THE EFFECTS OF SEDUCTIVE DETAILS AND TOPIC INTEREST ON LEARNING AND COGNITIVE LOAD IN HYPERTEXT ENVIRONMENTS

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DECLARATION OF ORIGINALITY

I, Yiğit Aydın, certify that

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ABSTRACT

The Effects of Seductive Details and Topic Interest
on Learning and Cognitive Load in Hypertext Environments

The purpose of this study is to investigate whether or not the seductive details effect and topic interest has any effect on learning and cognitive load in hypertext environments. Four types of treatment were designed: hierarchical and network hypertext, with and without seductive details. Data were collected from 109 participants who were undergraduate college students. Participants took a prior knowledge test and topic interest survey then they used the treatment they were assigned. Cognitive load questionnaire, a free recall test and five transfer questions were administered after the treatment. Analyses showed that seductive details seemed to facilitate recall performance whereas higher topic interest led to better transfer performance. On the other hand, hypertext structure has no effect on learning measures as well as on cognitive load. Participants possessing higher prior knowledge were more successful on both learning measures. However, cognitive load did not seem to be affected by any of the independent variables. Results were interpreted in terms of Kintsch's (1988) construction-integration model of text comprehension and cognitive theory of multimedia learning (Mayer & Moreno, 1999).

ÖZET

Çeldirici Detaylar ve Konu İlgisinin Hipermetin Ortamında Öğrenme ve Bilişsel Yüke Olan Etkileri

Bu çalışmanın amacı çeldirici detaylar ve konu ilgisinin hipermetin ortamlarında, öğrenme ve bilişsel yüke olan etkilerini araştırmaktır. Çalışma kapsamında dört farklı öğrenme ortamı hazırlanmıştır: Çeldirici detay içeren ve içermeyen, hiyerarşik ve ağ yapılı hipermetin ortamları. Veriler 109 lisans öğrencisinden toplanmıştır. Katılımcılar ilk olarak konu ile ilgili ön bilgilerini ölçen bir test alıp sonrasında da konu ilgisi formunu doldurmuşlardır. İstatistiksel hesaplamalar sırasında yalnızda düşük ön bilgiye sahip 93 katılımcının sonuçları dikkate alınmıştır. Her öğrenci kendisi için belirlenen öğrenme ortamında ilgili hipermetini kullanmış ve ardından bilişsel yük anketini doldurmuştur. Katılımcılar daha sonra hatırlama ve beş soruluk transfer testlerini yapmışlardır. Sonuçlar çeldirici detayların hatırlamaya olumlu anlamda etki ettiğini göstermiş aynı zamanda konu ilgisi yüksek olan katılımcıların transfer testinde başarılı olduğunu ortaya koymuştur. Öte yandan, hipermetin yapısının öğrenme ve bilişsel yük üzerinde hiçbir etkisinin olmadığı gözlemlenmiştir. Daha yüksek ön bilgiye sahip katılımcıların her iki öğrenme ölçümünde daha başarılı olduğu görülmüştür. Bilişsel yük ise hiçbir bağımsız değişkenden etkilenmemiştir. Sonuçlar Kintsch'in (1988) kurma-birleştirme ve Mayer ve Moreno'nun (1999) çoklu ortamlı öğrenmede bilişsel kuramı üzerinden değerlendirilmiştir.

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CHAPTER 1

INTRODUCTION

The use of hypertext in educational settings is a popular area of research. Hypertexts for educational settings enable readers to actively search and evaluate the information according to their learning goals, dynamically explore the space created by links and nodes, and design their own sequence of reading as opposed to the traditional linear texts (Amadieu, van Gog, Mariné, Paas, Tricot, 2009; Amadieu, Mariné, Tricot, 2009). The present study investigates the learning process within such environments to identify the effects of seductive details (Moreno & Mayer, 2000) and perceived cognitive load in networked and hierarchical hypertext structures.

1.1 Statement of the problem

Arousing students' interest for learning by making instructional material attractive is a concern for instructional designers, teachers, and publishers alike. It has been argued that students' engagement in learning and their satisfaction with the lesson will increase when the material is designed to sound interesting for the students (Brown, 2005; Izard & Ackerman, 2005). To make the material interesting, instructional designers sometimes use what is called "seductive details" —interesting information somewhat related to instructional content, but with little relevance for the learning goals (Harp & Mayer, 1998). However, the effect of such details on learning is not unequivocal. Sanchez and Wiley (2006) found that the presence of seductive details positively affected student achievement, while Chang and Choi (2014) reported poor student performance both on recall and transfer tests when seductive details were included in instructional material. On the other hand, findings from several studies are inconclusive: Sitzmann and Johnson (2014), for example, stated that seductive details improved student performance indirectly by reducing their negative affect towards the lesson, but at the same time hindered their learning performance by reducing time on task. A clear-cut conclusion is needed about the effects of seductive details in instructional material.

Hypertext environments have been used for educational purposes for over two decades. Most common forms of hypertext are hierarchical and network like structures (Shin, Schallert, & Savenye, 1994). Hypertext design imposes a predetermined pace on the learners. Hierarchical designs do not allow learners to traverse between nodes freely, whereas network designs permit learners to move between nodes more flexibly. Although it is safe to say that there is somewhat of a consensus on the hierarchical type of hypertext structure that nurtures students with low background knowledge and those with high background knowledge (Amadieu F., Tricot A., & Mariné C., 2009; Potelle H. & Rouet J. F. 2003), the effects of seductive details on hypertext environments are not clear. Since both types of structures are frequently used for educational purposes, seductive detail effect in hypertext environments needs to be clarified.

1.2 Purpose of the study

Hypertext is not only an inseparable component of the World Wide Web, but is also commonly used in educational multimedia. Given the inconclusive findings in the research literature about the effects of hypertext structure, this study aims to investigate the effects of different hypertext structures on learning outcomes.

The seductive details effect, on the other hand, is a popular topic in multimedia learning. However, there is a dualism where some researchers agree upon the benefits of seductive details, while others assert that seductive details have a detrimental effect for learning (Chang & Choi, 2014; Sanchez & Wiley, 2006; Moreno & Mayer, 2000). The effects of interesting but irrelevant details are not yet investigated within a hypertext environment. Another aim of this study is to further investigate seductive detail effect on hypertext environments to help understand how to best design hypertext materials for educational purposes.

This study also probes how the structure of hypertext affects students' cognitive load on a learning task. Antonenko & Niederhauser (2010) states that learning from hypertext requires additional cognitive resources as opposed to the traditional linear texts. Since information nodes are spatially separated, learners need to engage in extra cognitive activities to integrate these discrete nodes into a cohesive and meaningful whole (Antonenko & Niederhauser, 2010). On the other hand, Kirschner (2002) underlines that if the cognitive load is imposed within the limits of working memory capacity, it can foster, rather than hinder student learning.

Topic interest was studied frequently in a single type of environment throughout the literature (Erçetin, 2010; Lawless et al., 2003; Schiefele & Krapp, 1996).This study will also contribute to the literature by investigating the effects of topic interest in different hypertext structures, taking the seductive details effect into account.

1.3 Significance of the study

This study investigates two types of hypertext structures (hierarchical and network) with and without seductive details, designed for educational purposes to help identify appropriate design features for multimedia learning. However, the discrete nature of hypertext imposes an extraneous cognitive load on learners, requiring them to draw their reading patterns according to their needs. Students need to identify and explore the environment to enhance their understanding of a topic (Brown, Lawless, Mills & Mayall, 2003).

From textbooks to online educational resources, interesting but irrelevant seductive details are widely used. Mayer & Moreno (2000) suggested that such details have an impeding effect on learning and should be avoided. However, some researchers state the opposite, and argue that seductive details can reduce negative attitude towards the study material, and eventually improve student performance (Sitzmann & Johnson, 2014). As with hypertext environments, there is not a definitive conclusion about whether or not educators should use seductive details. This study will contribute to research in seductive details and learning from hypertext.

Another contribution of this study will be an investigation of the relationship between cognitive load and seductive details. Carefully designed seductive details in hypertext might arouse student interest. A negative relationship is expected between learner interest and cognitive load. Higher learner interest might lead to lower perceived cognitive load thus might result in higher recall and transfer performance.

1.4 Research questions

The research questions for this study are as follows:

(1) What are the effects of seductive details on the learners' recall and transfer of information in hierarchically structured vs. networked hypertext multimedia environments?

(2) How does the learners' interest in the topic of study affect their recall and transfer of information in hierarchically structured vs. networked hypertext multimedia environments?

(3) How does the learners' prior knowledge about the topic affect their recall and transfer of information in hierarchically structured vs. networked hypertext multimedia environments?

(4) What is the combined effect of prior knowledge and seductive details on the learners' recall and transfer of information?

(5) To what extent do the seductive details affect learners' perception of cognitive load associated with text in hierarchically structured vs. networked hypertext multimedia environments?

(6) What is the relationship between perceived cognitive load and interest in a hierarchically structured vs. networked hypertext multimedia environment?

Although this was an exploratory study, a number of predictions were made for each research question based on theory and previous research. Regarding the effect of hypertext structure, a significant effect on recall and transfer was expected (Hypothesis 1) based on research that point to facilitative effects of hierarchical structure for low prior knowledge learners (Amadieu et al., 2009; Potelle & Rouet, 2003). Previous studies (Harp & Mayer, 1998; Lehman et al., 2007; Sitzman & Johnson, 2014) showed that seductive details have detrimental effects on learning performance. Therefore a main effect of seductive details was also expected on recall and transfer (Hypothesis 2). As for the combined effects of hypertext structure and seductive details, no specific hypothesis was formed due to lack of theoretical and empirical justification. Topic interest was assumed to be a facilitative factor for both recall and transfer of information (Hypothesis 3) based on research showing the positive relationship between topic interest and recall performance (e.g., Erçetin, 2010; Schiefele, 1996; Schiefele & Krapp, 1996). No specific hypothesis was formed for the combined effect of topic interest and text structure. Prior knowledge was also predicted to be positively related to recall and transfer of information (Hypothesis 4) based on theoretical accounts of text comprehension (e.g., Dink & Kintsch, 1983) and numerous empirical studies (e.g., Lawless et al., 2003). Numerous studies showed that prior knowledge and seductive details have effects upon learning performance (Park et al., 2015; Wang & Adesope, 2016). Prior knowledge and seductive details were predicted to show a significant main effect on both recall and transfer performance (Hypothesis 5). Park et al. (2011) found that seductive details impose an extraneous load on students, negatively affecting learning performance. As for predictions regarding cognitive load, seductive details are expected to present a main effect on perceived cognitive load (Hypothesis 6). No hypothesis was formed for the main effect of topic interest on perceived cognitive load, since it is an exploratory question.

CHAPTER 2

LITERATURE REVIEW

2.1. Hypertext

Hypertext systems today are highly flexible, and varied in terms of structure as well. Hypertexts can be defined as non-linear electronic documents that provide flexibility while dynamically exploring the information in nodes which create a semantic space (Amadieu, van Gog, Paas, Tricot & Mariné, 2009). Most of the Internet pages are structured as hypertext, interconnected with many other pages and resources with multiple links, which users can use for navigation. Hypertext systems are widely used for educational purposes as well: A topic can be presented to students as interlinked web pages that can be navigated node by node (McDonald & Stevenson, 1996), or as slides accessed by clicking on buttons. The non-linearity of the information allows learners to create their own navigational path to reach the exact information they need. Amadieu et al. (2009) explains the use of hypertext for education as a way of allowing students to investigate information according to their needs and individual differences.

McKnight and Richardson (1993) defined hypertext as a system which requires the users to find their own path wherein the information is located in a complex structure. (McKnight & Richardson, 1993, p.169). Their definition underlines the complex structure where several pieces of information are interrelated and users are supposed to navigate through the material to find what they need. Lawless et al. (2003) compares hypertexts with traditional texts, and point out that hypertexts are actually electronic versions of traditional texts, but with the opportunity for the readers to interact with what they read. Landow (1992) states that one advantage of hypertext is giving control to the readers to create their own navigational path, to choose what they want to read next. She underlines that there are several ways to interact with hypertext: Readers may browse or search the information they need or they may connect to hypertext systems to contribute to what is already there. However, Zumbach (2006) states that this non-linearity of hypertext systems require students to develop complex schemas in order to comprehend the information conveyed. He also adds that providing students with complex structures, such as hypertext environments instead of mundane, simplified learning material might increase their motivation for the topic, and positively affect their performance.

Hypertext structures are associated with ways in which the human mind works. Berk and Devlin (1991) argue that computers provide linked information in which people navigate, and that people use an intuitive approach to locate the relevant information, and make choices depending on the decisions they make about how to proceed within the material. This is exactly the way hypertext presents linked information. It offers interlinked nodes depending on relevancy of information. Amadieu et al. (2009) asserts that in order to comprehend the information hypertext conveys, users need to create semantic relationships between nodes and come up with the semantic map representing the “big picture” that hypertext presents.

2.1.1 Hypertext environments

Reading and learning in hypertext environments have been studied from various points of view. The effects of prior knowledge, navigation patterns, text structure and type of representation have been researched (Amadieu et al, 2009; Cress & Knabel, 2003; Potelle & Rouet, 2003; Calisir & Gurel, 2003).

Prior knowledge refers to the background knowledge of a learner about a particular topic. Amadieu et al. (2009) investigated the extent to which prior knowledge and text structure in hypertext environments interact. Two groups of participants were identified based on their prior knowledge as determined by a pretest. Each group consisted of two sub-groups, those who interacted with hypertext organized in a hierarchy, and those who read from hypertext with a network structure. Hierarchical hypertext structure offered participants semantic information between nodes and pointed out the relevancy between them, forced learners into a more coherent reading path (Amadieu et al., 2009). Network structure, on the other hand, required learners to establish semantic relationships between nodes. Thus the hierarchical hypertext group was expected to spend less mental effort. The informational content in both types of hypertext was identical. They were equivalent in terms of textual content and headings of the nodes were exactly the same. Their findings pointed out that in the network structure condition, participants with high prior knowledge outperformed those with low prior knowledge in the recall task where they answered factual questions, but the groups did not differ significantly in terms of the transfer task where participants answered conceptual questions. Low prior knowledge groups outperformed high prior knowledge group in hierarchical structure in recall tasks. The researchers explained these outcomes in terms of the structure of hypertext: The hierarchical structure helped low prior knowledge learners when they process information and assisted them in making decisions about where to go between nodes. For high prior knowledge learners, the network structure had a fostering effect on recall, because its complexity increased the germane cognitive load while the students' prior knowledge compensated for its less coherent structure.

