A Web Based System Design for Creating Content in Adaptive Educational Hypermedia and Its Usability

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ABSTRACT

Adaptive educational hypermedia is an environment that offers an individualized learning environment according to the characteristics, knowledge and purpose of the students. In general, adaptive educational hypermedia, a user model is created based on user characteristics and adaptations are made in terms of text, content or presentation according to the created user model. Different contents according to the user model are shown as much as user model creation in adaptive educational hypermedia. The development of applications that allow the creation of adaptive content according to the features specified in the user model has great importance in ensuring the use of adaptive educational hypermedia in different contexts. The purpose of this research is to develop a web-based application for creating content in adaptive educational hypermedia and to examine the usability of the developed application. In order to examine the usability of the application developed in the scope of the study, a field expert opinion form was developed and opinions were asked about the usability of the application from 7 different field experts. As the result of the opinions, it has been seen that the application developed has a high usability level. In addition, based on domain expert recommendations, system revisions were made and the system was published at www.adaptivecontentdevelopment.com.

Keywords: *adaptive educational hypermedia, content development, e-learning, authoring tools, usability.*

INTRODUCTION

With the advancement of technology and the possibilities provided, the materials developed to be used in studies in class or out of class have got out of monotony. One of the types of materials used in learning environments is computer aided materials. One of the characteristics of these materials is helping students to meet their individual needs (Yalın, 2000). The aim of helping individual needs of students is to make students learn according to their characteristics (learning style, speed of learning, etc.). The environments that offer individual-specific learning processes based on student characteristics are adaptive educational hypermedia.

Adaptive educational hypermedia provides an individualized learning environment according to the characteristics, knowledge and purposes of students (Brusilovsky, 1996; Woolf, 2010). In a statically developed educational hypermedia, the same education is presented to students. In other words, in the static

educational hypermedia, the same education is provided to the students who differ in the level of knowledge through the same topic objectives, regardless of the student characteristics. This situation causes problems because it does not address different styles and purposes of students in their learning (Brusilovsky, 1996). In addition, if students' characteristics are different, presentation of the same content for all learners is inadequate when static hypermedia is presented to the students (Brusilovsky, 2001). It is an important indicator that the environment needs to be adapted for each student since they have different knowledge, skill, experience, goals, interests, learning styles (Jeong, 2016; Talhi & Djoudi, 2011; Yang, Kinshuk & Graf, 2010).

In general, adaptive educational hypermedia, a user model is created based on user characteristics and adaptations are made in terms of text, content or presentation according to the created user model (Brusilovsky, 1996; Brusilovsky, 2001). Process of creating a suer model is the most important part of the development of adaptive systems (Güyer & Çebi, 2015). Although the user model is correct, the content to be used in practice must be well-structured and contain different presentation formats in order to direct the user to the correct and effective content in terms of learning. In other words, the creation of the domain model of learned content (Brusilovsky, 2003) and the involvement of different presentation styles in the domain model are important in providing learning opportunities for personal learning (Howlin & Lynch, 2014).

The domain model is a model in which concepts and relationships between these concepts are defined in an adaptive educational environment (De Bra, Houben & Wu, 1999). As well as the connections between concepts in the domain model, the presentation style according to student characteristics is also of great importance (Howlin & Lynch, 2014). Furthermore, when the existing adaptive learning environments are examined, it is generally seen that these environments are content dependent (Dziuban, Moskal, Cossisi & Fawcett, 2016). This dependency brings the problem of application of adaptive educational hypermedia in different learning areas. From this point of view, the application of content creation for adaptive educational hypermedia has been developed in this study. The creation of content development tools is important for everyone to develop and deliver content to others (Talhi & Djoudi, 2011). Since adaptive educational hypermedia researches require advanced technical knowledge, it has been taken into account that the level is suitable for users with basic computer skills without any technical knowledge in order to develop adaptive educational content with the application developed in this study. In addition, the fact that the learning content developed through the application can be used in different learning management systems has a great importance for practitioners to prefer this application. Therefore, it is also taken into account that the content created with the application conforms to the SCORM standards that are frequently used in content management systems. The degree of usability of the developed application is also crucial to the continuity of the application (Nielsen, 2012). Therefore, the usability level of the developed application within the scope of the research has been examined based on the field experts' opinion.

The purpose of this research is to develop a web-based application for creating content in adaptive educational hypermedia and to examine the usability of this application.

The creation of content development tools is important for everyone to develop and deliver content to others (Talhi & Djoudi, 2011). In this study, the application was developed to develop content for adaptive educational hypermedia. The application developed within the scope of this research is important to examine the effectiveness of adaptive educational hypermedia in different contexts.

Turkey has a few studies for adaptive educational hypermedia and conducted studies mainly consist of examining the effectiveness of environment, literature review or developing adaptive educational hypermedia (Güyer & Çebi, 2015). This study is important in terms of the development of the first application for creating content in adaptive educational hypermedia.

The application developed as the result of the study does not require any code or technical knowledge to be used by researchers who will work on adaptive educational hypermedia. Hence, the developed content development environment has great importance to enable researchers with basic computer skills to easily develop their content.

In order to examine the usability of the web-based content creation tool for adaptive educational hypermedia developed within the scope of the study, field expert opinions were taken. The number of field experts who were interviewed in the study is limited to 7.

CONCEPTUAL FRAMEWORK

Adaptive Educational Hypermedia

Adaptive educational hypermedia creates a model for users' purposes, characteristics, and knowledge, and identifies and adapts the needs according to the user interaction (Brusilovsky, 1996; Woolf, 2010). For an environment to be adaptive; hyper-text and hypermedia systems, the user model must be included and the system must be able to adapt itself by using the model (Brusilovsky, 1998; Fransisco-Revilla, 2004). One of the important points to note in the student-centered approach is the transition from standardization to personalization (Reigeluth et al., 2015). Adaptive educational hypermedia systems provide a learning environment that is shaped by the preferences and needs of learners throughout the teaching process (Brusilovsky & Peylo, 2003). Adaptive learning environments adapt teaching approaches and techniques to create personalized learning environments and meet individual differences and needs (İnan & Grant, 2011).

Adaptive learning environments aim to provide a virtual teacher for each student (Woolf, 2010). In the constructivist approach, it is accepted that the learner constructs knowledge with his own methods, and the teacher has an auxiliary role in constructing knowledge (Jonassen, 1991). According to this approach, students should be provided with the opportunity to choose the sources according to their own characteristics, not the direct presentation of the contents (Ocepek, Bosnić, Nančovska Šerbec & Rugelj, 2013). Adaptive learning environments allow students to identify their own learning ways in the learning process (Park and Lee, 2003). In addition, personalized content presentations and interactive feedback are preferred for the processes which cannot be provided with written materials in adaptive learning systems. (Šimko, Barla & Bieliková, 2010). Adaptable learning systems can be preferred because of the need to provide quick access to the information needed within the information density, the environments that present the same content and navigation structure for all users cannot meet the needs of different individuals, and the need to avoid some usability problems of the linear navigation structure (Somyürek, 2009).

Adaptive educational hypermedia provides personalized learning opportunities for individual differences and needs. The basis is "adaptation for each need" approach instead of traditional "one-size-fit-all" approach. In adaptive educational hypermedia, a model is created for each user's purposes, characteristics and levels of knowledge, and adaptations are made according to user needs with this model (Brusilovsky, 1996; Brusilovsky, 2001).

In web environments, it is the basis of adaptive learning systems that learners can learn how to learn better according to navigation or behavior, and which teaching strategy will be suitable for the student. One of the limitations of traditional "static" hypermedia applications is that it offers the same page and link list for all users. If the user population differs, the presentation of the same things will be insufficient for all existing users in traditional systems (Brusilovsky, 2001). The implementation of the same educational situations for all students is inadequate in terms of pedology (Akbulut & Cardak, 2012). The difference of individual characteristics, such as knowledge, skill, experience, goals, interests, learning styles and past accumulations, of each learner brings the need for adaptation of the learning environment to every learner (Jeong, 2016; Talhi & Djoudi, 2011; Yang et al., 2010) .

Development Process of Adaptive Educational Hypermedia

According to Knutov, De Bra & Pechenizkiy (2009), the questions we need to answer in order to develop adaptive educational hypermedia: What can we adapt? (What?), What can we adapt to? (To what?), Why do we need adaptation? (Why?), Where can we use adaptation? (Where?), When can we use adaptation? (When?), How can we adapt? (How?).

