84.6%. The substance internal consistency coefficient of the test (Cronbach's alpha) was calculated as 0.71.

2.2.2. Hypertext explanations

These are the definitions that the researchers prepared to give information about hypertext to the students. In the research, hypertext definitions with four metaphors have been prepared as book (book-1); the book, the table of contents of which is emphasised (book-2); encyclopaedia; and city. The book metaphor whose table of contents was emphasised is given in Appendix 2 as an example.

2.2.3. Hypertext construction exam

This exam, which the researchers developed to determine the hypertext construction performance of students, consists of 17 HTML files, each of which includes a sub-subject on the Internet. The examples are given in Appendix 3.

In the assessment of the hypertext construction exam, qualitative research techniques were used. The exam yielded data on hypertext structure, meaningful and meaningless link percentage and the halting period during the construction. Moreover, the processes students applied on the computer have been recorded with screen record software.

For the analysis of the number of links, the Analysis Form for HTML Files, which is cited in Appendix 4, has been used. For the determination of links as meaningful or meaningless, the fact that the chosen word or sentence for a link has been forwarded to the relevant HTML file has been taken into consideration.

- Hypertext structure, obtained after the analysis, was categorised as linear or non-linear. Structures in which nodes are linked to the next one through a single link are assumed to be linear structures, and those in which nodes are not linked in a way to follow one another are assumed to be non-linear structures.
- For the analysis of halts (total length of the halts) during the construction durations, video records were used. For the calculation of halt durations during the construction durations, at least a 5-second duration, which passes without any process on the screen, has been accepted as a halt period (Bromme and Stahl 2005). Total length of the halts was calculated by summing up all halting durations of one student.

2.2.4. Achievement test

This test, which was developed to assess the achievements of the students on the subject dealt with within the scope of hypertext construction exam, consists of three sub-sections (content, relational and transfer knowledge) and 26 multiple-choice questions. Sample questions can be seen in Appendix 5. The test was evaluated over 26 points in total.

In order to determine the content validity of the test, the list containing the targeted behaviours desired to be measured by questions was handed out to six teachers. According to the entered information on specific questions, teachers themselves could measure the specific behavioural outcomes. Consistency between results of the evaluation carried out by six teachers has been determined to be 74%. Internal consistency coefficient (Cronbach's alpha) of the test was calculated as 0.86.

2.3. Procedure

The stages of the application are provided in Table 1. Before the application, basic knowledge of web editor software (opening a file, saving and closing) was explained to students, and students were given a pre-knowledge test consisting of the subject dealt with within the scope of the application. In the application, first of all, hypertext has been taught to students using different metaphors in each group, and students were given 10 minutes to read the hypertext definitions. At the end of the 10-minute period, link setting in web editor software was explained to students, and they were asked to do some practice. The cards to be used in the hypertext construction exam were distributed to students, and they were asked to form hypertexts through link setting. Before the initiation of the exam, students were given time to read the cards so that they would have an idea about the content (Appendix 3). The exam lasted for 60 minutes, and the application session ended after the achievement test.

3. Results

3.1. Background knowledge

To determine whether the study groups were equal in their performance in the computer course, their computer course grades were compared through 'one-way analysis of variance (ANOVA)', and it was detected that there was not a significant difference between study groups, $F(3, 123) = 2.44$, $p > 0.05$.

To determine whether the study groups were equal in their pre-knowledge on the subject dealt with within the scope of application, their pre-knowledge test scores were compared through one-way ANOVA, and it was detected that there was not a significant difference between study groups, $F(3, 123) = 0.88$, $p > 0.05$.

An interview with the computer teacher confirmed that students were not given information on hypertext construction and link setting before using the application. In order to reduce the possibility of students researching hypertext construction and link setting before taking the tests, they were not asked if they had been given training on this subject. In the course, when the application was practised and before hypertext training, students were asked to explain the concept of hypertext. The results showed that none of the students could explain the concept.

Table 1. The stages of the application.