Potelle and Rouet (2003) conducted a similar study where they investigated the relationship between prior knowledge and the effects of hypertext structure on learning outcomes. They based their study on Kintsch's (1988) construction-integration model of text comprehension. Kintsch proposes that comprehension of text is only possible by constructing a multi-layered mental model. The "textbase" layer contains semantic relationships of the information within the text. Readers need to learn the textbase information first to proceed to a deeper learning of the material. The other layer that Kintsch (1988) proposes is the situation model. It integrates the textbase with prior knowledge by reorganizing and restructuring it. This process results in deeper learning and transferring the mental representation to the learner's long-term memory. Potelle and Rouet (2003) compiled and presented a text on social influence to 47 college students in three different hypertext structures: Hierarchical, Network and Alphabetic. In the hierarchical structure, nodes and subordinate nodes were presented sequentially. Network structure was formed by connecting the nodes semantically (by their meanings) with links. Alphabetic structure presented nodes in alphabetical order without any semantic connections. A multiple choice test was conducted to measure recall (the textbase information) and transfer questions were prepared to measure transfer knowledge (the situation model). Potelle and Rouet (2003)'s experiment showed that the hierarchical structure helped learners with low prior knowledge in terms of recall and transfer task. Low prior knowledge learners scored significantly higher in both tasks in hierarchical hypertext condition. The researchers concluded that hierarchical structure aided learners in establishing a macro-structure, which improved their recall. They stated that because this particular structure of hypertext is highly memorable (as shown in both tasks), low prior knowledge students scored higher, whereas the network structure did not provide such an aid for high prior knowledge students.

Hypertext environments are more cognitively demanding than traditional learning materials since they require students' active attention on the process of reading, searching, comprehending and schematizing the information it conveys (Sweet & Snow, 2003). Cress and Knabel (2003) used previews to enhance hypertext, and tested how providing previews affected learning from hypertext. The previews were little pop-up windows that appeared when a link was clicked, and showed brief information about the page to which the particular link led. A hierarchical hypertext was developed about system theory with two versions: One version included previews and the other one did not. Participants were given two tasks: One involved searching specific information within the hypertext, and the other required browsing through the pages to learn about system theory as much as possible in a given time span. Research facilitated 50 undergraduate students as participants. The authors scored each task. The findings showed that the group with previews increased their knowledge about system theory more, based on the browsing tasks. They also found that the groups with previews opened less pages than the groups without previews. Cress & Knabel (2003) concluded that the previews provided the main concepts of the target page, giving learners a chance to make assumptions about the link, and helped them to establish a semantic connection, which lead to a more coherent reading path. The authors also state that previews can be useful as local navigational tools, and they have a potential to diminish possible disorientation in hypertext.

The multilayered, web-like structure of hypertexts can cause learners to fail to make informed decisions about where they should traverse: This is referred to as disorientation (McDonald & Stevenson, 1996). Disorientation in hypertext environments is an issue to which a large body of research is dedicated. Foss (1989) proposed a sophisticated approach to disorientation hypothesis and identified two problems that may cause disorientation in hypertext: “The embedded digression problem” and “the art museum phenomenon”. Embedded digression problem occurs when learner is presented multiple links to choose. This may lead learners astray from their main topic while traversing through the links and vast sources of information that particular hypertext offers. The art museum problem arises when learners indulge in browsing the hypertext pages but do not stop and actually read a single page. Foss (1986) claimed that these difficulties would seriously impede learning performance. Zumbach (2006) states that disorientation is a common problem with ill-structured hypertexts. He gives three possible situations where disorientation occurs in such hypertexts: Learners may not know where they are within the hypertext, they may not know how to reach a certain node, or they may not know if the information they seek is in that particular hypertext. Zumbach (2006) calls these three circumstances as “Lost-in-Hyperspace-Phenomenon”. He states that users’ information acquisition and the complexity of hypertext structure (linear vs. non-linear structure) are inversely proportional: As the complexity increases within a hypertext, users are more likely to get disoriented. However, the experiment conducted by Zumbach (2006) did not confirm his claims. He found that the participants who used the non-linear version of the material scored significantly higher. He explained this result by referring to the cognitive load theory (Sweller, 1994) and the factors involved in his study. Referring the available time, the nature of the learning task, learning goal and the complexity of the domain, he stated that these constructs might have reduced the influence of text structure on learning measures. He also mentioned that if the learning task exceeds a certain threshold of complexity it could be more beneficial for learners instead of being hindering, by referring the additivity principle of cognitive load. Fully occupying the working memory but not overwhelming it aids learning.

Cognitive load is another area of research on hypertext environments. DeStefano & LeFevre (2007) surveyed a remarkable number of studies on cognitive load in hypertext in their review study. They examined how the number and structure of links affected cognitive load, and indirectly how cognitive load affected learning from hypertext. The authors argued that the main source of cognitive load in hypertext environments is the decision making process about the links that lead the user from node to node. Zhu (1999) for example, found that the group with more number of links in the hypertext reported higher cognitive load. DeStefano & LeFevre (2007) suggested that this can be avoided if learners' navigational choices are limited by reducing the branching of the hypertext. They also stated that hierarchical hypertexts are less cognitively demanding since the links they offer in each node are close to the target nodes' level of hierarchy. In network structures, links can take learners hierarchically far away, thus imposing a cognitive load on the students, and may lead to disorientation (DeStefano & LeFevre, 2007). Hierarchical hypertexts, the authors argued, may decrease the extraneous cognitive load on low prior knowledge students by helping them to draw a map of the text structure, whereas network structures require learners to use their prior knowledge to create semantic relationships between nodes. This situation can be cognitively overwhelming for low prior knowledge learners, since they do not have a solid background to create a semantic network. However, for high prior knowledge learners, the reverse is possible: Network structures provide high prior knowledge learners germane cognitive load when they try to integrate their textbase knowledge with the situation model (Kintsch, 1988), which results in deeper learning.

However, a contradicting result was found by Madrid, van Oostendorp, and Melguizo (2009). The authors investigated whether or not the number of links given to participants to navigate in a hypertext system effects cognitive load. Forty-five college students from Utrecht University participated in the study, High prior knowledge participants were eliminated by a pretest. The hypertext material consisted of 21 pages on the human brain and neurons. Four versions of the hypertext material were prepared: one with 3 links, one with 8 links, and each with and without navigational support. Navigational support was provided by a ”>>” sign in front of 2 links on the page which were considered the most relevant links to follow. The participants were asked 21 multiple choice recall questions, and 10 inference questions, which required readers to combine the information from two or three slides The participants also completed a relatedness judgment task, where they needed to rate 91 pairs of concepts as “low related” to “highly related” on a scale of 1-6. Madrid et al. (2009) found no statistically significant difference between the cognitive loads of 3-links and 8-links groups. Students with navigational support scored higher than those without navigational support in inference questions. Madrid et al. (2009) explained these outcomes by pointing out that cognitive load and reading coherence can be related: The participants who created a more coherent reading path were exposed to less cognitive load, since reading two text passages that are related imposes less cognitive load than reading two text passages which are not related.

2.2 Cognitive load

Studies of human cognition have led to the understanding that the presentation of instructional material imposes a load on the human cognitive system. Paas & Merriënboer (1994a) asserts that this load can be characterized as a multidimensional load imposed on the learner's cognitive system while performing a particular task. Several different definitions of cognitive load can be found in the literature. Paas, van Gogh, and Sweller (2010) defined cognitive load as an overwhelming mental burden caused by complex tasks. Whilst this definition makes cognitive load sound like something to be avoided, de Jong (2010) reports that germane cognitive load (which will be explained later in this chapter) should be nurtured in order to promote schema construction.

Sweller (1988) put forward the cognitive load theory within the context of problem solving. He first related the cognitive load imposed on students with the number of steps to reach the solution. Each step in solving a problem requires the re-firing of working memory, inflicting further cognitive load on the cognition (Sweller, 1988). Element interactivity, which can be defined as the amount of interrelations between the elements in a learning material, is also a source of cognitive load (Chandler & Sweller, 1996). High degrees of element interactivity means higher cognitive load on the learner. Paas and van Merriënboer (1994a) defined cognitive load theory as the development of methods to foster efficient use of limited cognitive processing ability.

Sweller (1994) defined learning with schema acquisition and the automatization of the implementation of learned procedures. In the first step, learner organizes of the pieces of information in a way which they will be dealt with. This can be seen as classifying a problem to come up with ways to solve it. After schema acquisition the learner uses this new information with controlled processing which can be defined as thinking while acting. Applying a new knowledge without conscious control is called automatic processing. This transition from controlled processing to automatic processing is substantially dependent on the nature of the new information and the attention that the learner needs to devote to it. Sweller (1994) proposes that automatic processing reduces working memory load and causes better performance. The cognitive load a learner might face during these learning processes can be moderated by different either reducing the specificity of the learning goal or provide the learner with worked examples.

Cognitive load theory is often associated with memory: Long-term memory has unknown or unlimited boundary in terms of storage in contrast to short-term memory. Short term memory, frequently referred to as working memory, has much smaller storage capacity and even a smaller capability when it comes to processing (Kirschner, 2002). Thus, when limited working memory is overloaded learning can be hindered (Chandler & Sweller, 1996).

Researchers used different methods to measure cognitive load imposed on students. Sweller (1988) proposed the secondary task method to measure cognitive load. He asserts that if a main task demands a large amount of cognitive capacity, then less will remain for other, smaller tasks. He used means-ends analysis method, a technique which requires an interaction with the environment for a problem solving task, to investigate schema acquisition that resulted from problem solving as a secondary task. He stated that means-ends analysis demanded a considerable amount of cognitive resources, and therefore not enough resources were left for schema acquisition. In another application of secondary task method (Chandler & Sweller, 1996), participants used a computerized manual that teaches users to use a geometry program step by step (the main task). Meanwhile a letter appeared on the screen temporarily, and the participants were asked to recall the letter after it disappeared from the screen. Chandler and Sweller (1996) stated that the precision on recall reflected the amount of cognitive load imposed on the students during the main task.

Paas (1992) was one of the pioneers in measuring cognitive load with subjective rating scales. Rating scales were used to collect introspective data from participants simply by asking them to fill out a form in which they indicated the level of their cognitive processes during a treatment (Paas et al., 2003). Park et al. (2011) made an exemplary use of this technique in their study by asking participants to fill in the blank in the sentence “While working on this learning material my mental effort was…” and probed them to rate their mental effort on a 7-point Likert scale. These scales are generally multidimensional. They are composed of sub-scales that measure, for example, mental effort, frustration, and fatigue, which are all highly correlated with cognitive load. Paas et al. (2003) stated that this technique is easy to administer, reliable, and non-intrusive.

Another method to measure cognitive load could be physiological techniques. In this measurement method, data on physiological variables such as heart rate variability, brain waves or eye activity (saccades) are collected to determine the cognitive load imposed on the participants. However, most of these techniques are quite intrusive. Devices to measure physiological variables must be placed on the participant, which itself might produce stress or anxiety. Therefore, non-intrusive techniques such as self-reports are more preferred in learning-focused educational studies.

2.2.1 Intrinsic cognitive load

As the research on cognitive load advanced, the construct itself was investigated further. Bobis, Sweller, and Cooper (1993) stated that the difficulty of learning material can be defined first by its inherent difficulty, on which instructors and teachers have little or no control, and, secondly, by the manner of the presentation of the material, how the material is presented to students by instructors or teachers, which can actually be manipulated. Bobis and colleagues' definition was actually an attempt to devise sub-categories for cognitive load. Chandler and Sweller (1996) later named these two types of loads as intrinsic cognitive load, and extraneous cognitive load, respectively.

The intellectual complexity of the material, and the amount of personal dedication the material takes to learn, defines the intrinsic cognitive load (Chandler & Sweller, 1996). It is a context-dependent construct and cannot be manipulated directly. de Jong (2010) states that instructional treatments do not have a straightforward effect on intrinsic cognitive load. Sweller et al. (1998) proposed that intrinsic cognitive load can be related to element interactivity within instructional content. As the number of elements and their interactions with each other increases, the intrinsic cognitive load increases proportionally. The authors used a geometry problem as an example: As the variables, unknowns and their interaction with each other increase the internal difficulty of the problem increases as well. De Jong (2010), however, asserts that the element interactivity is not the only thing that defines intrinsic cognitive load. The ontological category problem can be a factor that increases the internal difficulty of instructional material. Force, for example, is not a concrete concept, and teaching force to students can be a problem. De Jong points out that students can see force as a material substance, which may produce an ontological category problem. When students experience such a misconception, the concept they are learning may impose an overwhelming intrinsic cognitive load (De Jong, 2010).

Intrinsic cognitive load is almost immune to instructional treatments. Ayres (2006b), for example, describes intrinsic cognitive load as unmodifiable, and rooted in the learning task. However, according to De Jong (2010) it can be mediated or eased at least with instructional techniques. De Jong (2010) proposed the part-whole approach where students are trained separately for each partial task as an easing solution. In the part-whole approach, the main task is divided into subtasks to reduce difficulty and the cognitive resources required. Training the learners for each subtask might reduce the internal difficulty of the main task, and thus resulting in lesser intrinsic cognitive load (De Jong, 2010). Another approach could be simple to complex sequencing, in which participants are trained with easy tasks at first, increasing the difficulty each time. Merriënboer et al. (2003) specifies that preparing students from simple tasks to solve complex problems in a context helps them to manage intrinsic cognitive load of the subject matter.

2.2.2 Extraneous cognitive load

Extraneous cognitive load refers to the load resulting from instructional design. Bobis, Sweller, and Cooper (1993)'s definition of extraneous load includes the manner in which the instructional material is presented. This definition implies that teachers and instructors take an active role while presenting the material, and make amends for any challenge the design might present. Merriënboer and Sweller (2005) stated that extraneous cognitive load is not compulsory for learning (in terms of schema construction and automation of information) and it can be altered with instructional treatments. When learning material imposes extraneous cognitive load on students, a different design is needed to avoid (or diminish) it.

A number of different sources of extraneous cognitive load is mentioned in the literature. The split-attention effect refers to the separate presentation of the elements that ought to be processed together (De Jong, 2010). This can happen spatially (elements are separated by distance, or they are grouped incorrectly) or temporally (elements that need to be processed simultaneously not presented sequentially). Such a design forces students to search for relevant information on the screen or to go between pages or slides to find the information needed. Mayer (2014) refers to this design aspect as contiguity principle in cognitive theory of multimedia learning. Moreno and Mayer (1999) assert that if contiguity principle is not met, split attention effect may occur that will impede learning outcomes.

Mayer and Moreno (1998) asserted that visual and auditory systems in human information processing support each other during schema construction when instructional material includes both verbal and pictorial representations. However, when information is presented through only one channel, either pictorial or verbal, a cognitive load would occur, since a single channel will be burdened, which may impair learning. The dual channel assumption also implies that verbal and pictorial representations should not be duplicates of each other, rather, they should be complementary (Moreno & Mayer, 1999). For example; a chart with explanations should not be accompanied by auditory explanation that is a duplicate of what is already represented verbally. Mayer & Moreno (1999) defines this principle as redundancy principle. If the redundancy principle is violated, the redundant information would burden the working memory causing an extraneous cognitive load. This is also problematic when the reader's pace of reading does not match that of the narrator's.

2.2.3 Germane cognitive load

Learning processes such as schema construction and automatization are sources of cognitive load. Schema construction involves interpreting, generating, classifying and inferring while automatization involves internalizing the information. The cognitive load imposed by these processes is called germane cognitive load (Mayer, 2002; De Jong, 2010). Mayer and Moreno (2003) also refers to germane cognitive load as essential processing which indicates the process of making sense of the presented learning material.