According to Brusilovsky (1996) and Knutov, De Bra & Pechenizkiy (2009), the process starts by determining objectives of adaptation with the question “Why do we need adaptation? (Why?)”. Then, the

required questions "What?" and "To what" are answered to determine domain model and user model. "When?" and "Where?" questions are used to define context and application. "How?" question is used to determine methods and techniques and adaptive system is developed at the end of the whole process.

Creating a Student Model

Creating a student model is the basis for personalization in computer-based education applications. The most important factor in designing an adaptive learning environment is to create an effective student model (Chrysafiadi & Virvou, 2013). Most used models in student modeling: covering model, pattern model, mixed model, bayes nets model, fuzzy logic model (Güyer & Çebi, 2015).

Which user characteristics are going to be used in content adaptation techniques in this study context is a determinant for the creation of environment. Therefore, this section deals with the student characteristics that are used in creating student models rather than student modeling process. Student characteristics include static and dynamic characteristics. Static characteristics are determined before the learning process starts (language, age, etc.) and do not change during navigation. Dynamic characteristics may change during the process of user navigation. A student model should be established after the current characteristics of the student are determined (Güyer & Çebi, 2015). The most common characteristics of a student are the cognitive characteristics of the student. These characteristics are attention, level of knowledge, ability to learn and understand, memory, perception, concentration, cooperation skills, problem solving and decision-making skills, ability to analyze own skills and critical thinking. In addition to their cognitive characteristics, students should be able to critically evaluate their knowledge so that they can decide what to learn. They should have metacognitive characteristics for this evaluation. Some metacognitive characteristics are reflection, self-awareness, self-audit, self-regulation, self-explanation, self-evaluation and self-management.

Creating Domain Model

The domain model is a model in which concepts and relationships between these concepts are defined in an adaptive educational environment (Brusilovsky, 1996). In addition to the connections between topics, the display of content according to the student model is another component of the domain model. As well as the connections between concepts in the domain model, the presentation style according to student characteristics has also great importance (Howlin & Lynch, 2014). Since application for content creation for adaptive educational hypermedia have been developed in this study, this section concentrates on content creation techniques.

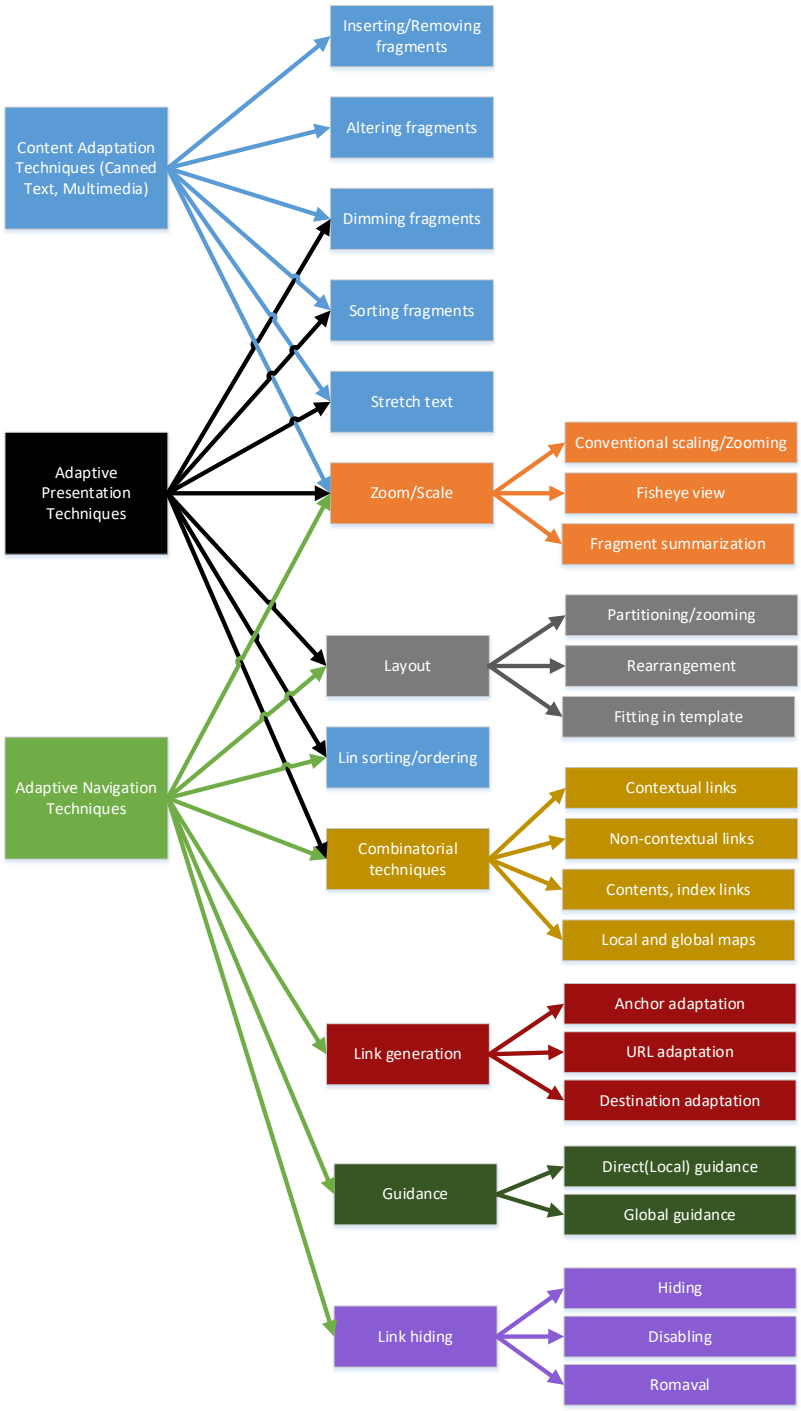

Figure 1. New taxonomy of adaptive hypermedia technologies, (Knutov, E., De Bra, P. & Pechenizkiy, M., 2009).

According to Knutov, De Bra, and Pechenizkiy (2009), information presentation in the content adaptation techniques seen in Figure 1 is affected in two main ways: to show/hide information or to emphasize/not to emphasize. The main difference between these two techniques is whether the information is accessible. Content is also changing when sections are added/removed or changed. Darkening sections, sorting sections, and the flexible text contain all the information, but it is suggested for user to access to certain parts. Since this suggestion is made with the changes made in the presentation, these techniques are also included in the adaptive presentation techniques. Flexible text represents text that includes additional clarifications that are not required for each user. Upsizing/scaling techniques are grouped under three headings. Traditional upsizing/scaling refers to changes in size, regardless of media type (text, picture, etc.). There is different view on fish-eye view information content or link, so this technique has also been

associated with adaptive navigation techniques. While some details are visible in the fisheye view, other details can be reduced, gathered or deleted. Section summarization is to give brief information with the relevant section.

It can be used to emphasize/not emphasize or suggest link to users in adaptive presentation techniques can be used. These techniques are also used in different presentations such as device compatibility or layout preferences. As adaptive presentation techniques require content to be presented in a pre-made presentation format, a layout is needed. Depending on the system used, it may be necessary to fit the information in different frames/windows, this technique is adaptation to theme. The use of different devices may also require adaptation using layout techniques. In large presentations, the fragmentation/zooming technique can be used in the system to create information sections.

The purpose of adaptive navigation techniques is to help user to follow the steps in the system, taking into account the goals, information and personality characteristics (Brusilovsky, 1996). There are two ways to influence navigation: forcefully implemented and suggested. Routing techniques offer destination with destination adaptation for pre-adapted anchors by selecting (by hiding/removing links that are not recommended) appropriate links from a wide list for users. Most adaptive navigation researches focus on adaptive navigation support that does not limit users, but suggests which links or paths are more appropriate than others. Users can be informed about which link is more appropriate to the user by using colors or icons in the list of organized links (ranked as the strongest recommended link is listed at the top) and in the link descriptions, the user does not have to apply the recommendation. Since some suggestions can be made by changing the presentation, some of the adaptive navigation techniques are also part of adaptive presentation techniques. Direct routing is not just a single step, but is performed using all recommended paths to the user. Link hiding, link building, passivation and deletion operations are frequently used in adaptive hypermedia systems. Three types of link building adaptation, which result in anchor adaptation, URL adaptation and destination adaptation, are possible in adaptive hypermedia systems, but the main purpose is to show that those exist. The difference between the URL adaptation and the destination adaptation is that during navigation the link on address bar changes with the URL adaptation while the link is not displayed in destination adaptation (Knutov, De Bra & Pechenizkiy, 2009). Map adaptation technology involves various ways of formal adaptation to the presented local and global maps. Local and global maps can be used to display the navigation structure with graphs.