Day 1	Step 1 (1 hour)	Basic knowledge of web editor (MS FrontPage) was explained
	Step 2 (1 hour)	Pre-knowledge test was applied
Day 2	Step 3 (3 hours)	Hypertext was taught to students using different metaphors
		Hypertext construction examination was given
		Achievement test was given

3.2. Study results

Hypothesis 1: Different metaphors used in hypertext education affect the hypertext structures constructed by students (i.e. the structure being linear or non-linear).

In order to determine whether the structure of the hypertexts constructed by the students differ in accordance with the metaphor used in the hypertext education, data on the structure obtained as a result of the analysis of the hypertexts have been compared with Chi-square test as shown in Table 2. The research showed that there was a significant difference between study groups, $[chi]^2$ $(3, N = 127) = 28.99$, $p < 0.05$. In line with the results, the first hypothesis was verified, and hypertexts were constructed in the non-linear structure in the city, encyclopaedia, and book-2 metaphor groups, and in linear structure in the book metaphor group.

Hypothesis 2: Different metaphors used in hypertext education affect the links students make in hypertext construction (i.e. links being meaningful or meaningless).

In order to determine whether the meaningful link percentages of experimental groups differ in accordance with the metaphor used in the hypertext education, the meaningful link percentage obtained as a result of analysis of constructed hypertexts was compared through one-way ANOVA as can be seen in Table 3. The comparison showed that there was a significant difference between study groups, $F(3, 123) = 3.49$, $p < 0.05$. As a result of the Tukey's honestly significant differences (HSD) test given in Table 4, it has been determined that the difference is between the encyclopaedia and the city metaphor groups and that the city metaphor group has set more meaningful links.

Table 2. Percentages and the number of hypertext structures.

Group	No. of students	Linear (*n*)	Non-linear (*n*)	Halting periods (sec)	Meaningful link (%)	Meaningless link (%)
Book-1	31	23	8	675	53	47
Encyclopaedia	31	10	21	448	40	60
Book-2	32	7	25	267	56	44
City	33	5	28	402	63	37

Table 3. The ANOVA results relating to meaningful link percentage.

Source of variation	Sum of squares	sd	Mean square	*F*	*p*	Significant difference (*p*)
Between groups	8,519.23	3	2,839.74	3.49	0.02	Encyclopaedia–city (0.01)
Within groups	99,922.15	123	812.37			
Total	108,441.40	126				

Table 4. Tukey's HSD test results for meaningful link percentages.

Groups	Mean difference	*p*
Encyclopaedia–book-1	12.96	0.28
Encyclopaedia–book-2	15.62	0.14
Encyclopaedia–city	22.63	0.01
Book-2–book-1	2.66	0.98
Book-2–city	7.00	0.76
Book-1–city	9.66	0.53

In order to determine whether the meaningless link percentages of experimental groups differ in accordance with the metaphor used in the hypertext education, the meaningless link percentage obtained as a result of analysis of hypertexts constructed was compared to relevant data through one-way ANOVA as can be seen in Table 5. This comparison showed that there was a significant difference between study groups, $F(3, 123) = 3.49$, $p < 0.05$.

As a result of the Tukey's test given in Table 4, it has been determined that the difference is between the encyclopaedia and the city metaphor groups and that the encyclopaedia metaphor group has set more meaningless links. In line with the results, the second hypothesis was verified.

> Hypothesis 3: Students who construct hypertext in linear structure experience more halts during hypertext construction.

In order to test whether the total halting periods experienced by students during hypertext construction differ in accordance with perceived hypertext structure (linear/non-linear), the data of total halting periods obtained by analysing video records of the hypertext construction exam were compared through independent-sample *t*-test as can be seen in Table 6. The comparison showed that there was a significant difference between linear and non-linear groups. A comparison of their mean showed that the study group that forms hypertext in linear structure ($M = 602.70$) experienced longer periods of halts than the non-linear group ($M = 360.00$). The results verified the third hypothesis.

> Hypothesis 4: When hypertext construction is used as an educational tool, students who use non-linear hypertext structure do better in terms of content knowledge than those who use linear structure.