Instructional design ought to promote germane cognitive load since it fosters schema construction. Paas et al. (2010) proposed a part-whole approach to promote germane cognitive load: The authors pointed out that the use of part-whole approach intrinsically divides the subject-matter into small pieces that are easier to process, and also increases the number of elements with interactivity. This increase in easy-to-process elements also causes an increase in germane cognitive load. Schema construction becomes easier with small elements. Renkl (2002) stated that asking students to explain the cognitive processes that they go through is also a way of increasing the germane cognitive load. Such self-explanation forces students to reiterate the schema construction process, and appropriately causes an increase in intrinsic cognitive load with higher demands on working memory, resulting in an increase in germane cognitive load. Paas and Merriënboer (1994a) also found in their study that using worked examples increased the intrinsic cognitive load but at the same time fostered schema construction, thus increasing the germane cognitive load.

Hollender et al. (2010) argued that intrinsic, extraneous, and germane cognitive load are additive in nature. This means that these three can be taken as a whole that occupies working memory. Therefore the total sum of the three types of load should not exceed the limits of working memory (Merriënboer & Sweller, 2005). In much of the research literature, intrinsic and extraneous cognitive load have negative connotations, while germane cognitive load tends to be treated as something positive. However, if students are forced to perform germane processes that are too demanding of the cognitive resources, working memory may get overloaded by germane cognitive load (De Jong, 2010), which would be frustrating. Therefore even the germane load may sometimes be impeding, if not managed properly. Antonenko and Niederhauser (2010) used electroencephalography (EEG) to measure cognitive load in their study. They reported that EEG could measure instantaneous cognitive load, which can help to determine the amount of germane cognitive load. However, being an intrusive technique, EEG is not preferred especially in educational studies.

2.3 Seductive details

To make a lesson or instructional text more interesting to read for learners, teachers and educational designers may include appealing examples, factoids, and trivia, which may not inherently be related to the learning goals. For instance, in a science class on lightning formation, the number of people who get stuck by lightning yearly (Harp & Mayer, 1998) could be considered an interesting fact. Or, for example, when the learning material is about mobile phone usage and car accidents, information about the death of two famous people in a car crash can be considered a seductive detail (Chang & Choi, 2014). Chang and Choi stated that reader/learner interest is a primary concern for learning, and such details seem attractive even if unimportant.

This seemingly interesting but not inherently relevant information is intended to “seduce” the learner to continue reading and hence the name, “seductive details.” Researchers have defined seductive details as textual or pictorial material that is interesting, memorable, and tangential to the main topic (Abercrombie, 2013; Johnson & Sitzmann, 2014; Lehman et al., 2007). Sitzmann and Johnson (2014) pointed out that students’ negative affect can be lower for the learning modules containing seductive details than for those without seductive details. However, these details draw learners’ attention, and therefore may require the learner to spend more cognitive resources to comprehend the material (Park et al., 2011).

The greater cognitive load caused by the seductive details may overwhelm the learner since the capacity of working memory is finite. Instructional material itself already burdens the learner with extraneous cognitive load and seductive details also produce cognitive load. So, seductive details can diminish the effectiveness of working memory capacity, and hinder the learning of the essential material (Moreno & Mayer, 2000; Renkl, Hilbert & Schworm, 2009). Chang and Choi (2014) found that because of the increased attention students devote to the seductive segments in an expository text, their recall and reading comprehension scores were significantly lower than the students who read the text without the seductive segments.

Sound and music used in instruction can also be tangential to learning. Moreno and Mayer (2000) included environmental sounds and background music in a multimedia tutorial about lightning formation. Their research included four treatment groups: Multimedia presentation with background music, multimedia presentation with background sounds, multimedia presentation with background music and sounds, and multimedia presentation with no background music or sound. Moreno and Mayer (2000) collected data from 75 college students. Their results showed that there was no statistically significant difference between the recall scores of the participants who received environmental sounds and those who only watched the tutorial. However, music and animation, or music and background sounds and animation group scored lower than background sounds and animation, and animation only groups.

In terms of problem solving or higher order thinking skills, findings in the literature suggest that seductive details seem to hinder learning (Abercrombie, 2013; Chang & Choi, 2014; Lehman et al., 2007; Moreno & Mayer, 2000). Abercrombie (2013) found in her study that including only four extraneous sentences in the learning material caused a significant decrease in learning, with a medium effect size ($d = .64$). Lehman, Schraw, McCrudden and Hartley (2007) studied the seductive details effect using two versions of the lightning formation text from Harp and Mayer (1998). They conducted a two-phase study: First, they asked forty undergraduate students to score each sentence of the explanatory version for how seductive it is. After the sentences were rated, the researchers edited the text to add seductive details. In the second phase, they used both of these versions with another set of participants to measure their learning in terms of recall and idea generation in written essays. The participants were asked to write an essay about why lightning occurs more often in warm and moist climates rather than dry and cool climates. They found that students in the no-seductive details group formed significantly more “legitimate claims” (Lehman et al., 2007, p.580) in their essays than the students who read the version with seductive details.

Schank (1979) stated in his seminal work that certain details are particularly interesting for readers. Themes such as sex, death, fight, and fear draw readers' attention and raise interest towards the topic of reading. However, he also stated that the overuse of such interesting details may divert and misdirect students' focus and may impede comprehension. The seductive details effect can be explained based upon this premise. Garner et al. (1991) investigated whether or not the placement of these details within a text had any effect on learning. In a text about Stephen Hawking's theories, the researchers changed the position of a "seductive details" paragraph that included personal information about him. Their results revealed that the position of the seductive paragraph in the text did not have any effect on recall, but the seductive details were recalled more than the main information. Similar results were obtained in another study by Wade et al. (1993) where students read from a slideshow. The results showed that seductive details were the most recalled information while factual details were the least.

In the last decade of research the seductive details effect was mediated by different variables. Sanchez and Wiley (2006) took a different approach by relating it to working memory capacity. They used an experimental design where they compared high and low working memory capacity among seductive and non-seductive details groups. Their results showed that the high working memory group was not affected by seductive details, and performed better than all the other groups. Sitzmann & Johnson (2014) associated the seductive details effect with students' affect towards the learning material. They prepared an online Microsoft Excel training about various formulas, macros and charts. The seductive details they used were cartoons that attracted interest yet conveyed irrelevant information. Sitzmann & Johnson (2014) added these cartoons to their modules on the one third of the material and the two thirds. The slides that contained seductive details did not have any other information, but only cartoons. The authors found that the seductive details positively affected student performance by reducing their negative attitude towards the material, but at the same time indirectly impeded their learning outcome by reducing their time on task, by increasing the speed that the students reviewed the material.

In their theory of text comprehension, van Dijk & Kintsch (1983) suggested that seductive details could impede recall but might have a positive effect on transfer. Towler et al. (2008) supported this claim, and explained that seductive details cause disruption of schema construction. When students were asked to recall information, distorted schemas would not allow them to succeed. However, in transfer tasks, students apply what they know in a new situation. This process could be fostered with seductive details, because students need to draw a macro structure of the material they have studied, and using their existing schemas they need to arrive at a certain point where they will build another schemata consisting of the previous ones. McNamara et al. (1996) stated that students using unorganized text like hypertext environments performed better on tasks where they needed to apply their knowledge. Towler et al. (2008) found that the students in seductive details condition performed better on the transfer task than those in the no seductive details condition. However, on recall task, the students in the seductive details condition performed worse. The researchers underlined that seductive details disrupted the organization of the information-, causing a decrease in recall performance, while they have a positive effect on transfer tasks which require students to apply their knowledge in new situations. However, a recent study by Chang & Choi (2014) that used eye-tracking to investigate the effects of seductive details demonstrated the opposite for transfer tasks. The participants of this study were 56 undergraduate students who read an expository text that was enriched with seductive sentences and pictures. The results showed a hindering effect caused by seductive details both for transfer and recall tasks. The authors explained this finding by attention allocation, and asserted that seductive pictures and sentences overly occupy participants' attention and impede information retrieval, thus resulting in a less cohesive mental representation. It is also stated that seductive details which are more concrete and tangible for learners may not impede remembering, but foster it. Seductive details in the study were about the deaths of two famous physicists, traffic accidents and mobile phone use. The authors stated that such details will be remembered more easily than abstract ideas which were the type of seductive details that the authors included in their study.

Another variable to mediate the seductive details effect was cognitive load. Park et al. (2011) explained the effects of seductive details on the learning outcomes of the participants using cognitive load theory. Since cognitive load and seductive details relationship had not been investigated much in the literature, their study paved the way for further research in this particular area. Park et al. (2011) integrated the modality principle (Mayer, 2001), and created high and low cognitive load conditions: They varied the extraneous load factor by changing the medium of presentation. Low cognitive load condition involved narrated explanation with visuals, whereas high cognitive load condition consisted of on-screen text with visuals. The topic of the presentation was a cellular molecule responsible for ATP synthesis. The participants completed recall and transfer tasks after the treatment. Cognitive load was measured by self-reporting of mental effort as recommended by Paas (1992). To increase the validity of the measurement, Park et al. (2011) asked the participants to fill out a perceived cognitive load form in the middle of the task and immediately after completing the task. The participants responded to the question "While working on the learning material, my mental effort was…" on a 7-point Likert scale. The findings suggested that the students in the low load condition (narration) with seductive details performed better than all the other groups, which were seductive details –narration, no seductive details – narration, seductive details – text and no seductive details – text. The authors based this finding upon the cognitive load theory: The students under a low cognitive load became less vulnerable to seductive details, since their working memory was less occupied by extraneous load caused by the design. Vice versa applies for the high load condition seductive details group: Since the design (text + on screen explanations) increased the extraneous cognitive load and kept working memory busy, the seductive details effect caused an overload, impeding learning outcomes in terms of both recall and transfer. Although being a low cognitive load condition, no seductive details-narration group also performed less. Authors state that freeing working memory capacity does not always mean that it will be used in productive activities, namely germane cognitive load. Learners should be motivated and should be using their cognitive resources as much as possible. Motivation in learning is a positively moderating factor (Moreno, 2006).

Taking prior knowledge and spatial ability into account, Park, Korbach and Brünken (2015) studied the seductive details effect using eye-tracking techniques. The authors prepared a self-paced multimedia learning program about ATP synthesis. Fifty participants were pretested for their working memory capacity, spatial ability, and prior knowledge by standardized tests. Learning was measured by a test of 12 items, 6 were multiple choice questions whereas 6 of them were open-ended questions. The authors used Paas (1992)'s method of subjective rating scale for perceived cognitive load. The eye-tracking device was used to measure fixations on the screen. The results showed that the participants with low spatial ability and low prior knowledge were much more affected by detrimental effects of seductive details and showed worse performance in learning measures as well as high cognitive load. Park et al. (2015) stated that the seductive details effect was moderated by prior knowledge and spatial ability. They recommended the use of seductive details in educational settings with learners who have high prior knowledge or high spatial ability.

Learners' interest in the topic of study is another variable linked to seductive details. Since seductive details are closely related to arousing interest in students, they can increase the total interestingness of the material. Harp & Mayer (1998) investigated if learners' interest has an effect on learning. They divided 74 college students into four treatment groups: Base text without seductive details, base text with textual seductive details, base text with seductive illustrations and, text with textual seductive details and illustrations. The base text included information about lightning formation and was about 550 words long. After the participants read the text, an interest questionnaire was given. The questionnaire included 4 questions, asking participants whether or not they found the material interesting or boring, and useful or worthless. Harp and Mayer (1998) found that students in seductive text plus illustrations group did worse than any other group in the recall and transfer tests. Also, there were no significant differences between the participants' interestingness ratings for the 4 types of material.

2.4 Topic interest

For learning, topic interest can be another factor that directly affects the amount of engagement with the subject matter. Schiefele & Krapp (1996) defined topic interest as a person's feeling of eagerness affiliated with a certain topic, and the amount of importance that person attributes to that topic. They also stated that text structure, text difficulty, and tests of learning outcome (recall, multiple choice, etc.) are independent of interest for a topic. Although many studies in the literature suggest a positive correlation between interest and learning, there could be many intervening factors. Schiefele & Krapp (1996) stated three main shortcomings: Most studies used one indicator for the assessment of learning (free recall, recognition of sentences or words, multiple choice, etc.). Secondly, there was not sufficient focus on the cognitive characteristics of learners. Reading ability, intelligence, and prior knowledge should be included in the studies. Thirdly, literature regarding the relation between interest and prior knowledge had conflicting results.

Topic interest is also considered a type of intrinsic motivation that causes people to feel attracted to a certain activity (Deci & Ryan, 1985). Lawless et al. (2003) argued that there were two types of interest: One being "individual interest," which could be defined as a long term interest on particular topic or subject, and the other being "situational interest" which can be defined as a momentary and temporal arousal caused by a stimuli. However, for topic interest, there is an on-going discussion in the literature about whether topic interest is an element of individual interest or situational interest. Clinton & Broek (2012) stated that topic interest can be considered an aspect of either of the interest types. It could stem from individual interest, since it is a persistent interest over a certain topic which is developed over a long time, or it can be an aspect of situational interest, since the material itself can trigger interest in the learner.

Schiefele (1996) explored the relationships between topic interest, prior knowledge, and text learning in a study with 107 twelfth grade students. The students read two different texts (one on “prehistoric people” and the other on “television”), after their prior knowledge, and interest were tested. Learning was assessed as verbatim, in propositional and situational text representations of the participants. Verbatim representation is defined as the superficial structure of the textual material. Propositional representation defined as the meaning of the text whereas the situational representation is the deepest level of comprehension. In the test, certain sentences were shown to participants: Some sentences were exactly the same, some were paraphrased, some had their meaning changed, and some were incorrect. Participants were asked to rate these sentences if they are exactly the same with the text about prehistoric people or television. If the response was negative, meaning the participant replied that the sentence shown was not in the main text, he is asked if the shown sentence was true or false. The answers were calculated using a measure of discriminability of distributions which is a statistical technique used to determine differences between two sets of answers. Schiefele (1996) found that topic interest was negatively correlated with verbatim representations, and positively correlated with propositional representations.

To explore the relationship between interest and recall performance Schiefele & Krapp (1996) conducted a study with 80 first-year college students from computer science, and social sciences. The students were pretested for prior knowledge, topic interest, and general intelligence. A two-part topic interest test was used, with sections on individual and situational interest. The participants then were presented a text entitled “Psychology of Communication.” Recall was measured by asking the participants to write down as much textual content as they remembered. Based on a list of idea units created beforehand, each correct answer was scored 1, a partially-correct answer was scored 0.5, and wrong answers received 0 points. The results showed that topic interest was highly correlated with recall of idea units, and that prior knowledge and intelligence were independent of recall performance.

Lawless et al. (2003) investigated recall performance and navigation patterns in a hypertext environment, and how the two types of interest, situational and individual, affected recall performance and reading path. Individual and situational interest was measured by separate forms with 5-point Likert scales. The participants included 34 undergraduate students from school of education. The learning material consisted of 60-page hypertext on Lyme disease, caused by ticks and other bugs, common in North America. The results indicated that domain knowledge and individual interest were highly correlated. The authors also found that domain knowledge was a significant predictor of recall performance. Nevertheless, interest did not show a meaningful correlation with recall. After coding of log files, the authors asserted that the participants with higher domain knowledge were better at drawing their reading path in the hypertext environment. They followed a more sequential reading path, and scored higher in recall test. Lawless et al. (2003) concluded from these findings that the type of hypertext could be a mediating factor. Since they only used network structured hypertext, authors refer to hierarchical and mixed structure and underline that for future studies, other hypertext structures can make a difference in results.