Usability

Usability is the subdivision of the Human Computer Interaction (HCI) domain. The scope of HCI responds to the following questions (Acartürk & Çağıltay, 2006, as cited in Booth):

- What are the characteristics of people that affect the use of technology?
- What are the factors of technology that influence people's use of technology?
- How do people acquire and conceptualize their interactive skills?
- How do we match people's needs to technical possibilities?
- How can usable technologies be designed?
- How technology affects organizations?

Since each individual has different needs, the biggest obstacle in front of technology design that addresses all needs is the needs (Özdemir, Atasoy & Somyürek, 2007). Although there is no system that meets all needs, there is a "system acceptability" for existing systems (Özdemir, Atasoy & Somyürek, 2007). The properties that a system must have in order to be acceptable (Neilsen, J., 1993):

1. Learnability: The system must be easy to learn in order for the user to be able to use the system quickly.
2. Efficiency: It is possible to achieve high efficiency after the system has been learned by the user.
3. Rememberability: The system should be easy to remember. The user should not try to learn when using the system again after a certain period of time.

4. Number of errors: The error rate in the system should be low. Even if an error occurs in the system, this error must be recoverable.
5. Satisfaction: Users should be satisfied and happy to use the system.

According to Nielsen (2003), people will leave the system if a website is difficult to use, the purpose and what can be done with it are not clearly shown, people get lost in it, the information is difficult to read and if important questions are not answered.

Usability test types used in measuring a system are divided into two (Çağıltay, 2011; Nielsen, 1993). These are formative tests and summative tests. As it can be understood from the names, periodic evaluations of certain criteria of the system development from the beginning to the end are called formative tests, and tests used after the system is developed and ready to be used are called summative tests.

Usability testing approaches are divided into four. These are;

- **Design guide:** It is used in interface design and its evaluation in systems.
- **Intuitions (Expert approach):** It is the approach that 10 usability intuitions are used in interface design and evaluation. It is used to obtain expert opinion.
- **Experimental approach:** With this approach, the actual individuals who will use the system test the system and the data is used for the assessment of usability.
- **Model-based approach:** It is the approach in which the physical and cognitive behaviors of users are tried to be modeled.

According to Çağıltay (2011), the number of experts in the expert approach to be done with intuition should be more than one, so the evaluations can be compared. According to Nielsen (1993), 5 users are sufficient to reveal 75% of the problem in the usability tests. As the number of users increases, the reveal percentage of problem increases. In usability testing, the use of experts in the domain area instead of specialists in the field of usability may be more effective in some areas (health, finance, and system) than those without information (Rubin & Chisnell, 2008).

RESEARCH METHOD

Research Model

In this study, a particular product or program was focused on and the usability of the focused product was examined. The model of this research is developmental research (Richey, Klein & Nelson, 2003). There are two types of developmental research, focusing on a specific product or program and focusing on the research process. This research focused on a specific product (Type 1). Comprehensive Type 1 surveys have phases of analysis, design, development, implementation and evaluation (Richey & Klein, 2005). According to these phases the process diagram of the study is given in Figure 2. In developmental researches, different data collection tools such as observation, interview, expert opinion and questionnaire can be used (Kuzu, Çankaya & Mısırlı, 2011).

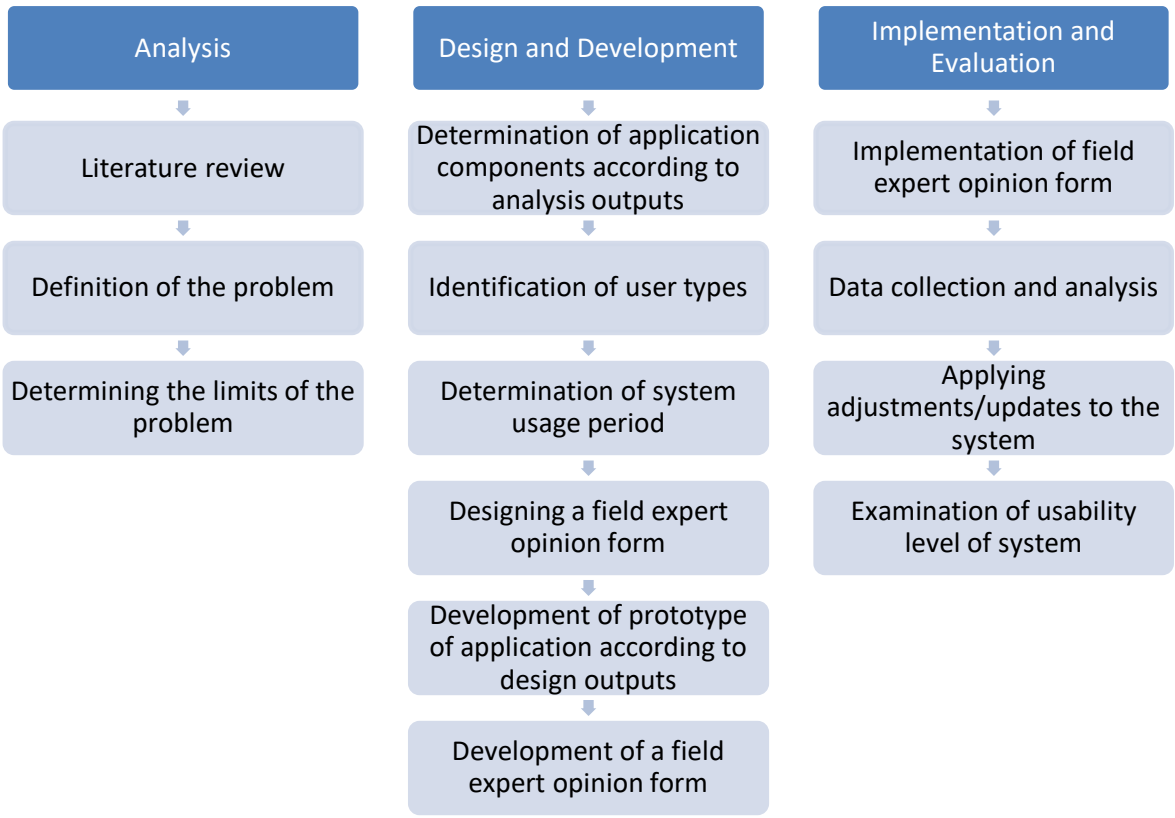

Figure 2. View of research process

Participants

In this study, 7 different field experts who have completed doctorate education in the field of Computer and Instructional Technologies have been consulted in order to examine the usability of content development application for adaptive educational hypermedia.

Data Collection Tool

Nielsen's (1995) 10 usability intuitions has been used in the field expert opinion form to examine the usability of the developed application. These intuitions are platform-independent and intended to increase usability (Çağıltay, 2011). A field expert opinion form (Appendix A) was developed in the direction of intuitions. Items created in the scope intuitions are given in Table 1.

Table 1. Items created regarding usability intuitions

Intuition Name	Item Content
Visibility of the system status	On-screen feedback is sufficient when using the system. The feedback given in the system is suitable for the purpose of the screen.
Match of the system with the real world	Terms used in the system are suitable for field terminology.
User control and freedom	In the system, delete buttons for user-induced errors are sufficient. Incorrect records made during system usage can be deleted later.
Consistency and standards	System functions overlap with expressions in the system. The use of existing components in the system is consistent with each other.
Preventing errors	The system automatically blocks the errors made.

Recognition instead of remembering.	The information on the system is sufficient.
Flexibility and utilization efficiency	The system is an easy-to-use system for expert users. The system is an easy-to-use system for novice users.
Aesthetic and minimalist design	System design is simple. It is difficult to understand which page you are on when using the system. The system has an aesthetic structure as a design.
Users should be assisted in diagnosing, recovering, and getting rid of the error	The error messages in the system are explanatory. The error messages in the system help to solve the problem.
Help and documentation	The help component in the system is easy to use. The help content in the system is sufficient. The information sought in the help content can easily be found.

Literature reviews, expert opinions or user evaluation are common methods to examine the content validity of the tools prepared for usability (Agarwal & Venkatesh, 2002). In this direction, expert opinions were applied.