In case of testing the fourth, fifth and sixth hypothesis, the content relation and transfer of information in hypertext construction were tested with the relevant subjects, and the results are provided in Table 7.

In order to determine whether the content knowledge on a relevant subject differs according to the structure of the hypertext constructed when hypertext construction is used as an educational tool, the scores obtained from the first part of the achievement test were compared through independent-sample *t*-test. The comparison showed that there was not a significant difference between the content knowledge scores of study groups. According to the results given in Table 8, the fourth hypothesis is not verified.

> Hypothesis 5: When hypertext construction is used as an educational tool, students who use non-linear hypertext structure do better in terms of relational knowledge than those who use linear structure.

In order to determine whether the relation knowledge on a relevant subject differs according to the

Table 5. The ANOVA results relating to meaningless link percentage.

Source of variation	Sum of squares	sd	Mean square	F	p	Significant difference (p)
Between groups	8,519.23	3	2,839.74	3.49	0.02	Encyclopaedia–city (0.01)
Within groups	99,922.15	123	812.37			
Total	108,441.40	126				

Table 6. t-Test results relating to halting periods experienced during hypertext construction.

Hypertext structure	N	Mean	Std. deviation	sd	t	p
Linear	45	602.70	242.96	125	6.17	0.000
Non-linear	82	360.00	192.29			

structure of the hypertext constructed when hypertext construction is used as an educational tool, the scores obtained from the second part of the achievement test were compared through the independent-sample t-test. The comparison showed that there was not a significant difference between the relation knowledge scores of study groups. According to the results given in Table 9, the fifth hypothesis is not verified.

> Hypothesis 6: When hypertext construction is used as an educational tool, students who use non-linear hypertext structure do better in terms of transfer knowledge than those who use linear structure.

In order to determine whether the transfer knowledge on a relevant subject differs according to the structure of the hypertext constructed when the hypertext construction is used as an educational tool, the scores obtained from the third part of the achievement test were compared through the independent-sample t-test. The results showed that there was not a significant difference between the transfer knowledge scores of study groups. According to the results given in Table 10, the sixth hypothesis is not verified.

Furthermore, independent-sample t-test was performed to determine whether there is any difference between groups that construct linear and non-linear links when considered in terms of the total score, which is assumed to be the total of the content, relation and transfer knowledge scores. It was also observed that there were no differences between groups ($t = 0.68$; $p = 0.49 > 0.05$). Similar results were obtained from the ANOVA test, which was used for comparing in terms of the total scores of metaphor groups; no differences found at all ($F(3,123) = 1.94$; $p = 0.12 > 0.05$).

3.3. Discussion

This research attempted to determine the effects of different metaphors used in hypertext teaching on the characteristics of hypertexts that are constructed, construction durations and the effects of hypertext construction when it is used as a tool in teaching. The findings that were obtained produced the following results.

It has been determined that different metaphors used in the scope of research affect the structures of the hypertexts constructed by students. Among the four different metaphors used in the study, the majority of the students in the book-1 metaphor group (74.2%) constructed metaphors in linear structure, while the students in the other metaphor groups constructed hypertexts in non-linear structure (encyclopaedia: 67.7%, book-2: 78.1% and city: 84.8%). In terms of both percentage of non-linear links and meaningful links constructed by the student groups, the group that is using the city metaphor was well ahead of the other student groups that are using other metaphors.

It can be thought that most of the students in the city metaphor group construct a non-linear hypertext structure because the metaphor used is a familiar, spatial one for students, an environment where the students live. This result is similar to previous research results. In the study by Bromme and Stahl (2005), two metaphors (book and space) were used for hypertext teaching, and it was found that hypertext structures differ according to the metaphors used, and that the book metaphor causes students to construct linear hypertext structures. It is known that the book metaphor is also frequently used in hypertexts and other web-based technologies; however, the book metaphor does not sufficiently reflect the structure of hypertexts due to its linear nature. It is also restricting (Cates 2001, Guss 2003, Dünser and Jirasko 2005, Keranen 2005).