Erçetin (2010) also studied topic interest, prior knowledge, and recall performance while also investigating annotation use in hypertext environments with second language readers. She worked with 54 undergraduate students from an English Language Teaching program at a School of Education is Turkey. The participants filled out a prior knowledge questionnaire, and an interest survey. The participants' actions were recorded while they were using the hypermedia material. The text was about the origin of the universe, consisting of 1143 words and 11 pages. A navigational map and buttons were made available to transverse between nodes while participants were not restricted with any limitations regarding time. Several interviews were conducted at the end to collect insights about how participants used annotations. The analyses showed a non-significant relationship between topic interest and prior knowledge. Moreover, topic interest showed a significant main effect on recall performance whilst prior knowledge did not. The participants with higher topic interest remembered significantly more idea units, independent of their prior knowledge. This study showed convincing evidence that topic interest can also be a facilitative factor for recall also for L2 readers.

CHAPTER 3

METHODOLOGY

This study investigates the effects of seductive details in two types of hypertext structure on recall and transfer of information, and how these relate to perceived cognitive load and learner interest. Two types of hypertext structures, network and hierarchy, are used either with or without seductive details. Perceived cognitive load in these conditions is measured to investigate the extent of its relationship to the learners' interest in the topic of study.

3.1 Research design

This study is designed as a 2x2 quasi-experimental study. Two different hypertexts about DNA and protein synthesis were created, each had a version with and without seductive details. Dependent variables were learning performance and perceived cognitive load. Recall and transfer tests were used to assess learning performance in the 4 groups. Independent variables were hypertext structure, presence of seductive details, topic interest, and prior knowledge. Recall, transfer, and perceived cognitive load scores were measured as continuous variables while hypertext structure, seductive details, topic interest, and prior knowledge were coded as categorical variables.

3.2 Participants

Ninety three undergraduate students from a School of Education in a university in Istanbul constituted the participants of the study. The students were enrolled in the departments of teaching math, science, English as a foreign language, educational technology, and school counseling. The majority were in their 2-4 year of study, and their age ranged from 19 to 28 with a mean of 22. There was also a 45-year-old participant. Since learners with low prior knowledge were targeted in the study, the data from the participants who indicated a high level of content knowledge were excluded. Data were collected from 109 participants in total. However, excluding participants with high prior knowledge, data from 93 participants were used (see Table 1). Twenty-one of the participants were male while 72 of the participants were female.

The participants were chosen via convenient sampling: Several instructors who conducted classes in a computer lab were contacted, and the students enrolled in these classes were requested to participate. Thus the sample included undergraduates from a variety of backgrounds. Assignment to treatment groups was done randomly, according to their seating arrangement in the computer lab.

Table 1. Descriptive Statistics of the Age Distribution of Participants

	N	Min	Max	Mean	SD
Age	93	19	45	22,05	2,78

3.3 Data collection instruments

Pretest:

A pre-test was prepared to collect the participants' prior knowledge on the subject matter. The test contained 5 fill-in-the-blanks and 8 short answer questions about DNA structure, DNA replication, and protein synthesis (see Appendix A). Each answer was rewarded 1 point, and the maximum point a participant could get was 13. Partial answers for short answer questions were not accepted. Low prior knowledge students were selected in order to observe a possible seductive details effect. After consulting a subject matter expert, the data from the participants who scored below the 8-points threshold were used. Park et al. (2011) stated that high prior knowledge reduces the cognitive load imposed by the material, thus diminishing the detrimental effect of seductive details, if any. So, students with high prior knowledge might fail to show, or they may conceal a possible seductive details effects. Sixteen out of 109 participants were eliminated since their pretest score were higher than the designated threshold.

Cognitive load measure:

Perceived cognitive load was measured by a subjective self-reporting technique developed by Paas (1992). As stated by Paas (1992) these scales are easy to administer, with sufficient reliability. The participants were asked to rate how much mental effort they spent as they worked with the material on a 5-point Likert scale (see Appendix B). The cognitive load measure was taken immediately after the treatment itself, so that the participants were allowed to respond before they were involved in any other activity.

Topic interest:

Topic interest was measured through a questionnaire, adapted from Schiefele & Krapp (1996). The form contained 2 questions and 5 descriptive adjectives for each, listed in two separate sections. The two questions were: "You will use an educational software about DNA and protein synthesis. How do you expect to feel about it?" and "What do you think about the topic of DNA and protein synthesis?" This two-part structure of the form was suggested by Schiefele & Krapp (1996) to measure individual and situational interest separately. The participants were asked to rate these questions using adjectives on a 5-point Likert scale: First question included adjectives such as bored, stimulated, and involved, whereas the second question included useful, worthless, and unimportant. All questions and adjectives were in Turkish (see Appendix C). Reverse coding was done for negative adjectives. The maximum possible score was 50. Participants were then divided into two groups of low and high topic interest by the median score.

Recall task:

In the recall test, the participants were asked to write down as many concepts/idea units as they remembered after they interacted with the material on the computer. Idea units expressed in complete sentences explaining a concept, or a word or a phrase naming the concept itself were accepted as responses. Each version of the hypertext included 44 idea units and 36 concepts. Each correct answer was rewarded 2 points. Ideas and concepts frequently used in daily life (such as sugar, hormone etc.) scored only 1 point. Maximum score a participant could get was 156 points, including both idea units and concepts. All concepts and idea units extracted from the hypertext was supervised by a subject matter expert from the science education department (see Appendix D for all concepts and idea units).

No specific questions were prepared to measure recall performance, as Sweller (1988) proposed. Sweller (1988) stated that during problem solving, reduced specificity of the problem enables learners to enhance their problem solving skills, and adapt themselves into the problem solving better than in the context of a specified problem. A specified problem, on the other hand, may lead learners to interact with the material/environment, which would result in an increased cognitive load, thus causing a poorer performance.

Transfer task:

The transfer task consisted of five questions that specifically required participants to combine and apply their knowledge in different contexts. Transfer questions were rigorously prepared in order to encompass most of the topics covered. Each question had several acceptable answers, all included in the Appendix E, and scoring was done according to this answer set. Participants received two points for each acceptable answer. If the answer partially corresponded to a possible response, one point was given. Exact matching of words was not required. The maximum score a participant could get was 56 which includes all possible answers for every transfer question.

The instructional material, pre-test, and transfer questions were reviewed by the same subject expert from the department of Science Education. All the materials were revised several times according to his suggestions, and necessary changes were incorporated.

An interrater reliability analysis using the Pearson correlation statistic was performed to determine consistency among raters. An unbiased rater scored approximately 20% of the data using the scoring scheme described above. Differences between ratings were discussed with the interrater. Results showed a strong correlation between two ratings, r=.98, after disagreements between raters were negotiated and necessary changes on scoring were incorporated.

In addition to the instruments above, participants were asked to fill out a demographics survey, asking age, term, department, and gender, and a consent form stating the purpose of this research.

3.4 Treatment/Implementation

3.4.1 Procedure

Participants were randomly assigned to one of the 4 treatment groups by their seating arrangement at the computer laboratory. There were 4 treatment groups, based on the structure of the hypertext the participants interacted with, and whether or not the text included seductive details: 1. Hierarchical hypertext with no seductive details (HNS), 2. Hierarchical-hypertext with seductive details (HSD), 3. Network-hypertext with no seductive details (NNS), and 4. Network-hypertext with seductive details (NSD). Data were collected in 5 discrete sessions in 5 different classes. At the beginning of each session, the participants were asked to fill out a consent form (see Appendix F), and they were given a pre-test to determine the level of their prior knowledge. Then the topic interest questionnaire was administered. After finishing the questionnaire, the participants were instructed to access the relevant hypertext environment from the web browser on their computers via a specific URL they were provided. Each participant worked on the computer individually at their own pace. When they were done, they first took the cognitive load survey. Then they were given the recall question, followed by the transfer tasks, each question on a separate page. Demographics form was the last form the participants filled out (see Appendix G). The total amount of time the treatment took was 60 minutes in average. Participants approximately spent 20 minutes purely on the hypertext material while perceived cognitive load form, recall and transfer tasks took 30 minutes in average.

3.4.2 Learning materials

The information covered in the learning material was adapted from mainly three reliable websites in English on DNA structure, DNA replication, and protein synthesis. Several reliable Turkish sources, including textbooks and websites were also used. This material was reviewed by the subject expert, a faculty member at the School of Education, to ensure coherence and accuracy.

Hypertext materials were designed based on the principles of multimedia design (Mayer, 2014) and basic visual design principles, and were developed using Articulate 2 with 1280 x 1024 screen resolution. Any problems with resolution were averted by using a very common resolution value. Hypertexts were created dividing the whole text material into nodes. The coherence between nodes was also supervised by the subject matter expert from Science Education department to guarantee integrity and accuracy. Text and pictures complemented each other in every node, and captions were used to aid understanding. The information covered in each version was identical

The hierarchical hypertext included 25 information nodes, 1 starting node, 1 tutorial node and 1 table of contents node. Nodes were grouped thematically under headings in the table of contents screen (see Fig.H4 in Appendix H). Each heading included several nodes, and users needed to read the content of each node to advance to the next heading. Forward and backward movement between nodes were allowed, and participants could visit the table of contents screen anytime by clicking a button provided in every screen (see Fig.H1 in Appendix H). The hypertext did not allow users to exit until all the nodes were read.

The network hypertext also contained 25 information nodes, along with 1 starting node and 2 tutorial screens (see Fig.H5 in Appendix H). It started with the same first information node as in the hierarchical version, but each node provided users 2 to 4 different choices to transverse between relevant nodes, instead of a predetermined hierarchical sequence (see Fig.H2 in Appendix H). Links to different nodes were determined according to the information covered in that particular node. The relevance of each link in each node was reviewed by the subject matter expert, and necessary changes were incorporated. After visiting 15 nodes, users were presented with a button, which, when clicked, would give a list of nodes covered until then, as well as those that were not yet visited. Thus, the general structure of the hypertext was shown to the user who had read more than half of the material, and a possible disorientation was averted. As in the hierarchical version, the network hypertext did not allow participants to quit before all the information was read.

3.4.3 Seductive details

The base text included 894 words, without the seductive details. Nine different seductive details were incorporated into the base text in the seductive detail versions, consisting of 132 words, approximately 15% of the base text. Ten out of 25 information nodes of the learning material (approximately 36% of the nodes) included seductive details. The seductive details selected were either scientific facts not directly related to the learning goals, or loosely related daily life trivia, which were tangential to the topic. Several websites were used to collect information for seductive details. All seductive details used were reviewed by the subject matter expert to ensure accuracy (see Appendix I).

3.5 Data analysis

Descriptive statistics which involves mean, mode, and median of all tests and forms administered were computed (including demographics). As for inferential techniques, this study used two-way ANOVAs to assess the effect of each dependent variable on the independent variables, and to investigate the interaction effects. SPSS 24 Statistics software was used for all statistical computations. Normality of the distributions were checked, and Log and square root techniques were used to deal with non-normal distributions (see Appendix J).

CHAPTER 4

RESULTS

4.1 Hypertext structure and seductive details

The effects of hypertext structure and seductive details on recall and transfer scores were investigated. For recall performance, descriptive statistics showed that the participants using network hypertext with seductive details had the highest mean scores, followed by the participants using hierarchical hypertext with seductive details (see Table 2). As for transfer performance, participants using hierarchy hypertext structure with seductive details produced the best results followed by participants using network hypertext structure with seductive details.

Table 2. Descriptive Statistics of Seductive Details and Hypertext Structure Groups

	Seductive details	Hypertext structure	N	Mean	SD	Min	Max
Recall	Yes	Hierarchical	22	20.45	9.96	2	36
		Network	23	23.70	8.07	9	35
	No	Hierarchical	22	18.73	9.75	2	40
		Network	26	17.62	8.64	3	38
Transfer	Yes	Hierarchical	22	8.18	4.49	2	18
		Network	23	7.35	3.36	2	16
	No	Hierarchical	22	6.09	3.32	0	14
		Network	26	6.96	3.72	2	18

Separate two-way ANOVAs were performed on both recall and transfer scores to detect the interactive or independent effects of hypertext structure and seductive details on recall and transfer. Homogeneity of variance assumption was sustained for recall scores with Levene's test p=.6.

The interaction effect between the hypertext structure and the presence of seductive details was not significant. This non-significance means that each variable may have independent effects on recall scores. The main effect for hypertext structure was found to be not significant. However, the main effect for the presence of seductive details was significant (see Table 3). Participants in seductive details group remembered significantly more concepts and idea units, compared to their counterparts in non-seductive group. The effect of seductive details explains 5% of the variance over recall scores.

Table 3. ANOVA Summary for the Effects of Hypertext Structure and Seductive Details on Recall Scores

Source	SS	df	MS	F	Sig.	Partial Eta²	Observed Power
Seductive details (SD)	352.66	1	352.67	4.25	.04	.05	.53
Hypertext structure (HS)	26.23	1	26.23	.31	.57	.04	.09
HS*SD	109.63	1	109.62	1.32	.25	.02	.21
Error	7382.84	89	82.95				

A two-way ANOVA was conducted to look for any interactive effects of the seductive details and the hypertext structure on transfer scores. The homogeneity of variances assumption was met (Levene's p=.27). The results indicated that interaction between these two variables was not significant. The main effects for the presence of seductive details and the hypertext structure were not significant, either (see Table 4).

Table 4. ANOVA Summary for the Effects of Hypertext Structure and Seductive Details on Transfer Scores

Source	SS	df	MS	F	Sig.	Partial Eta²	Observed Power
Seductive details (SD)	35.50	1	35.50	2.52	.12	.03	.35
Hypertext structure (HS)	.01	1	.01	.001	.98	.00	.05
HS*SD	16.81	1	16.81	1.19	.28	.01	.19
Error	1251.27	89	14.06				

Hypothesis 1 was rejected since a significant main effect of hypertext structure on recall and transfer was not found. Due to the significant main effect of seductive details on recall scores, Hypothesis 2 was partially confirmed.

When mean scores from recall and transfer tests are compared to possible maximum scores on these tests, it is possible to observe a floor effect on these two measures. The maximum score for the recall test was 156 (the total number of concepts and idea units one could list), while the maximum score for the transfer test was 56. However, the actual recall scores (*M*=20.05) ranged between 2 and 40, while transfer scores (*M*=7.14) ranged between 0 and 18. Converting these figures into percentages, all participants scored under 25% of maximum score in the recall test while they scored under 32% of maximum score in the transfer test.

4.2 Hypertext structure and topic interest

The mean scores show that the participants with high topic interest had the highest mean scores for both transfer and recall tasks (see Table 5). In order to examine the interactive or individual effects of topic interest and hypertext structure on recall and transfer scores, separate two-way ANOVAs were conducted. Homogeneity of variances assumption was sustained in both analyses (for recall Levene's p=.17 while for transfer p=.15).