In the process of the development of the opinion form, the aim was to control the writing and spelling errors and the suitability of the written items for the purpose of assessment, and opinions were obtained from an expert of the assessment and evaluation and an expert of the Turkish language. In the field expert opinion form there are 19 questions with 5-point likert scale and 1 open ended question. The answers to the Likert type items are in the form of Strongly Disagree, Disagree, Undecided, Agree and Strongly Agree, and the values for these answers range from 1 to 5. Data collected in the study were analyzed by descriptive analysis method.

Data Analysis

Data collected in the study were analyzed by descriptive analysis method.

General Structure of Developed System

In the developed system, users are required to register first and then start the content development process in order to create, save and update course content Process of the developed system in general is given in Figure 3.

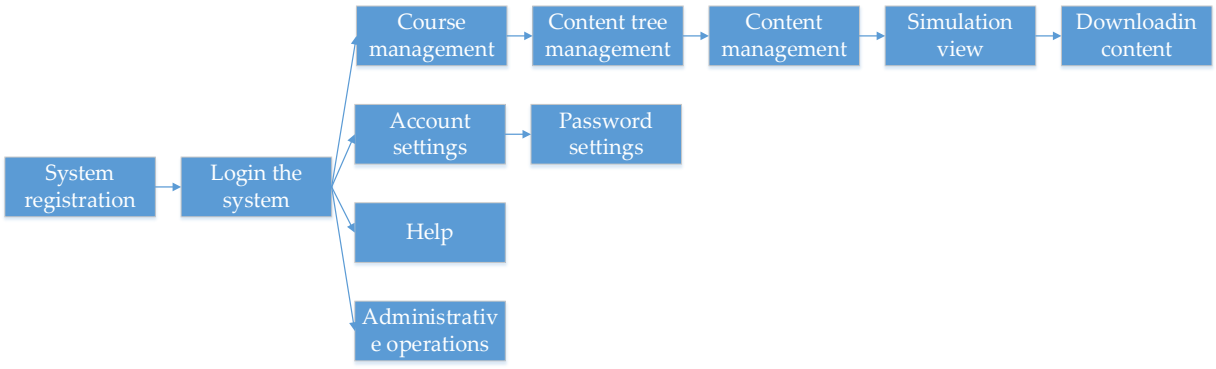

Figure 3.Process of the developed system

Users need to start using the system with the registration process so that users can access content that they have created at different times or update their content. Registered users are logged into the system with the user information they have registered to use the system.

Basically, in order for a user to develop content for adaptive educational hypermedia after logging in the system, user has to specify the course information of the content o to be developed. No method is used in the course management component, such as unit separation, because the user-control of the course-unit-content creation stages requires an additional step. Instead, in this application, if the user wants to define course content in different units, he could define each unit with the course name and thus create the course content.

As seen in Figure 4, basic components of creating course content are courses, content tree, conditional fields, and multimedia content.

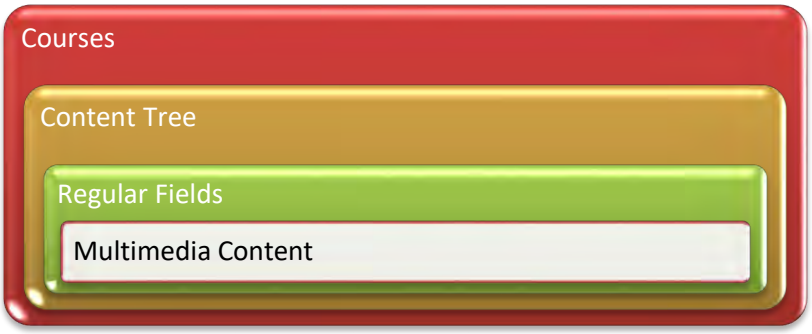

Figure 4. The basic components of creating adaptive content.

The basic components of creating adaptive content given in Figure 4 are explained below.

- **Courses:** This component states the related course in which educational content is developed. The courses created in application are specific to the user and each user is responsible for the management of his/her own course.
- **Content tree:** The content tree is the component in which topics and sub-topics where users navigate are managed. Therefore, the content tree can be thought of as a contents section of a book. In the developed application, the researcher who develops the content must construct the content tree before creating the course contents.
- **Conditional fields**: Adaptations according to student characteristics are made in adaptive educational hypermedia. With conditional fields, it is possible to determine which parts of the content will be displayed according to the student characteristics. If an area should be displayed for all users, then it is sufficient to specify no conditions or set rules for all user characteristics.
- **Multimedia content:** The content of the generated conditional fields is defined with this component. This component can be composed of multimedia objects (text, image, video, etc.).

Through the above components content adaptation techniques can be applied such as adding/removing sections, changing sections, darkening sections, sorting sections, flexible text and enlarging/scaling.

The content tree can be thought of as the contents section of the created courses as mentioned in the basic components. User can specify topics and sub-topics in the content tree management. In this section, the user can specify as many topics and subtopics as he needs, depending on the topic content. A recursive function has been used to include an unlimited subtopic in the navigation screen of the generated content. The screen shot of creating content tree is given in Figure 5.

Figure 5. View of content tree creation.

The content included in topics of content tree created in the content management process is prepared. One of the key components of the content management process is content entry areas which are called conditional fields (Figure 6). At this point, the user can add a conditional field with the button to add a new content area on the screen that comes after selection of the desired content. User can update or delete the contents of the course in the area created with the Edit content, save content and Delete content buttons. Adaptations are made according to the parameters from the system and edit rules button is used to define rules to be applied. Here, the user can specify the information will be displayed in different cases according to the level of knowledge and learning style selected on the rules editing screen (Figure 7).

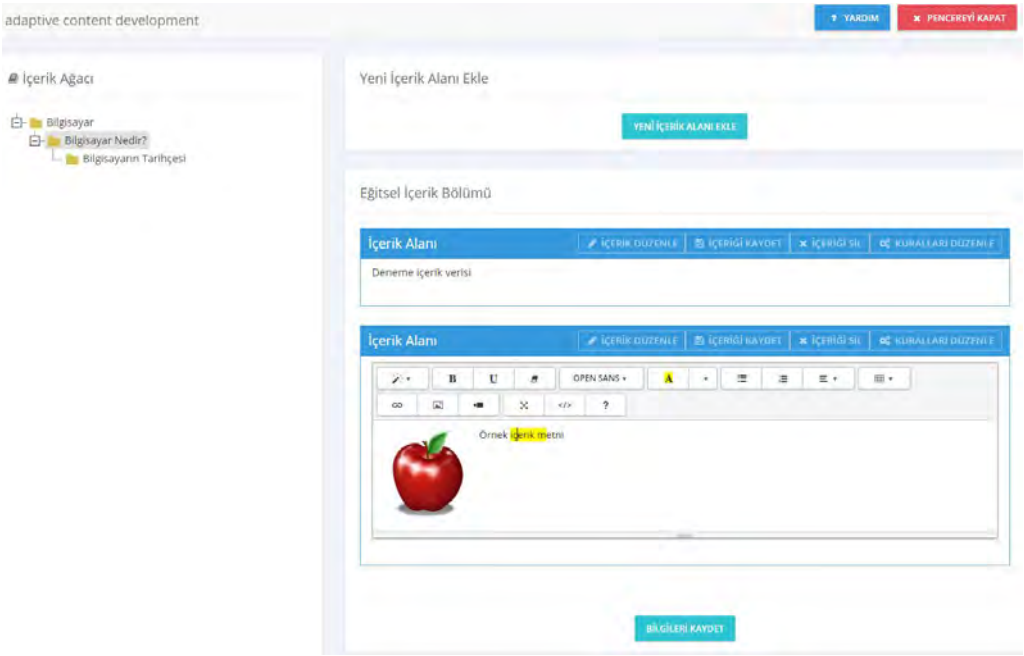

Figure 6. Content creation screen.