Sun (1999) discovered that hypertext construction can be used as a learning method, but linear content on the paper given to students before the construction of the hypertext affects the structures of the hypertexts they construct. Considering the study results of Sun, in this research, before the construction exam, the content used in the hypertext construction test was given to students in divisions with different subheadings. However, on the contrary, it has been observed that hypertexts constructed in the book-1 metaphor group are of linear structure. This situation can be interpreted as another result indicating that metaphor usage in hypertext teaching can affect the hypertext structures that students construct.

Table 7. Results of achievement exam consisting of three sub-sections.

Group	No. of students	Linear (*n*)	Non-linear (*n*)	Content	Relation	Transfer	Total
Book-1	31	23	8	4.2	2.1	3.2	9.5
Encyclopaedia	31	10	21	3.3	1.8	2.4	7.5
Book-2	32	7	25	3.8	1.8	2.6	8.3
City	33	5	28	4.2	2.2	2.9	9.3
Average				3.9	2.0	2.8	8.7

Table 8. *t*-test results relating to differences between content knowledge scores.

Hypertext structure	*N*	Mean	Std. deviation	sd	*t*	*p*
Linear	45	3.64	1.85	125	1.09	0.279
Non-linear	82	4.04	2.00			

Table 9. *t*-test results relating to differences between relation knowledge scores.

Hypertext structure	*N*	Mean	Std. deviation	sd	*t*	*p*
Linear	45	2.00	1.43	125	0.047	0.962
Non-linear	82	1.99	1.37			

Table 10. *t*-test results relating to difference between transfer knowledge scores.

Hypertext structure	*N*	Mean	Std. deviation	sd	*t*	*p*
Linear	45	2.71	1.55	125	0.328	0.743
Non-linear	82	2.80	1.54			

Another result obtained in the research is that the manner of metaphor usage is also important. When the contents part of the book is emphasised in the group which is given training by way of the book metaphor (book-2), it was determined that the majority of the students form hypertexts in non-linear structures. This result contradicts the study results of Bromme and Stahl (2005) in which the contents part is not emphasised for the book metaphor. According to Bromme and Stahl (2005), students receiving hypertext education using the book metaphor constructed linear hypertexts. However, it has been determined in this research that when a different aspect of a book which is the same metaphor is emphasised, students formed a nonlinear hypertext structure. Yet, Foltz (1996) also emphasises the fact that using properties of traditional texts, like the table of contents and index, to facilitate the user's task can be useful. Guss (2003) stated that the book metaphor used in several websites can be structured by using the table of contents in a way that supports the opinion of Foltz.

According to the research results, it has been determined that different metaphors used in the hypertext teaching affect the links (whether they are meaningful or meaningless) in hypertexts constructed by students. It has been found that the difference in the meaningful/meaningless link percentages occurs in encyclopaedia and city metaphor groups. The encyclopaedia metaphor group constructs more meaningless links than the city group, which constructs more meaningful links. The cause of this result can be that students make research via the Internet with developing technology, and they may have taken the encyclopaedia out of their lives. It would be useful to research this situation in other studies. As Lakoff and Johnson (1980), Senemoğlu (2004) and Guss (2003) also stated, a familiar tool must be chosen for metaphor usage to make a contribution to understanding. The fact that the average of meaningless link percentage is the least in city metaphor group can be thought to result from the fact that the metaphor used is a familiar one for students, represents a frequently-used environment and is a spatial metaphor. As a matter of fact, Kuhn and Blumenthal (1996) think that abstract concepts frequently become understandable with spatial metaphors. The places we use in our daily lives have significant properties that can be a source for metaphors used in interfaces and spatial structures. Cities, landscapes, buildings and tables present familiar processes.

As a result of the hypertext training given with different metaphors used within the scope of research, it has been detected that halting periods experienced by the study group that has constructed hypertext in linear structure during the construction duration are longer than those of the study group that has constructed hypertext in non-linear structure. As the reason for this situation, we can think that the group that has constructed the linear structure might have experienced longer halt durations while trying to order the nodes. While the results support the research results of Bromme and Stahl (2005), they contradict the results of the study by Miall and Dobson (2001) in respect of their hypertext reading and construction

durations. Miall and Dobson compared the reading durations per node of the two groups who read linear and non-linear hypertexts and have found that the average of the group that reads the non-linear hypertexts is higher. In this respect, it can be stated that the halting durations observed in non-linear structure in hypertext reading are observed in linear structures in hypertext construction.