Table 5. Descriptive Statistics of Topic Interest and Hypertext Structure Groups

	Topic interest	Hypertext structure	N	Mean	SD	Min	Max
Recall	Low	Hierarchic	11	16.18	12.59	2	40
		Network	30	19.67	8.88	3	38
	High	Hierarchic	33	20.73	8.58	2	36
		Network	19	21.74	8.86	3	35
Transfer	Low	Hierarchic	11	5.27	3.82	0	12
		Network	30	6.10	2.61	2	12
	High	Hierarchic	33	7.76	3.97	2	18
		Network	19	8.79	4.18	2	18

The results from the ANOVA indicate that there was not no interaction between hypertext structure and topic interest on recall performance. The independent effects of these two variables were not observed, either (see Table 6). Findings show that recall score is not affected by either hypertext structure or the interest of the learner.

Table 6. ANOVA Summary for the Effects of Hypertext Structure and Topic Interest on Recall Scores

Source	SS	df	MS	F	Sig.	Partial Eta²	Observed Power
Hypertext structure (HS)	97.50	1	97.50	1.14	.29	.01	1.14
Topic interest (TI)	211.25	1	211.25	2.46	.12	.03	2.46
HS*TI	29.57	1	29.57	.34	.55	.004	.34
Error	7646.53	89	85.92				

Another two-way ANOVA was conducted to see if hypertext structure and topic interest have interactive effects on the transfer scores of the participants. The results did not show a significant interactive effect of hypertext structure and topic interest (see Table 7). When the independent effects of these two variables were investigated, a significance was found for the main effect of topic interest. In contrast to the recall task, the participants with high topic interest scored higher in transfer tasks compared to participants with low topic interest. 10% of the variance is explained by the effect of topic interest on transfer scores.

Hypothesis 3 was partially confirmed since the results only pointed out a significant main effect of topic interest on transfer scores but not on recall scores.

Table 7. ANOVA Summary for the Effects of Hypertext Structure and Topic Interest on Transfer Scores

Source	SS	df	MS	F	Sig.	Partial Eta^2	Observed Power
Hypertext structure (HS)	16.68	1	16.68	1.27	.26	.01	1.27
Topic interest (TI)	129.23	1	129.23	9.86	.002	.10	9.86
HS*TI	.20	1	.20	.015	.90	.00	.015
Error	1166.10	89	13.12				

4.3 Prior knowledge and hypertext structure

Although only low prior knowledge participants were used in this study, they were also divided as lower and higher prior knowledge by their pre-test scores. Grouping was made by calculating the median of pretest scores. Participants who scored lower than median were grouped as lower prior knowledge while participants who scored higher than median were grouped as higher prior knowledge participants. The descriptive statistics regarding prior knowledge and hypertext structure data revealed that the participants with higher prior knowledge had the highest mean scores for both transfer and recall tasks. Also, descriptive statistics suggest that higher prior knowledge participants who used network hypertext scored more than lower prior knowledge participants who used hierarchical hypertext (see Table 8).

Table 8. Descriptive Statistics of Prior Knowledge and Hypertext Structure Groups

	Prior knowledge	Hypertext Structure	N	Mean	SD	Min	Max
Recall	Lower	Hierarchical	13	15.92	11.21	2	31
		Network	31	18.06	8.05	3	34
	Higher	Hierarchical	31	21.13	8.87	4	40
		Network	18	24.61	8.81	6	38
Transfer	Lower	Hierarchical	13	6.23	4.87	0	18
		Network	31	6.42	2.77	2	12
	Higher	Hierarchical	31	7.52	3.67	2	14
		Network	18	8.39	4.37	2	18

A two-way ANOVA was conducted to see whether or not these differences were statistically significant. The homogeneity of variances assumption was satisfied (for recall scores Levene's p=.2, for transfer scores Levene's p=.18).

The results suggested that prior knowledge and hypertext structure did not share any variance on recall scores. However, an independent effect of prior knowledge was found (see Table 9). This indicates that the participants with higher prior knowledge remembered significantly more concepts and idea units than the participants with lower prior knowledge. Prior knowledge accounted for 9% of the variance in recall scores.

Table 9. ANOVA Summary for the Effects of Hypertext Structure and Prior Knowledge on Recall Scores

Source	SS	df	MS	F	Sig.	Partial Eta²	Observed Power
Hypertext structure (HS)	160.53	1	160.53	2.00	.16	.02	.29
Prior knowledge (PK)	701.15	1	701.15	8.75	.004	.09	.83
HS*PK	9.12	1	9.12	.11	.74	.001	.06
Error	7130.56	89	80.12				

The same statistical procedure, a two-way ANOVA, was carried out for transfer scores. The results did not show any interactive effects of hypertext structure and prior knowledge on transfer performance. In the same fashion, no independent effects of these variables were found (see Table 10). However, the effect of prior knowledge may be considered nearly significant, with a value of p=.053, which may suggest that participants with higher prior knowledge may be more successful also in the transfer task, compared to those with lower prior knowledge.

Hypothesis 4 was confirmed due to significant main effect of prior knowledge on recall, and somewhat on transfer scores, as suggested by the findings.

Table 10. ANOVA Summary for the Effects of Hypertext Structure and Prior Knowledge on Transfer Scores

Source	SS	df	MS	F	Sig.	Partial Eta²	Observed Power
Hypertext structure (HS)	5.72	1	5.72	.41	.52	.01	.10
Prior knowledge (PK)	53.78	1	53.78	3.85	.05	.04	.49
HS*PK	2.38	1	2.38	.17	.68	.002	.07
Error	1241.88	89	13.95				

4.4 Prior knowledge and seductive details

As can be seen in Table 11, descriptive statistics showed higher mean scores both for transfer and recall tests for conditions with seductive details.

Table 11. Descriptive Statistics for Prior Knowledge and Seductive Details Groups

	Prior knowledge	Seductive details	N	Mean	SD	Min	Max
Recall	Lower	Yes	21	20.00	9.25	2	34
		No	23	15.09	8.31	2	28
	Higher	Yes	24	23.96	8.72	4	36
		No	25	20.92	9.02	6	40
Transfer	Lower	Yes	21	7.24	3.73	2	18
		No	23	5.57	3.06	0	10
	Higher	Yes	24	8.21	4.13	2	16
		No	25	7.48	3.75	2	18

A two-way ANOVA was conducted to look for the main effects of prior knowledge, seductive details and the combined effect of these variables on recall and transfer scores. Homogeneity of variances assumption was sustained for both ANOVAs (Levene's p=.96 for recall and p=.58). For recall performance, figures failed to show an interactive effect of seductive details and prior knowledge (see Table 12). This means that these two variables shared no variance over recall scores. Nonetheless, individual effects of these variables were found. Participants in seductive details condition scored significantly higher than participants in the non-seductive details condition. Prior knowledge is accounted for 7% of the variance in recall scores while seductive details are accounted for 5%.

Table 12. ANOVA Summary for the Effects of Prior Knowledge and Seductive Details on Recall Scores

Source	SS	df	MS	F	Sig.	Partial Eta²	Observed Power
Prior Knowledge (PK)	554.93	1	554.93	7.12	.01	.07	.75
Seductive details (SD)	365.96	1	365.96	4.70	.03	.05	.57
PK*SD	20.34	1	20.34	.26	.61	.003	.08
Error	6932.62	89	77.90				

To inquire the combined or independent effects of prior knowledge and seductive details over transfer performance, another two-way ANOVA was performed. The analysis pointed out no combined effect of prior knowledge and seductive details over transfer scores. Results also showed no independent main effects of these variables on transfer performance (see Table 13). Transfer performance does not seem to be affected by any of these variables.

Independent effects of prior knowledge and seductive details were found for recall scores but not for transfer scores. Interactive effects of these two variables were not observed for either recall or transfer scores. Thus, hypothesis 5 was only partially confirmed.

Table 13. ANOVA Summary for the Effects of Prior Knowledge and Seductive Details on Transfer Scores

Source	SS	df	MS	F	Sig.	Partial Eta²	Observed Power
Prior Knowledge (PK)	48.18	1	48.18	3.53	.06	.04	.46
Seductive details (SD)	33.37	1	33.37	2.45	.12	.03	.34
PK*SD	5.16	1	5.16	.38	.54	.004	.09
Error	1213.66	89	13.63				

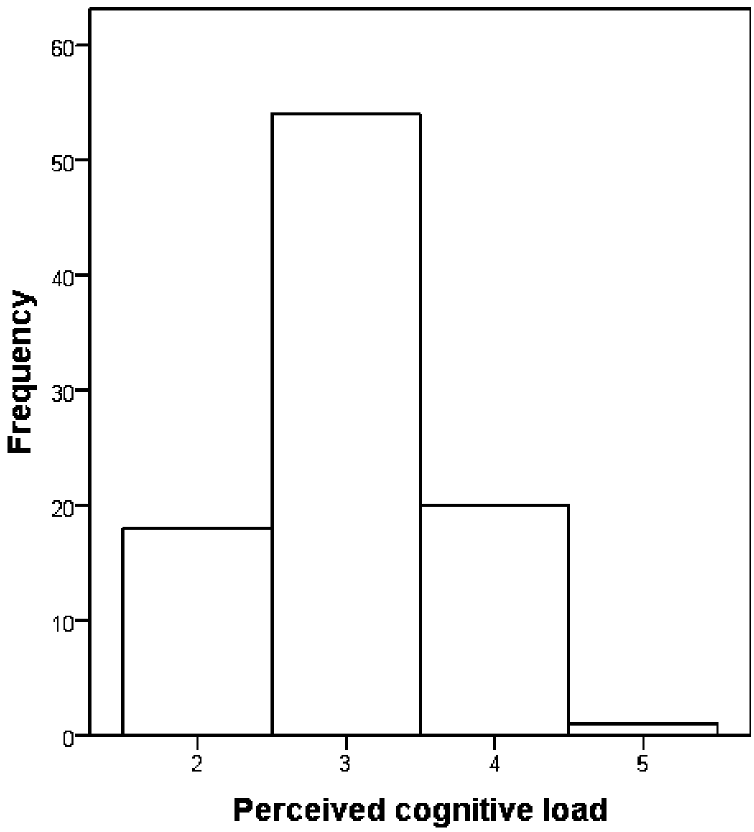
4.5 Perceived cognitive load

This study used a 5-point Likert scale self-reporting technique for the measurement of cognitive load as suggested and recommended by Paas (1992). As can be seen on Figure 1, perceived cognitive load data showed an extreme central tendency over 5-point Likert scale, thus causing a lack of variance for the whole sample. Table 14 shows the descriptive statistics of the whole sample for the cognitive load.

Table 14. Descriptive Statistics of Perceived Cognitive Load Scores

	N	Mean	SD	Variance	Skewness	Kurtosis
PCL	93	3.04	.674	.455	.167	-.140

Figure 1. Histogram of Perceived Cognitive Load Data



ANOVAs regarding hypothesis 6 were performed but due to this central tendency of cognitive load data, no significant interactions were found (see Table 15 and Table 16). Thus, hypothesis 6 was not rejected.

Table 15. ANOVA Summary for the Effects of Hypertext Structure and Seductive Details on Perceived Cognitive Load Scores

Source	SS	df	MS	F	Sig.	Partial Eta²	Observed Power
Hypertext Structure (HS)	1.024	1	1.024	2.24	.14	.00	.32
Seductive details (SD)	.15	1	.15	.32	.57	.03	.09
HS*SD	.07	1	.07	.16	.69	.00	.07
Error	40.584	89	.47				

Table 16. ANOVA Summary for the Effects of Hypertext Structure and Topic Interest on Perceived Cognitive Load Scores

Source	SS	df	MS	F	Sig.	Partial Eta²	Observed Power
Hypertext Structure (HS)	.778	1	.778	1.706	.20	.02	.25
Seductive details (SD)	.002	1	.002	.00	.95	.00	.05
HS*SD	.196	1	.196	.429	.51	.00	.01
Error	40.5	89	.456				

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Discussion

This exploratory study primarily aimed to investigate the effects of the hypertext structure and topic interest on recall and transfer performance, while looking for any possible seductive details effect, either detrimental for or fostering for learning. The findings of the study did not yield significant effects of hypertext structure on recall, transfer, or cognitive load, unlike the findings of other studies in the literature. The interaction effects of hypertext structure with topic interest, prior knowledge, and seductive details were not statistically significant either. On the other hand, a significant main effect for seductive details was observed, suggesting that seductive details facilitated the recall of information. Topic interest also showed a significant main effect, suggesting that higher topic interest leads to better transfer performance. There was also a significant main effect of prior knowledge, proposing that higher prior knowledge facilitates the recall of information. Perceived cognitive load did not seem to be affected by hypertext structure, presence of seductive details and topic interest.

Findings of the current study indicate that the hierarchical and network hypertext groups did not differ from each other in terms of the two learning measures, contrary to expectations. Since participants in this study possessed low prior knowledge, hierarchical structure should have fostered their learning processes. A plausible explanation for this could be given with Kintsch's (1988) construction-integration model of text comprehension. Kintsch's double-layered proposition of comprehension presumes that learners build the textbase first by constructing semantic relations within the text, and then build a situation model by uniting the textbase with prior knowledge, and reconstructing it. As the participants' prior knowledge was low on the subject matter, this reconstruction process might have been interrupted and might require more practice to make up for the lack of prior knowledge. Since hypertexts bring out a complex and non-linear structure, learners with low background knowledge might also have had difficulties constructing these semantic relations. The floor effect on recall and transfer measures also proves that participants did not benefit from hypertext medium. All participants scored lower than 25% of the maximum score in recall test while they scored lower than 32% of maximum score in transfer test.

Regarding the effects of seductive details, the findings point to facilitative effects in contrast to earlier studies that demonstrated detrimental effects (e.g., Abercrombie, 2013; Harp & Mayer, 1998). The participants who interacted with hypertexts that included seductive details recalled significantly more information than those who read hypertexts without seductive details, regardless of the way the hypertext was structured (i.e. hierarchically or networked). This finding could be explained with the content and the context of the seductive details included. The seductive details designed for this study were based on tangible scientific facts aligned with daily life, even if not included in the learning goals of the material covered. Similar to the findings of this study, Chang & Choi (2014) found that if the seductive details included in a learning material are concrete, then a possible impeding effect can be averted. This result can also be supported by the findings of Park et al.'s (2011) study, where low cognitive load and high cognitive load conditions were created, using Mayer's (1999) modality principle. Each condition had versions with or without seductive details. Their findings revealed that participants in low CL with seductive details condition performed best, as measured by open-ended and multiple choice questions. This study on the other hand, was designed taking into account the principles of cognitive theory of multimedia learning. The aim was to create the minimum cognitive load conditions for participants to foster learning from multimedia. Therefore a plausible explanation for higher performance of the seductive details groups could be that little extraneous load was caused by the design, and thus the learners had the opportunity to allocate their cognitive capacity for essential processing.