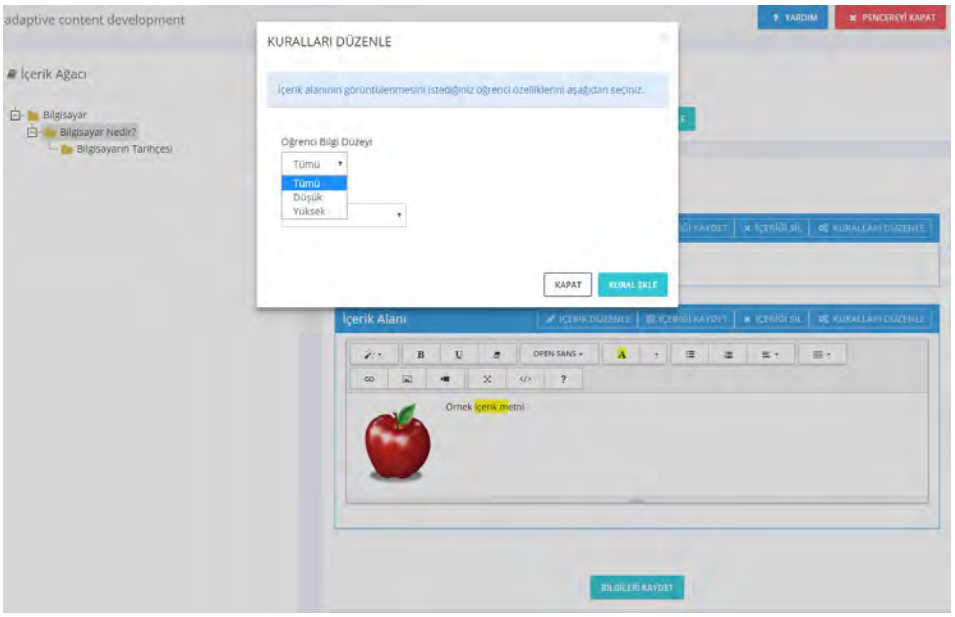

Figure 7. Rule definition screen in content creation.

After the conditional fields have been created, the simulation screen has been developed for the purpose of previewing how the conditional fields that exist before the course is published will look according to the student characteristics. This feature has been developed in order to resolve problems of conditional fields before they are published.

The fact that a developed content is downloadable and recognizable by different learning management systems has great prospects for the widespread use of the application. Therefore, the course content created through the application was provided to be downloaded in accordance with the SCORM standards used as the content standard. In this way, content developed through the application can be used in different learning management systems. Courses can be downloaded as zip file. In order to enable course content to be displayed as standard on different browsers and mobile learning environments, the bootstrap library components are compressed into a folder called assets. The course content developed through the application is merged under the content folder as pages with different html extensions. Here the content tree created by the user is recorded in the file imsmanifest.xml according to the tree structure.

The only file obtained from the application that is outside of SCORM standards is the file called "adaptations.xml". This file contains information about the display situation of conditional field based on which page, which areas, and which rules (Figure 8). Although this file content is not supported in existing systems, a plugin can be developed to process this file in later applications.

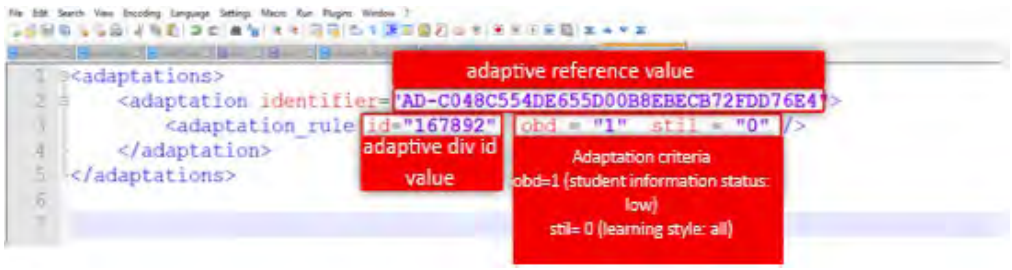

Figure 8. Sample adaptations.xml content

In addition, help component is crucial for users to find solutions to the problems experienced in the use of the system. It is also important to ensure ease of use of the existing component as well as the

availability of the help component in the system. Therefore, the help content is not given as a single file in the developed application. Instead, the user can access help content on the page using the help component located on the top right of the screen. Rather than searching through a single file, the user can directly access the screen help and examines the shorter content to find a solution for the problem faster.

Administrative Operations

Administrative operations are for a user who logs in to the system as an administrator. This section provides information on administrative operations. Sub-subsections of the administrative operations are given below. Screen shots for the components are given in Appendix-B.

- **System Management:**The system management component consists of features of adding/deleting/updating system menu, module and user type. The development of the application in the following stages and the addition of new modules are carried out through this component. In addition, adding and authorizing new user types to the system are also performed through the system management component.
- **Help Management:** As mentioned above, the component used to prepare the page-specific help content is the help management component.
- **Rule Management:** Student characteristics that are specified when creating the conditional fields can be identified through this component. Thus, the new rule definition will be provided through this component when the version update and new student characteristics need to be included in the adaptation. For the rule definition, the user needs to specify the student characteristics (knowledge level etc.) to be adapted, the components of this characteristic (low, high etc.) and the label to define in adaptations.xml file (i.e. "sis" for student information status). The system allows the creation of adaptive content within the framework of the defined rules.

Technical Infrastructure

The application was developed using the PHP programming language. MySQL database was used to record the data in the application. In addition, a theme with jQuery and bootstrap libraries was chosen for the application to work seamlessly on mobile devices.

FINDINGS

When the collected data about the usability of the developed system are analyzed, firstly, the statement of 13th item was reverse coded because it specifies a negative judgment (it is difficult to understand which page you are on when using the system).

The minimum score to be taken from the form is 19, the maximum score is 95. When the mean score ($\overline{X}$ = 82.57) collected from the participants is examined, it can be stated that the degree of usability of the developed application is high. Frequency, percentage and mean values of the collected data are given in Table 2.

Table 2. Frequency, percentage and mean values of the data obtained from the field expert opinion form

Item	Strongly Disagree		Partially agree		Moderately agree		Largely agree		Totally agree		Total		$\overline{X}$
	f	%	f	%	f	%	f	%	f	%	f	%	
1.On-sreen feedback is sufficient when usig the system.	0	0	0	0	1	14.3	4	57.1	2	28.6	7	100	4.14
2.The feedback provided in the system is suitable for the purpose of the screen.	0	0	0	0	0	0	3	42.9	4	57.1	7	100	4.57
3.Terms used in the system are suitable for the field terminology.	0	0	0	0	0	0	5	71.4	2	28.6	7	100	4.29
4.In the system, delete buttons for user-induced errors are sufficient.	0	0	0	0	0	0	2	28.6	5	71.4	7	100	4.71
5.Incorrect records made during system usage can be deleted later.	0	0	0	0	0	0	0	0	7	100	7	100	5.00
6.System functions overlap with expressions in the system.	0	0	0	0	0	0	3	42.9	4	57.1	7	100	4.57
7.The use of existing components in the system is consistent with each other.	0	0	0	0	0	0	1	14.3	6	85.7	7	100	4.86
8.The system automatically blocks the errors made.	0	0	1	14.3	2	28.6	3	42.9	1	14.3	7	100	3.57
9.The information on the system is sufficient.	0	0	0	0	2	28.6	3	42.9	2	28.6	7	100	4.00
10. System is an easy-to-use system for expert users.	0	0	0	0	0	0	1	14.3	6	85.7	7	100	4.86
11. The system is an easy to use system for novice users.	0	0	1	14.3	2	28.6	3	42.9	1	14.3	7	100	3.57
12.System design is simple.	0	0	0	0	0	0	1	14.3	6	85.7	7	100	4.86
13. It is difficult to understand which page you are on when using the system.	4	57.1	1	14.3	1	14.3	1	14.3	0	0	7	100	4.14
14.The system has an aesthetic structure as a design.	0	0	0	0	0	0	4	57.1	3	42.9	7	100	4.43

15. The error messages in the system are explanatory.	0	0	0	0	0	0	5	71.4	2	28.6	7	100	4.29
16.The error messages in the system help to solve the problem.	0	0	0	0	1	14.3	6	85.7	0	0	7	100	3.86
17.The help component in the system is easy to use.	0	0	0	0	0	0	3	42.9	4	57.1	7	100	4.57
18.Help content is sufficient in the system.	0	0	0	0	2	28.6	4	57.1	1	14.3	7	100	3.86
19.The information sought in the help content can easily be found.	0	0	0	0	1	14.3	2	28.6	4	57.1	7	100	4.43

The frequency and percentage values are given for the item "On-screen feedback is sufficient when using the system." When frequency values are examined, it is seen that the majority of the participants (57.1%) think that on-screen feedback is largely sufficient. Systems should provide continuous and appropriate feedback on the person's current status and events (Çağıltay, 2011). Feedback is crucial for the user not to be lost and to be aware of his/her condition.