According to another result of this research, if hypertext construction is used as an educational tool, it was found that there was not a significant difference between groups for whom the hypertext structures are linear and non-linear with regard to content, relation and transfer knowledge on the relevant subject. And also when the averages were examined, it was seen that the averages of the groups that were calculated over 26 (total score of the achievement test) were very low with 8.7. The final results of the study show that the way of hypertext teaching prevented the students from learning the content of the concepts. This is mostly based on focusing too much on metaphors to teach the structure of the hypertext. As Lakoff and Johnson (1980) pointed out, while metaphors might emphasise some aspects of the target, they may miss the others.

Another reason for this result might be that, during the hypertext construction process, both groups made decisions on the links they set by using the key words in the content without trying to understand the whole text. Yet, in their studies about information search in hypertexts, Marchionini and Schneiderman (1988) determined that when the research questions given to students are open and comprehensible, users prefer to use the key words and table of contents part instead of reading the whole text, and when the questions are not comprehensible, they prefer to search by way of skimming.

Another reason obtained in respect of knowledge acquisition might be that, during hypertext construction, students carry out multiple tasks such as reading the content, thinking over the links that can be set, setting the links and checking the accuracy of the links they set. This situation might have obstructed the knowledge acquisition of both groups. Then, there are arguments that in hypertext the user has to carry out multiple tasks, and the execution of those tasks puts pressure on the user (Foss 1989, cited in Kim and Hirtle 1995). The fact that there is more than one way to go within the hypertext might be difficult for the user (Foltz 1996), and the user who goes through a non-linear structure feels more lost than the user who goes through a linear hypertext document (Mohageg 1992). This result also matches with the results of another study. In this study, it was observed that there are no significant differences between the metaphor groups in terms of knowledge acquisition (neither between totals nor among subsections). But considering the total score, the book-1 metaphor group that constructed the most linear links had the highest score by 9.5.

Based on the research results on the usage of hypertext construction as an educational tool, it can be useful to repeat the research by using different measurement tools for the assessment of students' knowledge acquisition. For example, concept maps can be used as a measurement tool for the assessment of association of concepts. In his study in 1998, Khalifa measured the ability of groups who read the non-linear hypertexts to interrelate the concepts with concept maps and found a difference in favour of the group that read hypertext (Khalifa 1998).

4. Conclusion

This research confirmed that it is useful to use spatial metaphors for the apprehension of hypertext structure. In hypertext teaching, the manner of metaphor usage is very important because, when the table of contents is emphasised in the book (book-2) metaphor, it has been observed that students form non-linear hypertexts. This study found that the halts experienced in non-linear structures during the reading process have also been observed during the construction process of linear structure. It has been found that when hypertext is used as an educational tool, students' knowledge acquisition is not at the expected level, and using different metaphors does not have any effect. As specified by Lakoff and Johnson (1980), this situation once more emphasises the importance of being careful in using metaphors. In addition to the new studies, it would be worthwhile to investigate whether the content of hypertext influences the effect of metaphors used or not.

Future studies can develop strategies to enable students to read the whole content text before hypertext construction. Moreover, to increase knowledge acquisition might be done by adding tool tips and the map-similar properties for web editors. In this way, it displays the inter-link relations during hypertext construction. (While constructing the hypertext stage, the add tip text features of web editor software can be used to reduce the likelihood of students' constructing links by using keywords before reading and understanding the whole texts used. Similar construction of the links using keywords can be reduced, if students are asked to enter tip texts in such a way to contain summary information relating to the text to be accessed when links are clicked.)

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Appendix 1. Example questions from pre-knowledge test.