The findings indicate that topic interest had a main effect on transfer, but not on recall. The participants who had high interest for the topic of study scored better on transfer tasks, compared to those with low interest. This corroborates the literature, suggesting that higher topic interest leads to better performance on generating inferences (Clinton & van der Broek, 2012). The non-significant effect of topic interest on recall is in line with Lawless et al.'s (2003) findings, which indicated no significant relationship between situational interest and hypertext recall. Since this study addressed both situational and individual interest, the results confirm and add to the literature suggesting that individual interest does not seem to affect recall performance, either.

Confirming the results found by Potelle and Rouet (2003), as well as many others in the literature, this study showed a significant relationship between prior knowledge and learning performance, both in recall and transfer. The participants with higher prior knowledge performed better in both types of learning tasks. Lawless et al. (2003), among others, also asserted that prior knowledge is a statistically significant predictor of recall performance.

The lack of relationships between cognitive load and hypertext structure, seductive details, topic interest and prior knowledge is consistent with several studies in the literature that also showed a lack of interaction. Amadieu, van Gog, Mariné, Paas and Tricot (2009) stated that the hypertext structure does not affect cognitive load. Amadieu, Tricott and Mariné (2009) also reported no significant difference in mental effort invested in the learning task between high and low prior knowledge participants. The results regarding cognitive load can be explained based on the cognitive theory of multimedia learning. The hypertext material used in this study was developed based on the cognitive theory of multimedia learning, aiming to reduce extraneous cognitive load imposed by instructional design. The perceived cognitive load of the whole sample showed high central tendency on a 5-point Likert scale. This might also indicate that the design itself did not impose a large amount of extraneous cognitive load. Since the cognitive load is additive in nature (Kirschner, 2002), the perceived cognitive load measured in this study is the sum of extraneous, intrinsic, and germane cognitive load.

5.2 Implications for instructional design

Since hypertext environments are commonly used in educational settings, this study provides useful suggestions for designing hypertext learning environments.

Numerous studies suggested that students with low background knowledge were more successful while using hierarchical rather than network type of hypertext structure (e.g. Potelle & Rouet, 2003; Amadieu et al., 2009). However, this study did not confirm this finding, since no difference in learning was found between low prior knowledge students who used hierarchy and network hypertext. Yet a significant effect of prior knowledge on learning was found, which may suggest that the learners who would benefit from hypertext learning environments would be those students with relatively higher prior knowledge.

Seductive details, on the other hand, proved themselves beneficial for recall performance. Including such details in learning material may help students to remember the presented information more. However, educators should be rigorous about selecting seductive details: Such information should be tangible and familiar for students. Details which are aligned with daily life may aide student learning. Basic and simplified scientific facts, such as the ones employed in the hypertext environments designed in this study can be good examples of what type of seductive details to include.

Higher topic interest also leads to higher transfer performance, which is a predictor of deeper learning (Moreno & Mayer, 2000). Thus, instructors should try to raise learners’ interest towards the topic in every educational setting. Seductive details can be used to raise topic interest.

5.3 Limitations and suggestions for future research

Although the results of this exploratory study is supported by statistical significance, they should be generalized to larger populations only with caution. The convenience sampling method was used in the study. This puts certain limitations on the interpretation of results, and further research is needed before conclusions for larger populations are made.

The measurement of perceived cognitive load was done with a self-report technique, suggested by Paas (1992). However, self-reporting mainly measures perceived overall cognitive load, while EEG can be used to determine the instantaneous load, which may provide a hint about germane load (Antonenko and

Niederhauser, 2010). Due to lack of instruments, this can be counted as a limitation for this study.

Individual differences of the participants also affects the generalizability of the results. This study did not include measures such as working memory capacity, computer literacy, and learning styles. These all may affect learning comprehension, thus affecting the results.

Future studies can replicate this study with different student profiles. This study only includes college students while the results may vary with participants from high school or primary school.

The navigation patterns on hypertext can also affect learning outcomes. The information about navigational patterns of certain learners can also be useful in designing educational materials. The effect of disorientation in hypertext could be a mediating factor for both learning indicators (recall and transfer). Eye-tracking data in future studies may help collect data for disorientation and navigational patterns.

Seductive details in this study were only textual details. Future studies should include both textual and pictorial seductive details to investigate how they affect learning and how tectual and pictoral seductive details differ.

APPENDIX A

PRIOR KNOWLEDGE TEST

Aşağıdaki sorulardaki boşlukları uygun kelime(ler) ile doldurunuz.
(Please fill in the blanks with appropriate word(s).)

1- DNA sarmalında karşılıklı bazlar birbirine _________ ile bağlanır.
(In the DNA spiral, the corresponding bases are bonded by _______)

2- Kısaca DNA denen molekülünün tam ismi __________dır.
(DNA is the abbreviation of the molecule is _________)

3- Yavru bireyin hücrelerinde bulunan mitokondri organelinin DNA'sı tamamen ________ bireyden gelir.
(The mitochondrial DNA of the offspring comes from __________)

4- DNA'nın, bükümlü bir merdivene benzeyen şekline ____________ denir.
(The spiral-staircase-like shape of DNA is called ________)

5- Hücrenin protein üreten birimine __________ denir.
(The unit that produces protein in the cell is called ______)

Aşağıdaki soruları cevaplayınız.
(Please answer the questions below)

1. DNA sarmalında Adenin bazının her zaman eşleştiği baz hangisidir?
Which base does Adenine always pair with in the DNA helix?

2. Kromozom ve DNA arasındaki ilişki nedir?
What is the relationship between chromosomes and DNA?

3. Kromozomlar nerede bulunur?
Where are chromosomes located?

4. DNA'nın yapısında kaç çeşit azotlu baz vardır?
How many types of nitrogenous bases are found in the DNA structure?

5. mRNA'nın görevi nedir?
What does mRNA do?

6. Gen ve DNA birbiriyle nasıl ilintilidir?
How are genes and DNA related?

7. Genom nedir?
   What is genome?

8. Kodon nedir?
   What is codon?

APPENDIX B

PERCEIVED COGNITIVE LOAD QUESTIONNAIRE

	1-Hiç	2-Çok az	3- Orta	4- Fazla	5- Çok fazla
Bilgisayarda DNA ve Protein Üretimi konusunu çalışırken ne kadar zihinsel çaba harcadınız?					

(How much mental effort have you spent while working with "DNA and Protein Synthesis" on the computer?

1- *None*
2- *A little*
3- *Average*
4- *A lot*
5- *Too much)*

APPENDIX C

TOPIC INTEREST SURVEY

Aşağıdaki soruları, 1 (En az) – 5 (En fazla) olmak üzere, seçenekler arasından işaretleyerek cevaplayınız.

(Please rate your answer to the following questions between 1 (the least) and 5 (the most) on the scale given.)

1 = Kesinlikle katılmıyorum *(strongly disagree)* 2 = Katılmıyorum *(disagree)* 3 = Emin değilim *(not sure)* 4 = Katılıyorum *(agree)* 5 = Kesinlikle katılıyorum *(strongly agree)*	1	2	3	4	5

1) Birazdan bilgisayarda DNA ve Protein Üretimi konusunda kısa bir eğitsel yazılım sunulacak. Bu konuyu okurken nasıl hissedeceğinizi düşünüyorsunuz?
(You will be presented an educational software about DNA and Protein Synthesis. How do you think you will feel while using it?)

Sıkılmış *(Bored)*	O	O	O	O	O
İlgili *(Interested)*	O	O	O	O	O
İstekli *(Involved)*	O	O	O	O	O
Meraklı *(Stimulated)*	O	O	O	O	O
İlgisiz *(Uninterested)*	O	O	O	O	O
Dikkatli *(Engaged)*	O	O	O	O	O

2) DNA ve Protein Üretimi konusuyla ilgili neler düşünüyorsunuz?
(What do you think about the topic of DNA and Protein Synthesis?)

Anlamlı *(Meaningful)*	O	O	O	O	O
Önemsiz *(Unimportant)*	O	O	O	O	O
Kullanışlı *(Useful)*	O	O	O	O	O
Değersiz *(Worthless)*	O	O	O	O	O

APPENDIX D

CONCEPTS AND IDEA UNITS FOR RECALL TASK

1. DNA / Deoksiribonükleik asit *(Deoxyribonucleic acid)*
2. Biyolojik bilgi/yönerge (*Biological information / instruction)*
3. Çekirdek* *(Nucleus)*
4. Kromozom *(Chromosome)*
5. Genom *(Genome)*
6. Çekirdek DNAsı *(Nuclear DNA)*
7. Mitokondri *(Mitochondria)*
8. Sperm *(Sperm)*
9. Yumurta* *(Egg cell)*
10. Nükleotit *(Nucleotide)*
11. Fosfat / Fosfat grubu *(Phosphate / Phosphate group)*
12. Azotlu baz *(Nitrogenous base)*
13. Şeker* *(Sugar)*
14. Adenin *(Adenine)*
15. Timin *(Thymine)*
16. Sitozin *(Cytosine)*
17. Guanin *(Guanine)*
18. Çift sarmal *(Double helix)*
19. Hücre Bölünmesi *(Cell division)*
20. Tırnak hücresi *(Nail cell)*
21. Saç hücresi *(Hair cell)*
22. Kemik hücresi *(Bone cell)*
23. Beyin Hücresi *(Brain cell)*
24. Karaciğer Hücresi *(Liver cell)*
25. Deri hücresi *(Skin cell)*
26. Hormon* *(Hormone)*
27. Protein /Protein üretimi *(Protein/Protein Synthesis)*
28. Ribonükleik asit /RNA *(Ribonucleic Acid/RNA)*
29. Gen *(Gene)*
30. Adrenalin /Adrenalin hormonu *(Adrenaline/Adrenaline hormone)*
31. Fizyolojik cevap *(Physiological response)*

32. Ara molekül *(The intermediate molecule)*
33. mRNA *(mRNA)*
34. Amino asit /Amino asit dili *(Amino Acid/Amino acid language)*
35. Kodon (Codon)
36. Ribozom *(Ribosome)*

---

1. X canlısı X canlısı doğurur. *(X breeds X)*
2. DNA biyolojik bilgileri taşır *(DNA carries biological data)*
3. DNA biyolojik bilgi aktarır *(DNA transmits biological data)*
4. DNA çekirdekte bulunur *(DNA is located in the cell nucleus)*
5. DNA paketlenmiştir *(DNA is packed)*
6. Paketlenmiş dna'ya kromozom denir *(The packed DNA is called a chromosome)*
7. Hücre çekirdeğindeki dna'ya çekirdek dna'sı denir *(DNA that is located in the nucleus is called the nuclear DNA)*
8. Tüm çekirdek DNA'sına genom denir *(The entire nuclear DNA is called the genome)*
9. Canlılarda mitokondri bulunur *(Living beings have mitochondria)*
10. Mitokondri enerji üretir *(Mitochondria produces energy)*
11. DNA'nın yarısı anneden yarısı babadan gelir *(Half of DNA comes from the mother and the other half comes from the father)*
12. DNA nükleotitlerden oluşur *(DNA is comprised of nucleotides)*
13. Nükleotit, fosfat grubu, şeker grubu ve bir azotlu baz içerir *(A nucleotide includes a phosphate group, sugar group, and a nitrogenous base)*
14. Nükleotitler zincir şeklinde bağlanır *(Nucleotides bond to each other in chains)*
15. Dört çeşit azotlu baz vardır: adenine, timin, sitozin ve guanine *(There are four types of nitrogenous bases: Adenine, Thymine, Cytosine, and Guanine)*
16. Bazların dizilişi biyolojik yönergeleri belirler *(Biological instructions are determined by the sequence of bases.)*
17. DNAnın şekline çift sarmal denir *(The shape of DNA is called the double helix)*

18. DNA sarmalının her basamağı birbirine Hidrojen bağı ile bağlı iki bazdan oluşur *(Each step of the DNA helix is comprised of two bases, connected by a hydrogen bond)*
19. A->T ile C->G ile eşleşir *(A matches with T, and C matches with G)*
20. Hücre bölünürken çekirdeğindeki bilgileri kopyalar *(A cell make a copy of the information it contains while dividing)*
21. DNA kopyalanırken zincir çözülür/ayrılır *(The DNA double helix separates while in replication.)*
22. Zincir ayrılınca tek kalan bazlara, eşleri eklenir *(When the helix is separated the matching bases bond with the lone bases during DNA division)*
23. Bazı hücreler (saç, tırnak vb) sürekli bölünür *(Certain cells, such as those found in hair and nails, divide continuously)*
24. Bazı hücreler bir kaç bölünüp durur (kalp, ve beyin) *(Certain cells like those in the heart and brain, divide a few times, and then stop dividing)*
25. Bazı hücreler yaralanmayı onarmak için bölünür (karaciğer, deri) *(Certain cells like liver and skin divide to heal a wound)*
26. Bölünme emir hormonlarla verilir *(Division is induced by hormones)*
27. RNA protein üretimi için mesaj/kod içerir *(RNA contains codes for protein synthesis)*
28. Nükleotitlerin birleşmesiyle cümleler/genler oluşur *(Nucleotides come together to form sentences/genes)*
29. Genler DNA'nın %1'ini oluşturur *(Genes constitute 1% of DNA)*
30. Kalan DNA protein üretimini denetler *(The remaining DNA controls protein synthesis)*
31. Hormonlar proteinlerden üretilir *(Hormones are produced by proteins)*
32. Adrenalin hormonu korktuğumuz anlarda fizyolojik tepki vermemize neden olur *(Adrenaline causes us to give physiological reactions when we are scared)*
33. mRNA protein üretiminde ara molekül görevi görür *(mRNA works as an intermediary molecule during protein synthesis)*
34. Protein üretimi için ilk olarak DNA okunur *(First DNA is read for protein synthesis)*
35. Sonra bilgi mRNA'ya aktarılır *(Then the information is conveyed to mRNA)*
36. Bu bilgi amino asit dilindedir *(This information is in amino acid language)*

37. Amino asit dili protein üretimi için mRNA'daki sırayı belirler *(The amino acid language determines the sequence in mRNA for protein synthesis)*
38. 20 çeşit amino asit vardır *(There are 20 varieties of amino acids)*
39. mRNA 4 bazdan oluşur *(mRNA contains 4 types of bases)*
40. mRNA tek ipliklidir *(mRNA has a single thread)*
41. 3 harflik amino asit şifrelerine kodon denir *(3-letter amino acid codes are called codons)*
42. Bazı kodonlar protein üretimi başlatır/bitirir *(Certain codons either start or end theprotein synthesis)*
43. Ribozom protein üretim birimidir *(Ribosome is the protein synthesis unit)*
44. Ribozomlar mRNA'yı okur ve amino asitleri birleştirerek protein üretir *(Ribosomes read mRNA and synthesize proteins by combining amino acids)*

APPENDIX E

TRANSFER QUESTIONS AND ACCEPTABLE ANSWERS

Aşağıdaki soruya uygun cevapları yazınız. Paragraf ya da maddeler halinde yazabilirsiniz.