As shown in Table 2, 4 out of 7 participants (57.1%) strongly agree and 3 (42.9%) largely agree that the feedback given in the system is appropriate for the purpose of use of the screen. This finding is interpreted to mean that the feedback provided in the system is suitable for the purpose of use of the screen. If a message in the system is prepared in accordance with its purpose, results that do not cause different perceptions are produced (Fleming & Levie, 1978). Therefore, it is important that the screens in the system do not contain objects out of its purposes (Yalin, 2000).

Frequency and percentages are given in Table 2 according to the answers given by field experts to the item "Terms used in the system are suitable for field terminology." In this question, 5 participants (71.4%) of the 7 participants largely agree with the suitability for the field terminology, while 2 participants (28.6%) totally agree with this view. This finding can be interpreted that the terms used in the system developed within the scope of the study are appropriate to the field terminology. Terms used in systems should be preferred to include specific words according to developed target group (Nielsen, 1994).

The sufficiency of the delete buttons for incorrect records was questioned with the statement "In the system, delete buttons for user-induced errors are sufficient". For this item, 2 (28.6%) of the participants largely agree and 5 (71.4%) totally agree that delete buttons are sufficient. Based on this finding, it can be concluded that the delete buttons in the system are sufficient.

It seems that all participants agree with the item "Incorrect records made during system usage can be deleted later." The highest average score ($\overline{X}$ = 5.00) in the Table 2 belongs to this item. It can be concluded with this finding that sufficient flexibility in the developed system to delete incorrect records is provided.

The opinions regarding the matching of expressions in the system with the system functions have been taken with the item "System functions overlap with expressions in the system." 3 participants (42.9%) largely agree and 4 participants (57.1%) totally agree that the expressions used overlap with the system functions. This result can be used to conclude that the page titles and contents overlap with the system functions.

When the answer given to the item "The use of existing components in the system is consistent with each other." are examined, it is seen that 1 participant (14.3%) largely agrees and 6 participants (85.7%)

totally agrees that he components in the system are consistent with each other. This finding can be interpreted that the components in the developed system are correctly identified. Users should not think about the meaning of different words, actions and situations on the system (Nielsen, 1995). If there is consistency in the system, users know that the same command or action will have the same effect and increase their self-confidence for the use of the system (Lewis, Hair & Schoenberg, 1989).

One participant (14.3%) partially agrees, 2 (28.6%) moderately agree, 3 (42.9%) largely agree and 1 (14.3%) totally agrees with the statement “The system automatically blocks the errors made.”. Although the level of participation is lower than other items, it seems that most of the participants agree with the automatic prevention of mistakes. When the average scores are checked, it is seen that this item is one of two items with the lowest mean ($\overline{X}$ = 3.57). Although the average score for this item is low, it can be interpreted that the level of usability of the system is higher than the median score (3) to be taken from the item. It is also believed that the reason for this low score is due to the fact that the users of the system are field experts and that they enter the data without error. Asking questions such as "Are you sure, do you mean?" to the users before making an operation in the system will have an effect in blocking the mistakes that may occur (Nielsen, 1994).

When the findings related to the item “the information on the system is sufficient.” are examined, it is seen that 2 (28.6%) of the participants moderately agree, 3 (42.9%) largely agree and 2 (28.6%) totally agree. This finding can be interpreted as the information on the system is sufficient. Users should not be lost in the page they are on, and to prevent this it is very important to inform them (Çağıltay, 2011).

When the answers given to the item “The system is an easy-to-use system for expert users.” are examined, it is seen that 1 of the participants (14.3%) largely agrees, 6 agree that the system is an easy-to-use system for expert users. It can be said that the system developed is very easy to use for expert users.

1 (14.3%) of participants partially, 2 (28.6%) moderately, 3 (42.9%) largely and 1 (14.3%) totally agree with the item “The system is an easy-to-use system for novice users.” From this finding, it can be assumed that participants partially or moderately agree because some components are not directly accessible for novice users. The reason why this item is one of the lowest average value ($\overline{X}$ = 3.57) may be that the experts think that there are additional buttons except for the buttons specified in the interface. As a matter of fact, the field experts' answers to comments and recommendations parts which were asked as open-ended questions such as" Adding topic and sub-topic buttons instead of right-clicking may increase the usability for identifying topic and sub-topics of the course" and "Adding the new course button on every page in the Course Management screen may increase usability" support this interpretation. The developed system should have different interaction objects for both expert and novice users (Çağıltay, 2011).

It is seen that 1 of the participants (14.3%) largely agrees with the statement “System design is simple” and 6 (85.7%) totally agrees that system is an easy to use for expert users. From this finding, it can be said that the developed system has a simple design. The less the use of unnecessary objects in the design of a system is used, the less cognitive load users have (Fleming & Levie, 1978).

When the findings related to the item “It is difficult to understand which page you are on when using the system.” are examined, it is seen that 4 (57.1%) of the participants strongly disagree, 1 (14.3%) partially agrees, 1 (14.3%) moderately agrees, and 1 (14.3%) largely agrees. With the help of this finding, it can be said that even at a low level, the users who use this system may be perceived to be lost. Therefore, it is thought that the use of the breadcrumbs component which is used in the existing systems and which allows easy navigation on which page you are on will make it easier to understand which page you are on.

4 (57.1%) of the experts largely and 3 (42.9%) totally agree that system has an aesthetic structure as a design. It can be concluded from this finding that the colors and writing styles used in the system are used at the top level.

When the findings of the item “The error messages in the system are explanatory.” are examined, it is seen that 5 of the participants (71.4%) largely and 2 (28.6%) totally agree with this statement. This finding can be interpreted as the error messages in the system are explanatory.

1 of the participants (14.3%) moderately and 6 (85.7%) participants largely agrees the item "The error messages in the system help to solve the problem.” It can be said that the error messages in the system are majorly aimed at resolving the problem. A good error message should provide explanatory, detailed, problem-oriented solutions and should not be accuse the user (Shneiderman, 1982).

When the findings obtained from the item “The help component in the system is easy to use” are examined, 3 (42.9%) of the users largely and 4 (57.1%) totally agree. From this finding, it can be said that the help component in the system is easy to use.

According to field experts' opinion on the item "The help content in the system is sufficient", it is seen that 2 of the participants (28.6%) moderately, 4 (57.1%) largely and 1 (14.3%) totally agree. From this finding, it can be said that help content available in the system is largely adequate.

1 of the participants (14.3%) moderately, 2 (28.6%) largely and 4 (57.1%) totally agree that “The information sought in the help content can easily be found.” From this finding, it can be said that it is easier to access the requested information to the help component on the related page instead of accessing it as a single file. Users tend to learn by using rather than reading a whole document (Rettig, 1991). In order for user's to read a document, information should be positioned for specific needs and explanations should be understandable and procedurally described (Wright, 1991).

6 of the 7 participants (85.7%) entered data in the other comments and suggestions section of the form developed for the usability of the system. Suggestions and remedies from the feedback that can be implemented in the system are presented by organizing reiterated data as follows:

1. In the new course addition section of the system, the use of a template course can facilitate usability.
2. The creation of adding topic and subtopic buttons instead of right click function may increase the usability.
3. On the Course Management screen, adding a new course button to each page can increase usability.
4. For added content, audio recording can also be added to support students who want to learn by listening.
5. Shortening the system's published domain name (adaptivecontentdevelopment.com) can increase memorability.
6. A different expression can be used instead of the simulation.

In accordance with the findings obtained from the field expert opinion form mentioned above, the following developments/updates were made in the application:

1. The feedback provided in the system has been made more descriptive.
2. A template course has been created so that users can produce new course with this one.
3. A breadcrumbs component has been added to make it clearer when user navigates.
4. The Add New Course button is located on the Course Management screen to increase accessibility.

Since the content developer can prepare and add audio recordings, no additional enhancements have been made in this context. The domain name alternatives were reviewed and it was determined that the application will be published under adaptivecontentdevelopment domain name. If more useful and shorter domain name is found in the future, it may be used in the application. Therefore, there is no update in the domain name at this stage. The simulation statement is used to display the course content according to the determined student characteristics. Since there is no new word suggested for this statement and it is assumed that this statement meets the current operation, no update have been made.

CONCLUSION AND RECOMMENDATIONS

In this study, a web-based application for creating content in adaptive educational hypermedia was developed and its usability was examined. It was paid attention to include content adaptation techniques to the developed adaptive content development environment. In this context, techniques such as adding/removing sections, changing sections, darkening sections, sorting sections, flexible text, enlarging/scaling are supported by the application. PHP programming language was used for the development of the application and the MySQL database to record the data in the application. In addition, a theme with jQuery and bootstrap libraries was preferred so that the application can work with mobile devices.