1. Which one of the following is not necessary to connect to Internet?
   a). Computer
   b). Modem
   c). Telephone machinery
   d). Internet account
   e). Web browser
   f). I don't know

2. What is Web (www)?
   a). It is an Internet environment which includes all kinds of information such as written material, movie, audio, etc.
   b). It's a kind of Internet service provider.
   c). It's the mails sent on Internet.
   d). It's the service used to do search on Internet.
   e). It's a general name given to Internet addresses.
   f). I don't know.

3. Which one of the following is NOT one of the services which enable live chat and messaging on Internet?
   a). Messenger
   b). icq
   c). irc
   d). skype
   e). news group
   f). I don't know

4. 'It is the name given to the organisation which gives the necessary user name and password to connect to Internet.' To which one of the followings does this definition belong to?
   a). web
   b). Internet explorer
   c). e-mail service
   d). web browser
   e). Internet service provider
   f). I don't know

13. Have you ever prepared a website before?
   ( ) Yes ( ) No

14. If your answer to the 13th question is 'Yes', please briefly explain how you prepared the website.

Appendix 2. Hypertext explanation

The article below has been prepared to introduce the *hypertext*. After reading this article, you will have learned the basic knowledge of hypertext.

What is hypertext?

You might have surfed on the Internet before. Well, have you ever realised that the texts on the Internet are different from the ones on paper?

The texts on the Internet offer some convenience to people. For example, you go from one text to another with only one click. When you come onto such clickable texts, the mouse indicator turns into a hand icon, and when you click on it, it passes onto another text. You see, the texts with this nature are called *hypertexts*. You can draw a parallel between hypertexts and *books with table of contents*. There are two concepts we need to know to understand what hypertext is. These concepts are *nodes* and *links*: *nodes* are like the each page in a book, and *links* are the 'table of contents' part in a book.

As you all know, you can read the texts in a book by moving through the pages in order one by one. However, in a book that has the 'table of contents' part, you can reach the subject you want to read more easily and quickly by finding its page number in the 'table of contents' part. We can compare hypertexts to such a book. Each page on which the subjects are written is like the each node on hypertexts. The 'table of contents' part of the book is like the links of a hypertext. While you can pass onto a node by clicking on the links of a hypertext, you go to the desired page by locating the subject in the 'table of contents' part of a book. In other words, briefly: hypertext → book with a table of contents part; node → book page; and links → table of contents.

Appendix 3. Example of html files contents that were used in the hypertext construction exam.

Internet

The Internet is a big system that connects several computers to each other. All the computers connected to the Internet can exchange information with each other.

Connection to the Internet requires computer, modem and telephone line as hardware and web browser and Internet account as software.

Required software for internet connection

Web browser: It is the required software for us to be able to see the websites on the Internet. As examples of frequently used Internet scanners of our day, Internet Explorer, Netscape Navigator, Firefox and Opera can be given. Besides software, we need an Internet account to connect to the Internet. Internet account consists of user name and password.

Required hardware for internet connection

- Computer
- Modem: It is the tool that enables the communication between computers by using the telephone lines.
- Telephone line: Information on the Internet is transmitted through telephone line. It is not required for the telephone line to be plugged to a telephone machine

Besides the hardware mentioned above, we also need software to be able to connect to the Internet.

Internet service provider (ISP)

It is the general name given to the organisation that provides an Internet account, i.e. the user name and password required to connect to the Internet in exchange for a specific price. As an example for ISPs, we can say e-kolay, mynet and superonline.