1-Kalıtsal bilginin nesilden nesile aktarılabilmesi için DNA kendini kusursuz bir şekilde eşlemelidir. Aktarılacak bilgiyi içeren DNA moleküllerinde eşlenirken bir hata olduğunu düşünün. Sonuçlar neler olabilirdi?
(, DNA must replicate itself precisely so that the hereditary information is passed to the offspring. Imagine that there was an error in the DNA molecule during replication. What could be the result?)

- Mutasyonlar oluşabilir *(Mutations may form)*
- Genetik hastalıklar oluşabilir *(Genetic diseases may occur)*
- Fiziksel özellikler değişikliğe uğrayabilir *(The physical features may change)*
- Zihinsel hastalıklar görülebilir *(Mental illnesses may be seen)*
- Protein üretimde hatalar meydana gelebilir *(There can be errors in the protein synthesis)*
- Kalıtsal bilgiler tam olarak aktarılamazdı *(The hereditary information may not be precisely passed on)*
- Hücre yaşamsal faaliyetlerini sürdüremeyebilir *(Cells may not be able to continue their vital routines)*

2-Kromozomlar ve DNA hücre çekirdeğinde korunaklı şekilde saklanmayıp hücre içinde serbestçe dolaşsaydı neler olabilirdi?
(What could happen if it were the case that the chromosomes and DNA roamed freely in a cell instead of being carefully protected in the nucleus?)

- Hücre içi çeşitli etkileşimler esnasında genler değişikliğe/zarara uğrayabilir *(The genes might get altered, or incur losses during various interactions within the cell)*
- DNA bölünmesi süreci sekteye uğrayabilir *(The DNA replication process might be interrupted)*
- Kalıtsal bilgilerin saklanması söz konusu olmayabilir *(The hereditary information might not be protected)*
- Hücre içi diğer yapıların işleyisi aksayabilirdi *(The functioning of the other organelles in the cell might be interrupted)*
- Gelecek herhangi bir zarara karşı korumasız olabilir *(The chromosomes would be vulnerable to any damage)*
- Hücre bölünürken kromozomlar eşit ayrılamayabilir *(The chromosome might not be divided equally as the cell divides)*

3- Genler ve proteinler arasında nasıl bir ilişki vardır?
(What kind of relationship is there between the genes and proteins?)

-Genler protein üretimini belirler/denetler *(Genes determine/coordinate protein synthesis)*
-Genlerin belirlediği dizilişler hangi proteinin üretileceğini belirler *(The specific sequences determined by the genes determine which protein to synthesize)*

4- Protein üretim sürecini daha verimli hale getirmek için hücre yapısında ne gibi değişiklikler yapılabilirdi? Yani daha kısa sürede daha çok protein üretebilmek için ne gibi değişiklikler yapılabilirdi?
(What could be done to make the process of protein synthesis more productive? What could be done to produce more protein in less time?)

- Ribozomlar da çekirdek içinde olabilir, böylece mRNA hücrede mesaj taşırken daha kısa yol alır. *(Ribosomes can be placed within the nucleus so that mRNA travels a much shorter distance while transmitting messages)*
- Her üretilen proteinin DNA'dan alınan mesajı daha sonraki üretim işlemleri için korunabilir. Böylece her seferinde DNA açılıp ilgili kısmı kopyalanmaz. *(The message received from the DNA in each protein produced can be saved and kept for further use, so that the DNA will not be obliged to split each time while synthesizing proteins.)*
- Daha fazla mRNA/Ribozom olabilir *(The number of mRNA and ribosomes could be increased)*
- Ribozom'un saniyede işlediği amino asit sayısı artırılabilir *(Ribosome could be made more productive by increasing its rate of processing amino acids)*
- Protein kodunun amino asit diline çevrilmesi sürecini ortadan kaldırıp DNA'da doğrudan amino asitlerden kod bulunabilir. *(Removing the step of translating protein code to amino acid language could make the process a lot faster. DNA could have amino acid codes)*

5- Hücrede protein üretimi için gerekecek kodlar neden mRNA tarafından taşınır? Yani, DNA protein üretim kodlarını hücrenin protein üretim düzeneğine neden kendisi iletmez?
(*Why does the mRNA carry the codes for protein synthesis? In other words, why is it the case that DNA itself does not transmit the relevant codes by?)*

- DNA'nın kendisi çok uzun yapılı ve çok karmaşık bir moleküldür. *(DNA itself is a very long and complicated molecule)*
- Süreç çok fazla uzar ve hatalar oluşabilir. *(The process may become too long and prone to errors)*
- DNA yalnızca üretilecek olan proteinin bilgisini mRNA'ya vermektedir. Tamamının Ribozom'larda kullanılması durumunda süreç içinde hata olma olasığılı molekülün büyüklüğünden dolayı artardı. *(DNA only transmits the*

information of the protein that will be produced. If the entireDNA is used in Ribosomes, an error could occur.)

- RNA'nın yapısı gereği taşıma işlemini gerçekleştirmesi daha kolaydır *(RNA is a more convenient molecule due to its structure when it comes to carrying information)*
- RNA tek zincirli olduğu için esnek bir yapıya sahiptir *(RNA is a more flexible molecule because it has a single thread)*
- DNA'daki bilgi amino asit diline çevrilmelidir, doğrudan kullanılamaz *(The information on DNA should be converted into amino acid language. It cannot be directly used in protein synthesis)*
- DNA hareket etme kabiliyetine sahip değildir *(DNA cannot move)*
- Ribozom tek zincirli yapıları okuyabilir *(Ribosome is made to read single-thread carriers)*

APPENDIX F

CONSENT FORM AND ETHICAL APPROVAL

KATILIMCI BİLGİ ve ONAM FORMU

Araştırmayı destekleyen kurum: Boğaziçi Üniversitesi
Araştırmanın adı: Çeldirici detayların, Hypertext ortamlarında öğrenme ve bilişsel yüke olan etkileri.

Proje Yürütücüsü/Araştırmacının adı: Yrd. Doç. Dr. Günizi Kartal / Yiğit Aydın
Adresi: Boğaziçi Üniversitesi, Kuzey Kampüs, ETA-B blok, Kat 3
E-mail adresi: gunizi.kartal@boun.edu.tr
Telefonu: 212 359 7571

Proje konusu: Bu çalışmanın amacı; eğitim teknolojilerinin kullanıldığı tüm alanlarda sıklıkla rastlanan bir ortam olan Hypertext ortamının öğrenmeyi en iyi şekilde destekleyebilmek için nasıl tasarlanması gerektiğini tespit etmektir. Araştırmanın bulguları eğitim teknolojisi alanında tasarım ilkelerine katkıda bulunacaktır.

Onam: Araştırmaya katılmayı kabul ettiğiniz takdirde DNA konulu bir eğitsel yazılım kullacak, öntest ve sontest sorularına cevap vereceksiniz. Ayrıca kısa bir anketi doldurmanız da istenecek.

Çalışmaya katılmanız tamamen isteğe bağlıdır. İsminiz tamamen gizli tutulacaktır. Katılmamayı tercih ederseniz ya da herhangi bir noktada araştırmadan çekilirseniz ders notunuz kesinlike olumsuz etkilenmeyecektir.

Yapmak istediğim araştırmanın size risk getirmesi kesinlikle beklenmiyor. Araştırma çerçevesinde toplanan verilerden ulaşılan sonuçlar eğitimle ilgili bilimsel konferanslarda sunulabilir, yayınlanabilir.

Bu formu imzalamadan önce çalışmayla ilgili sorularınız varsa sormaktan çekinmeyin. Daha sonra gerekirse 212 359 7571 numaralı telefondan proje yöneticisine ulaşabilirsiniz. Araştırmayla ilgili haklarınız konusunda yerel etik kurullarına da danışabilirsiniz.

Yukarıdaki açıklamaları okudum ve anladım. Çalışmaya katılmayı kabul ediyorum.

Katılımcı Adı-Soyadı:…………………………………..
İmzası:………………………………………………
Tarih (gün/ay/yıl):........./.........../.............

T.C.

BOĞAZİÇİ ÜNİVERSİTESİ

İnsan Araştırmaları Kurumsal Değerlendirme Alt Kurulu

Sayı: 2017 - 37

29 Mayıs 2017

Yiğit Aydın
Bilgisayar ve Öğretim Teknolojileri Eğitimi

Sayın Araştırmacı,

"Çeldirici detaylar ve hipermetin yapısının öğrenme, konuya duyulan ilgi ve bilişsel yüke olan etkileri" başlıklı projeniz ile ilgili olarak yaptığınız SBB-EAK 2016/22 sayılı başvuru İNAREK/SBB Etik Alt Kurulu tarafından 29 Mayıs 2017 tarihli toplantıda incelenmiş ve uygun bulunmuştur.

Saygılarımızla,

İnsan Araştırmaları Kurumsal Değerlendirme Alt Kurulu

Doç. Dr. Ebru Kaya

Yrd. Doç. Dr. İnci Ayhan

Doç. Dr. Gül Sosay

Doç. Dr. Mehmet Yiğit Gürdal

Yrd. Doç. Dr. Bengü Börkan

APPENDIX G

DEMOGRAPHICS FORM

Ad: *(Name)*	
Soyad: *(Last name)*	
Yaş: *(Age)*	

1) Bölüm:
(Department)

…………………………………………………………………………………………..

2) Dönem
(Semester)

………………………………………………………………………………………….

APPENDIX H

SAMPLE SCREENSHOTS FROM TREATMENT

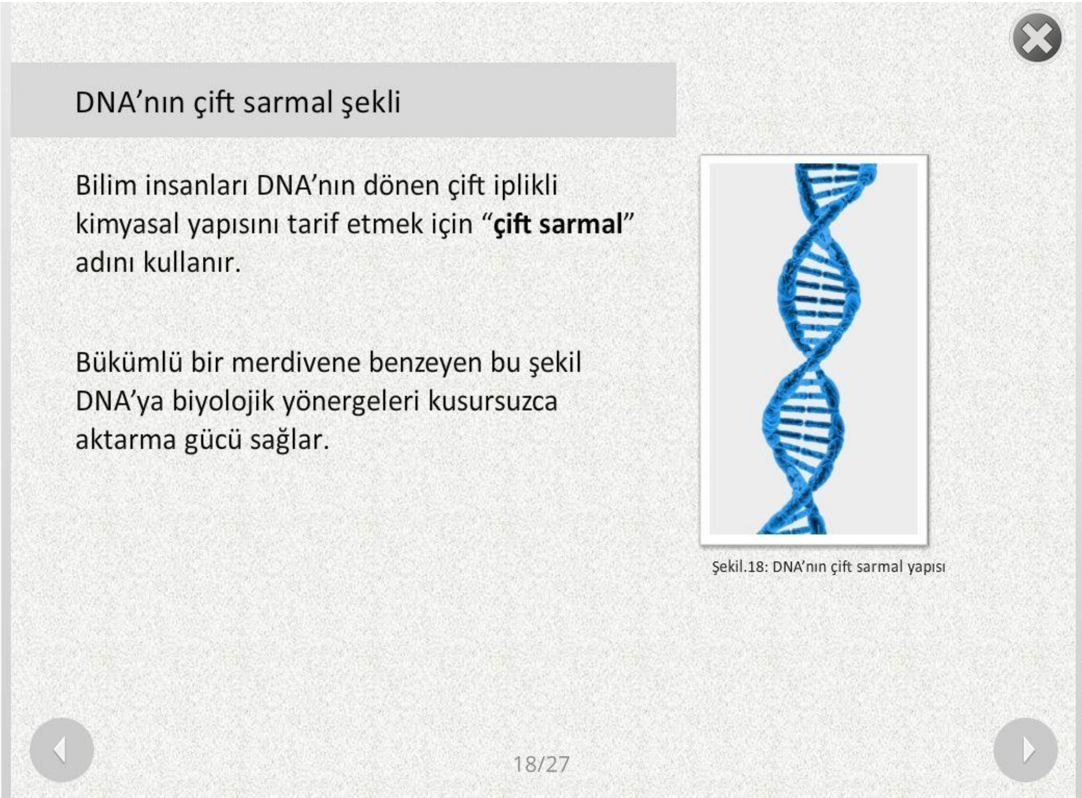


Figure H1. A Sample Screen from Hierarchy Hypertext Version

(The double helix of DNA
Scientists use the phrase "Double Helix" to describe the shape of DNA. Resembling a spiral ladder, this shape makes it possible for DNA to precisely transmit biological instructions.)

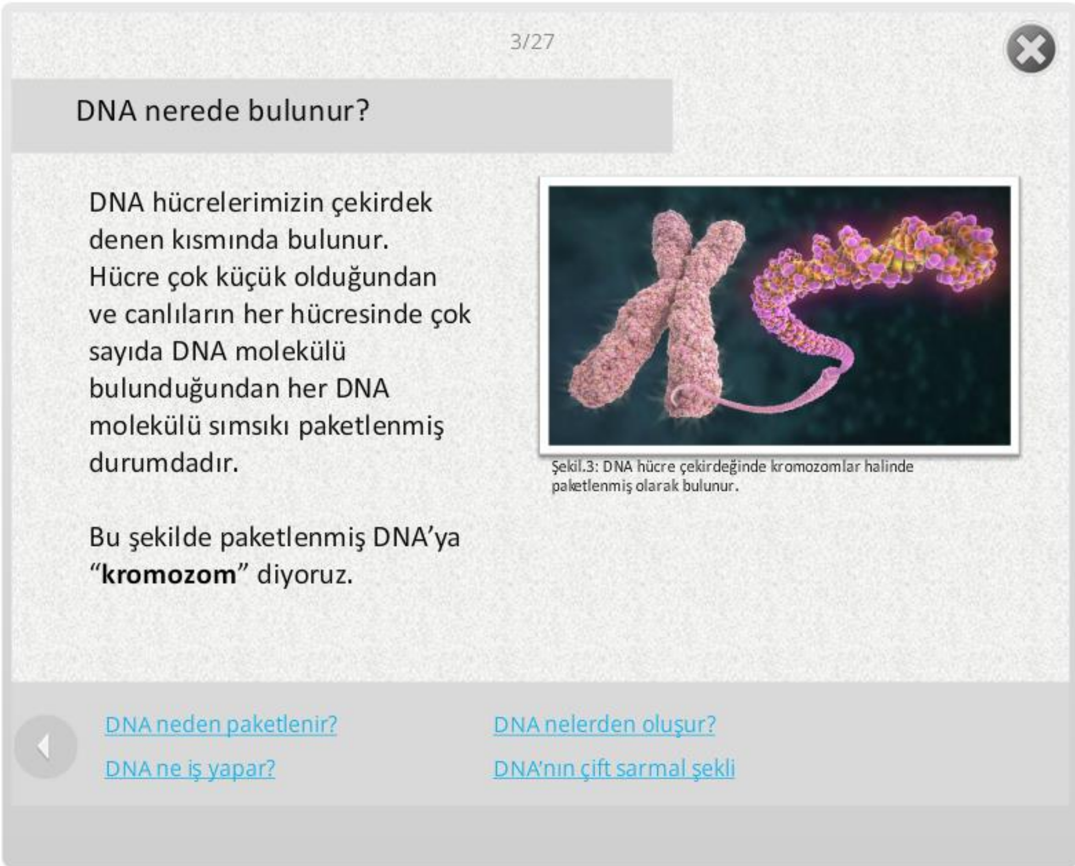


Figure H2. A Sample Screen from Network Hypertext Version

(Where is DNA found?
DNA is found in the nuclei of our cells. Since cells are very small, and there are several DNA molecules within the nucleus, DNA is tightly packed. We call these tightly packed DNA molecules "chromosomes".