The application developed in line with the purpose of the research was published in adaptivecontentdevelopment.com and the field expert opinion form, which was developed based on the usability intuitions to examine the usability of the application, was completed by 7 different field experts.

As a result of the opinion form applied in the research process, it is understood that the developed application has high usability level. In addition, according to the feedback from the field experts, correction/improvement processes were also carried out in the system.

Content for adaptive educational hypermedia can be developed with the application developed within the scope of the study. The adaptation rules defined in this application are limited to content adaptation techniques. In further research, the domain modeling application may be developed to define the rules between pages in the course content. In this way, an environment for navigation adaptation techniques can be provided as well as content adaptation techniques.

Since the developed application involves a lot of technical terms and components, it is recommended that designers who will develop such applications should use the existing JavaScript and bootstrap libraries.

By using the developed system, the effects of the course contents produced for adaptive educational hypermedia for different learning areas on different variables can be examined. It may also be suggested to create tasks for users and measure the usability of the components in the system through effectiveness, efficiency and user satisfaction.

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APPENDICES

Appendix A-Field Expert Opinion Form

UYARLANABİLİR İÇERİK GELİŞTİRME ORTAMINA YÖNELİK ALAN UZMANI GÖRÜŞ FORMU

Sayın Hocam,

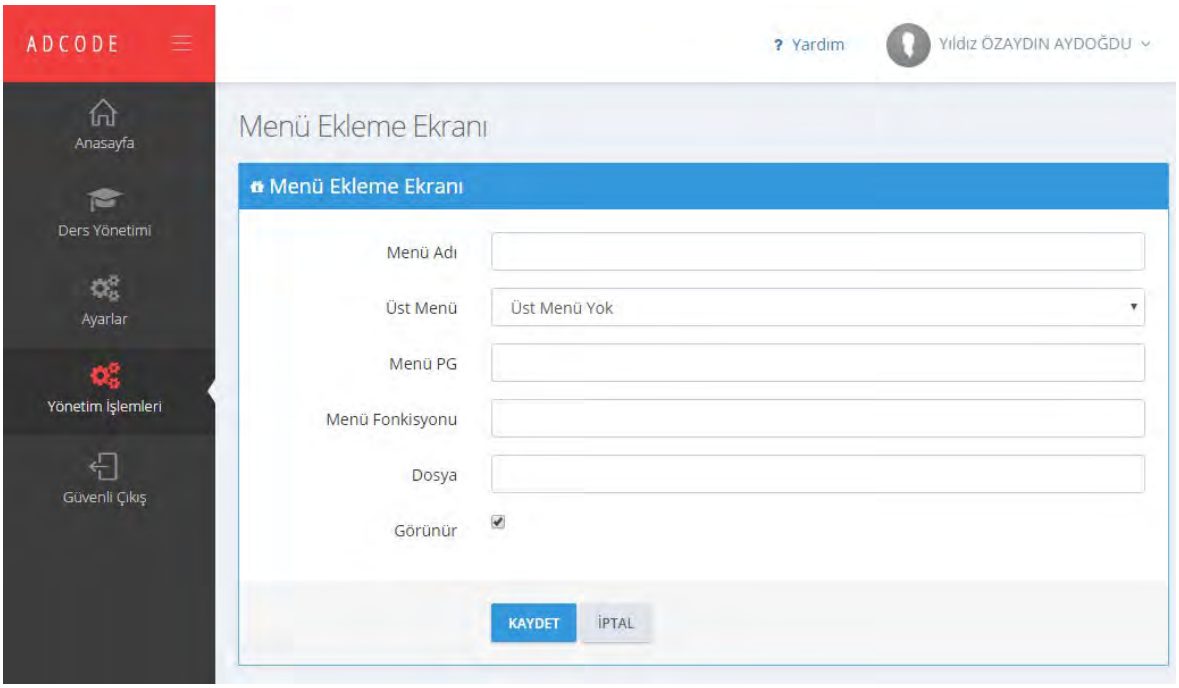
Akademik bir çalışma kapsamında geliştirilen uyarlanabilir içerik geliştirme ortamına yönelik görüşlerinize ihtiyaç duyulmaktadır. Sizden istenen www.adaptivecontentdevelopment.com adresinde bulunan sistemi inceleyerek, sisteme yönelik görüş ve önerilerinizi alt kısımda yer alan formda belirtmenizdir. Değerli katkılarınız için şimdiden teşekkür eder, iyi çalışmalar dilerim.