Appendix 4. Example analysis forms for HTML file

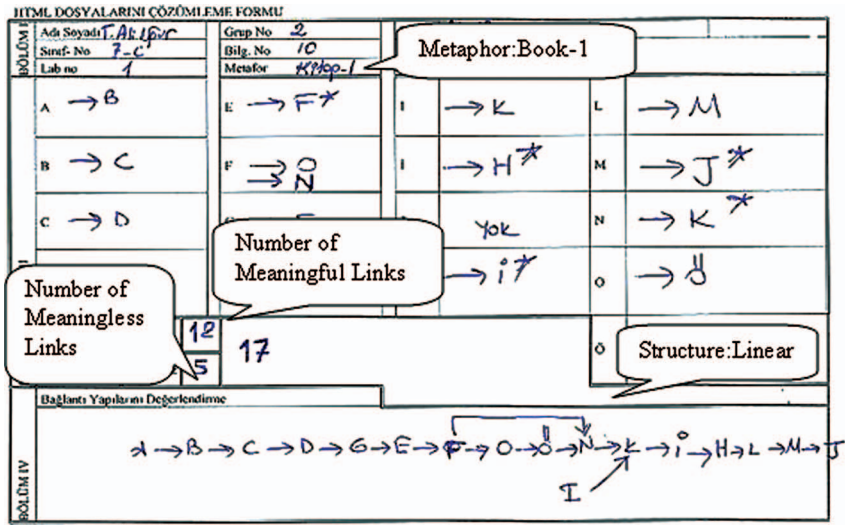

Figure A1. Hypertext structure was accepted as linear.

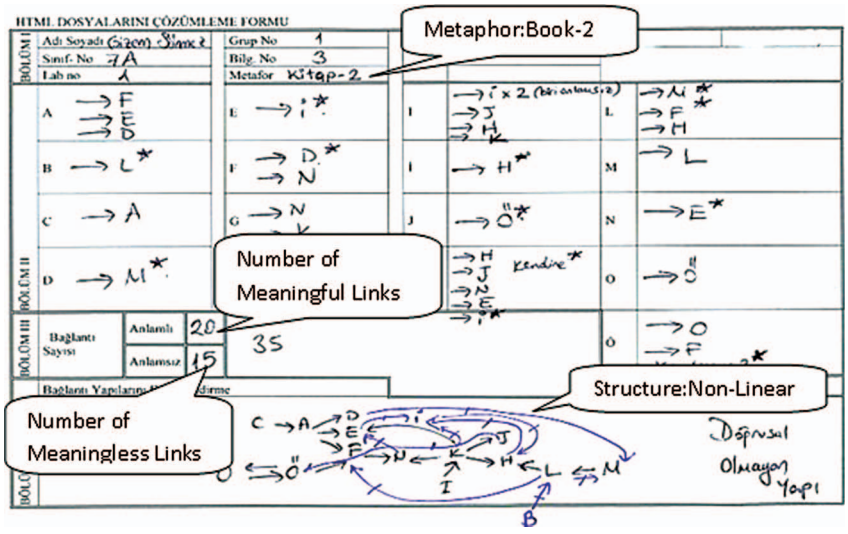

Figure A2. Hypertext structure was accepted as non-linear.

Appendix 5. Example questions of achievement test

Part 1

1. Which one of the following is not necessary to connect to the Internet?
   a). Computer
   b). Modem
   c). Telephone machinery
   d). Internet account
   e). Web browser

2. What is the Web (www)?
   a). It is an Internet environment which includes all kinds of information such as written material, movie, audio, etc.
   b). It's a kind of Internet service provider.
   c). It's the mails sent on the Internet.
   d). It's the service used to do a search on the Internet.
   e). It's a general name given to Internet addresses.

Part 2

What kind of relationship is there between the concepts cited in the questions below?

Internet account – e-mail account
   a). Both are used for connection to the Internet.
   b). Both are used to send mail.
   c). Both consist of user name and password.
   d). You cannot get an Internet account without an e-mail account.
   e). E-mail account is used to connect to the Internet while an Internet account is used to send e-mail.

Firefox – URL
   a). Both are web browsers.
   b). Both are Internet service providers.
   c). URL and Firefox are two of the services the Internet offers.
   d). Firefox is used to write URLs.
   e). URL and Firefox are searching services.

Part 3

Please complete the comparisons cited in the questions below. There is a similar relation between the concepts in the right column as in the left column. However, one of the concepts in the right column is absent. Find the absent concept in the right by making use of the relation between the concepts on the left. Go through the example below before starting to answer.

Required software to connect to the Internet – Firefox	Required hardware to connect to the Internet–
a) Internet explorer b) Netscape c) Telephone d) Modem e) Internet account	