Why is DNA packed?	*What is DNA comprised of?*
What does DNA do?	*The double helix shape of DNA)*

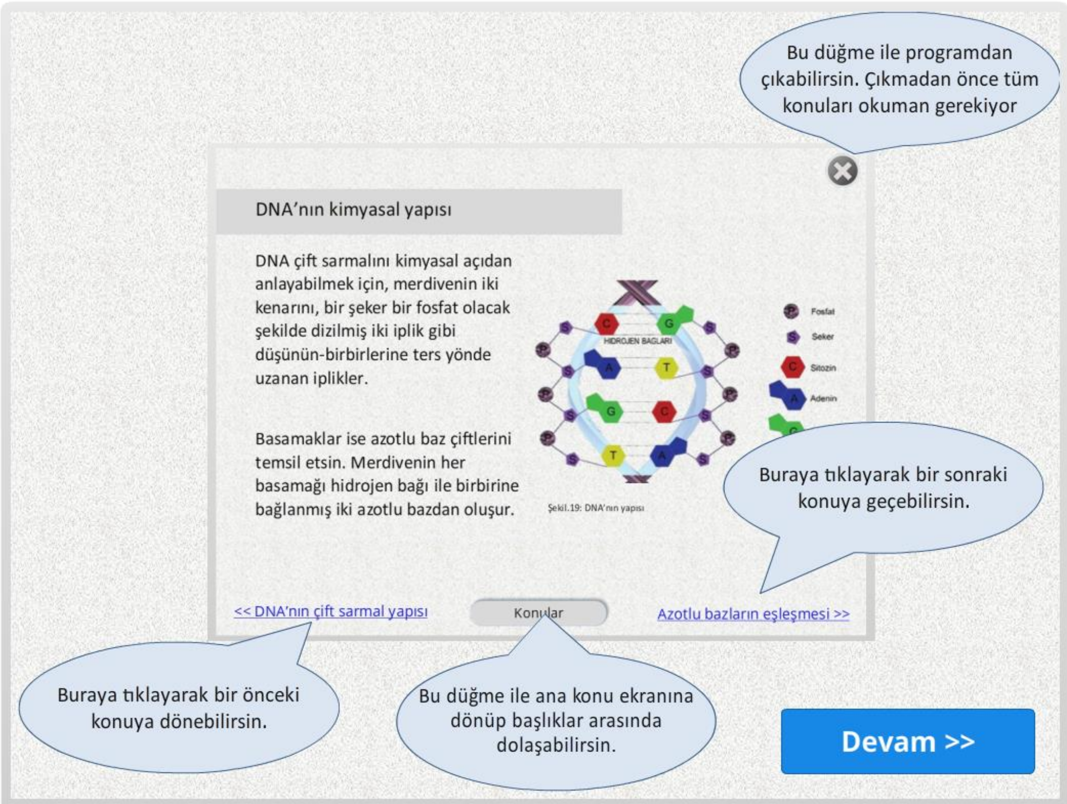


Figure H3. The Tutorial Screen of the Hierarchical Version

From top right to bottom left

(You can exit using this button. But you need to read all of the topics first.
You can advance to the next topic by clicking this button.
You can return to the title screen and choose another topic by clicking this button.
You can return to the previous topic by clicking here)

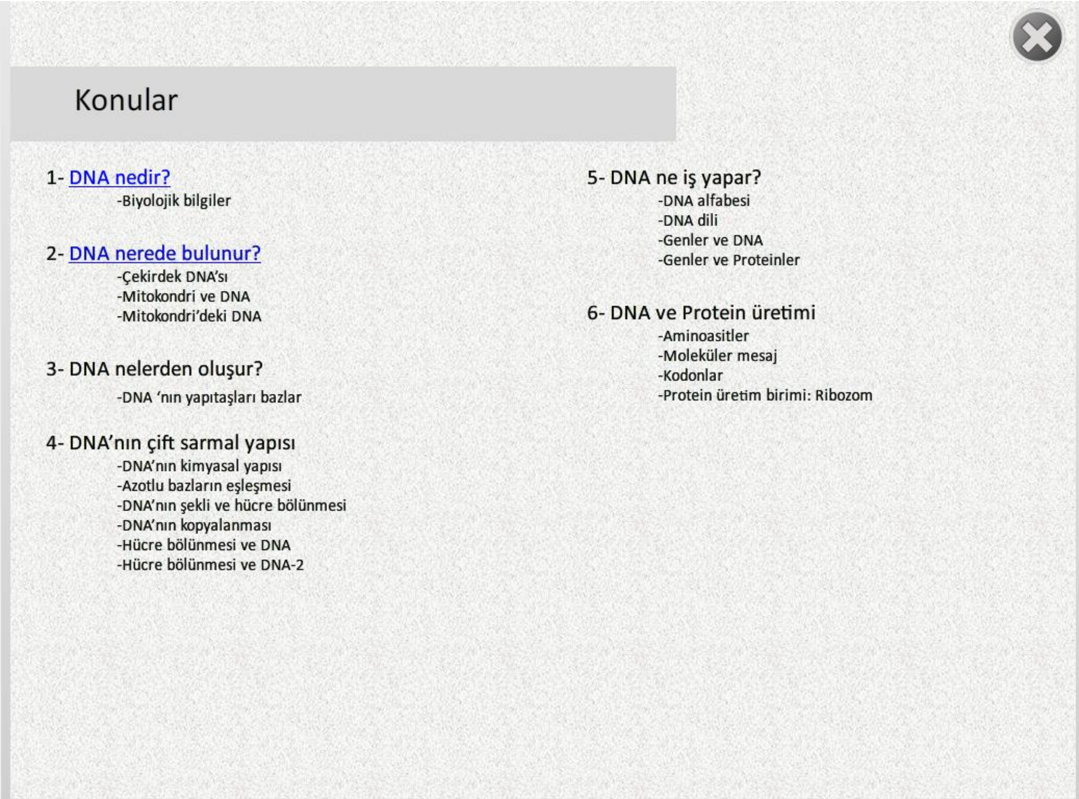


Figure H4. The Index Screen of Hierarchical Version

(Topics

1- *What is DNA?*
    a. *Biological information*
2- *Where is DNA found?*
    a. *Nuclear DNA*
    b. *Mitochondria and DNA*
    c. *DNA in the mitochondria*
3- *What is DNA comprised of?*
    a. *Building blocks of DNA*
4- *Double helix shape of DNA*
    a. *Chemical structure of DNA*
    b. *Matching of nitrogenous bases*
    c. *DNA's shape and cell division*
    d. *Cell division and DNA*
    e. *Cell division and DNA-2*
5- *What does DNA do?*
    a. *The DNA alphabet*
    b. *The DNA language*
    c. *Genes and DNA*
    d. *Genes and proteins*
6- *DNA and protein synthesis*
    a. *Amino acids*
    b. *Molecular message*
    c. *Codons*
    d. *A unit of protein synthesis: Ribosome)*

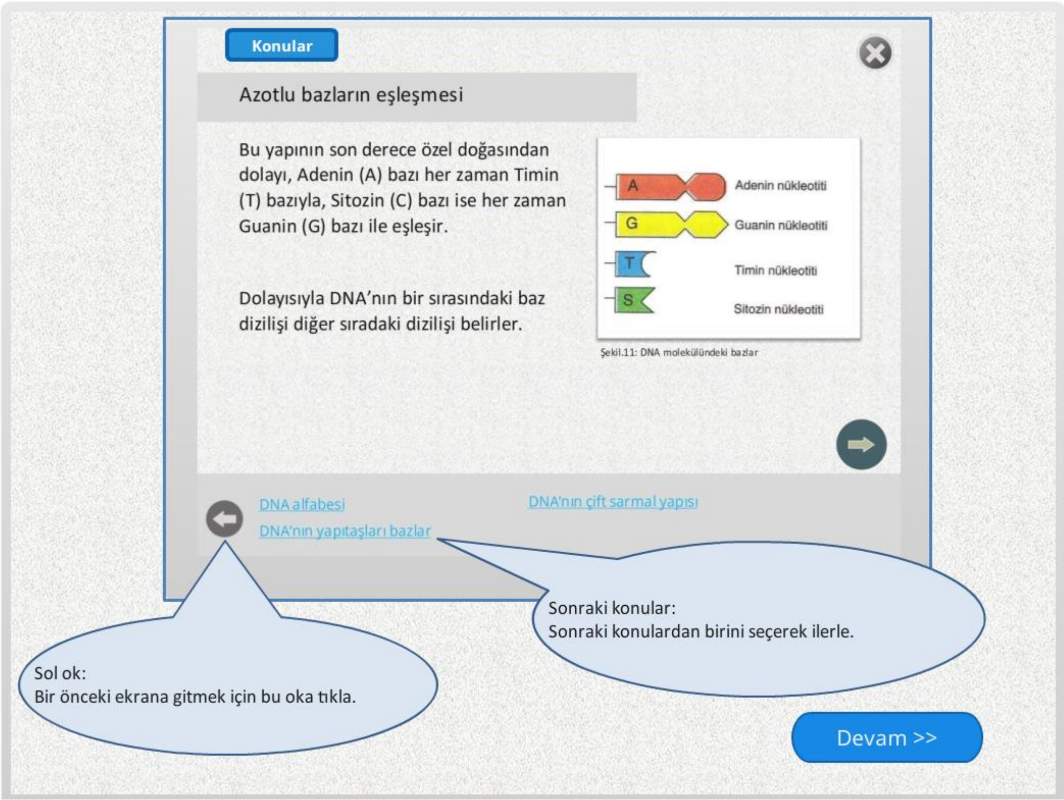


Figure H5. Tutorial Screen from Network Version

From right bubble to left:

(Next topics: Choose one of the topics to advance

Left arrow: Click this arrow to go back to the previous screen)

APPENDIX I

SEDUCTIVE DETAILS USED IN THE STUDY

1. Bir yavru bireyin DNA'sı %99.5 oranıyla evebeyninkiyle aynıdır.
   (An offspring's DNA is 99.5% identical with its parent)

2. İnsan genomonun dizilenmesi 13 yıl sürmüş ve 2003 yılında tamamlanmıştır.
   (Lining up the human genome took 13 years, and was completed in 2003)

3. Neye benzeyeceğimizi belirleyen yapı taşında bolca şeker bulunur. Hoşumuza giden birine "ne kadar tatlısın" dememiz belki de sebepsiz değildir.
   (The building blocks of our physical appearence contain a lot of sugar. So it is not weird to call someone we love "sweet" after all!)

4. DNA'nın çift sarmal yapısının ilk kez 1953 yılında James Watson ve Francis Crick tarafından tespit edildiği bilinir, oysa ikilinin buluşu 1860'lardan beri devam eden bilimsel çalışmaların son halkasıdır.
   (Even though it is widely known that James Watson and Francis Creek found the double helix shape of DNA, their work was only a sequal to the scientific experiements originated in 1860's.)

5. Eğer DNA'nın tamamı açılsaydı 2 metre uzunluğunda olurdu. Demek ki tüm hücrelerimizdeki DNA'yı uç uca eklersek güneş sisteminin çapının iki katı kadar bir uzunluğa ulaşırdık.
   (If all DNA in a cell would come undone, it would measure 2 meters long. This means that if we add all the DNA in all our cells end to end, we would come up with a length longer than double the diameter of our solar system.)

6. Vücudumuzda sudan sonra en çok bulunan madde proteinlerdir.
   (*Proteins are the second mostly-found substance in human body, after water*)

7. DNA ayrıca tarımsal mahsulün saflığını ölçmek için kullanılır. Farklı bir organizmanın DNA'sını içeren mahsül genetik olarak değiştirilmiş demektir.
   (DNA is also used to measure the purity of crops. If a product possesses DNA of another crop, it means that it is genetically modified.)

8. Bazı üzüm cinslerinin RNA'ları değiştirilerek daha uzun zamanda olgunlaşmaları sağlanıp daha lezzetli üzümler elde ediliyor.
   (Altering RNA of certain grapes, causes them to take longer to ripe, which in turn would cause a more delicious taste.)

9. Bazı virüslerde genetik bilgiyi taşıyacak DNA yerine yalnızca RNA bulunur.
   (Certain viruses only have RNA to carry genetic information instead of DNA)

APPENDIX J

NORMALITY TESTS OF DEPENDENT VARIABLES

Table J1. Normality Test of the Whole Sample

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Topic Interest	.11	93	.01	.96	93	.01
Cognitive Load	.30	93	.00	.81	93	.00
Recall	.06	93	.20*	.98	93	.24
Transfer	.12	93	.00	.96	93	.00

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table J2. Normality Tests of Seductive and Non-seductive Groups

		Kolmogorov-Smirnova			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
Topic Interest	SD	.10	45	.20*	.98	45	.50
	NSD	.14	48	.024	.91	48	.00
Recall	SD	.10	45	.20*	.95	45	.06
	NSD	.07	48	.20*	.98	48	.62
Transfer	SD	.12	45	.12	.96	45	.08
	NSD	.12	48	.08	.94	48	.02
Cognitive Load	SD	.34	45	.00	.77	45	.00
	NSD	.26	48	.00	.81	48	.00

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table J3. Normality Tests of Hierarchical and Network Hypertext Groups

	Group	Kolmogorov-Smirnova Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Topic Interest	Hierarchical	.12	44	.12	.96	44	.12
	Network	.08	49	.20*	.98	49	.42
Recall	Hierarchical	.12	44	.12	.97	44	.24
	Network	.08	49	.20*	.98	49	.52
Transfer	Hierarchical	.15	44	.02	.96	44	.10
	Network	.11	49	.20*	.94	49	.02
Cognitive Load	Hierarchical	.27	44	.00	.80	44	.00
	Network	.34	49	.00	.79	49	.00

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table J4. Normality Tests of Low and High Topic Interest Groups

	Interest	Kolmogorov-Smirnova Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Topic Interest	Low	.15	41	.03	.92	41	.01
	High	.17	52	.00	.92	52	.00
Recall	Low	.08	41	.20*	.98	41	.55
	High	.08	52	.20*	.97	52	.21
Transfer	Low	.13	41	.08	.96	41	.13
	High	.12	52	.08	.95	52	.04
Cognitive	Low	.27	41	.00	.84	41	.00
Load	High	.32”	52	.00	.77	52	.00

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table J5. Normality Tests of Lower and Higher Prior Knowledge Groups

	Prior Knowledge	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Topic	Lower	.10	44	.20*	.98	44	.93
Interest	Higher	.19	49	.00	.88	49	.00
Recall	Lower	.08	44	.20*	.97	44	.21
	Higher	.07	49	.20*	.98	49	.68
Transfer	Lower	.14	44	.03	.94	44	.03
	Higher	.11	49	.11	.96	49	.08
Cognitive	Lower	.29	44	.00	.83	44	.00
Load	Higher	.31	49	.00	.78	49	.00

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

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