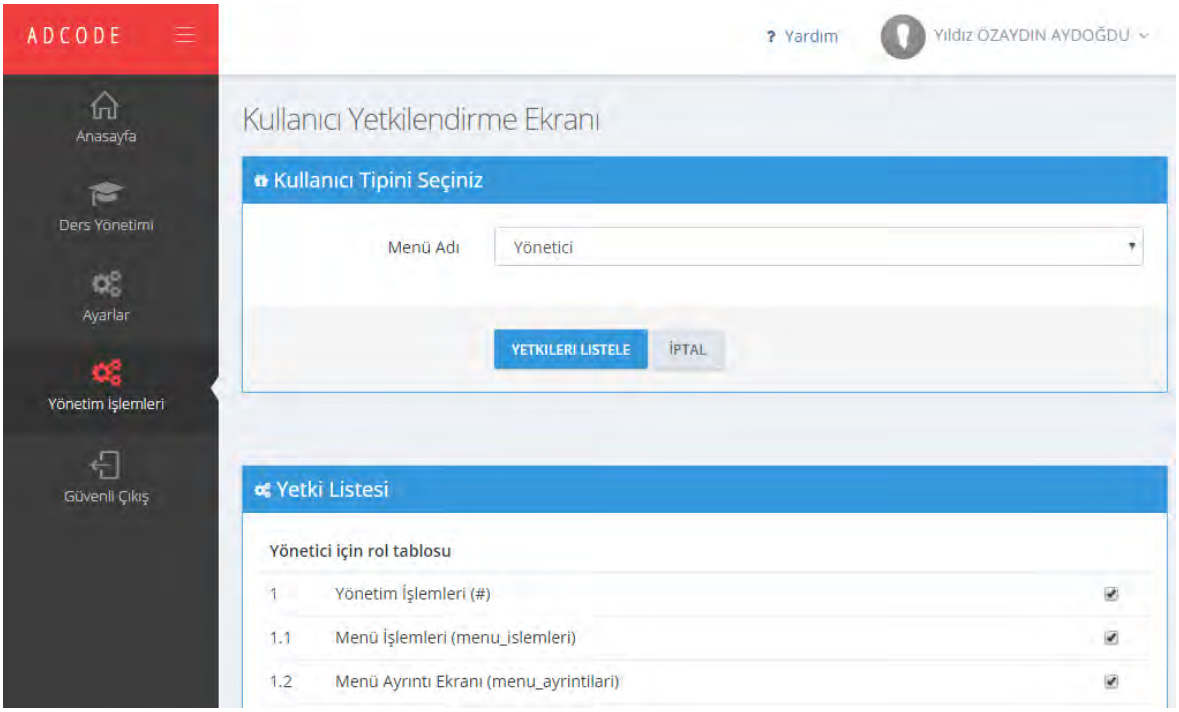
Saygılarımla

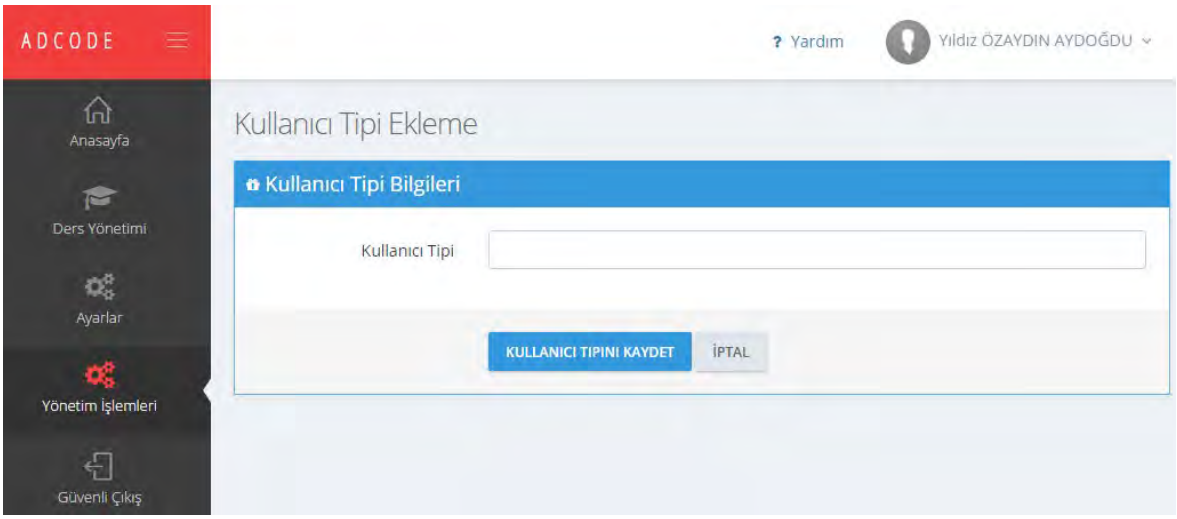
Yıldız ÖZAYDIN AYDOĞDU

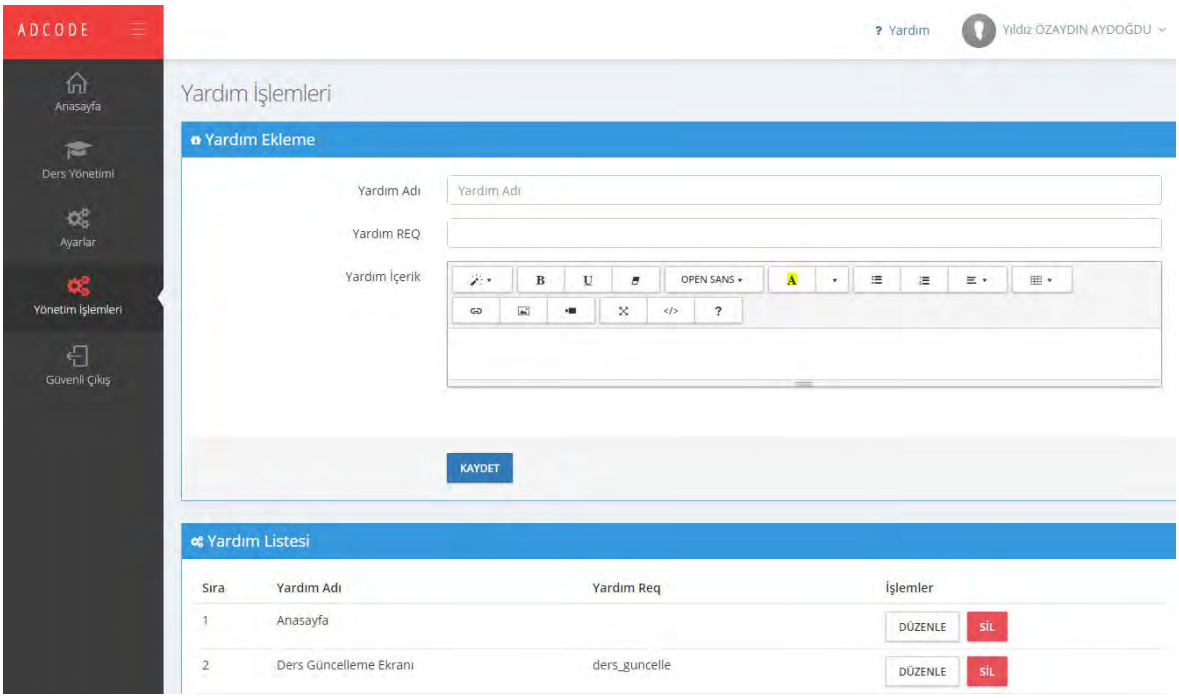
Sıra	Soru İçeriği	Hiç Katılmıyorum	Çok Az Katılıyorum	Orta Düzeyde Katılıyorum	Büyük Ölçüde Katılıyorum	Tamamen Katılıyorum
1	Sistemi kullanırken ekrandaki geri bildirimler yeterlidir.					
2	Sistemde verilen geri bildirimler, ekranın kullanım amacına uygundur.					
3	Sistemde kullanılan terimler alan terminolojisine uygundur.					
4	Sistemde kullanıcıdan kaynaklı hatalara yönelik silme butonları yeterlidir.					
5	Sistem kullanımı esnasında yapılan hatalı kayıtlar daha sonra sistemden silinebilmektedir.					
6	Sistemde yer alan ifadeler ile sistem fonksiyonları örtüşmektedir.					
7	Sistemde var olan bileşenlerin kullanımı birbiriyle tutarlılık göstermektedir.					
8	Sistem, yapılan hataları otomatik olarak engellemektedir.					
9	Sistemdeki bilgilendirmeler yeterlidir.					
10	Sistem, uzman kullanıcılar için kullanımı kolay bir sistemdir.					
11	Sistem, acemi kullanıcılar için kullanımı kolay bir sistemdir.					
12	Sistem tasarımı sadedir.					
13	Sistem kullanımı sırasında hangi sayfada olunduğunu anlamak zordur.					
14	Sistem, tasarım olarak estetik bir yapıya sahiptir.					
15	Sistemde belirtilen hata mesajları açıklayıcıdır.					
16	Sistemde belirtilen hata mesajları karşılaşılan problemin çözümüne yardımcı olmaktadır.					
17	Sistemde bulunan yardım bileşeninin kullanımı kolaydır.					
18	Sistemde bulunan yardım içeriği yeterlidir.					
19	Yardım içeriğinde aranılan bilgi kolayca bulunabilmektedir.					
Belirtmek istediğiniz diğer görüş ve öneriler						
.....						
.....						
.....						
.....						

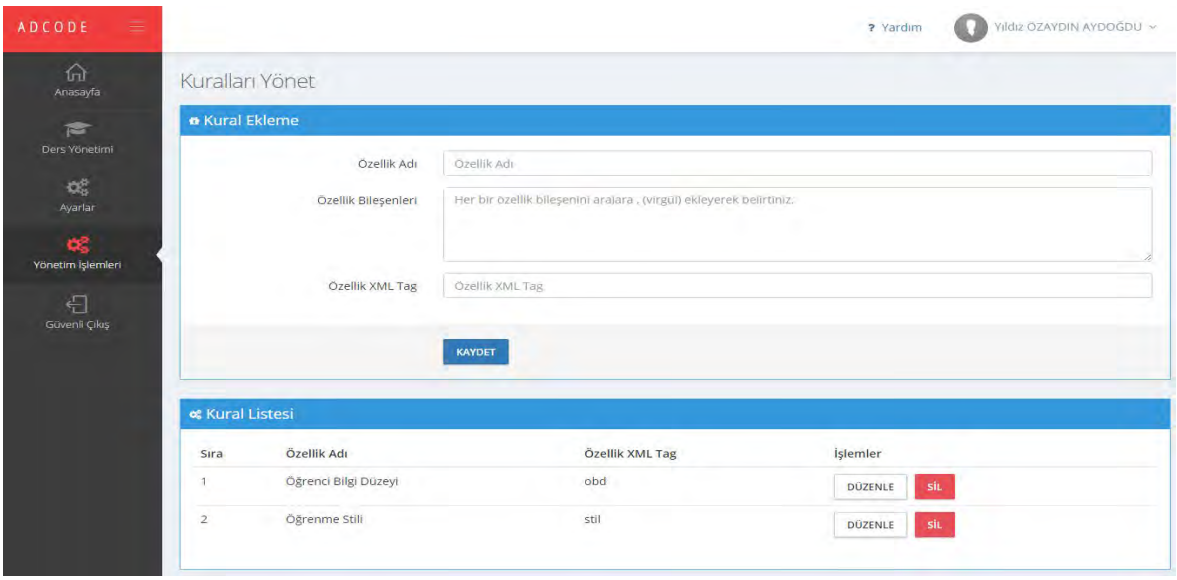
Appendix B- Administrative Operations Screenshots






ADCODE
? Yardım
Yıldız ÖZAYDIN AYDOĞDU
Anasayfa
Ders Yönetimi
Ayarlar
Yönetim İşlemleri
Güvenli Çıkış
Kullanıcı Tipi Ekleme
Kullanıcı Tipi Bilgileri
Kullanıcı Tipi
KULLANICI TİPİNİ KAYDET
İPTAL


ADCODE
? Yardım
Yıldız ÖZAYDIN AYDOĞDU
Anasayfa
Ders Yönetimi
Ayarlar
Yönetim İşlemleri
Güvenli Çıkış
Yardım İşlemleri
Yardım Ekleme
Yardım Adı
Yardım Adı
Yardım REQ
Yardım İçerik
OPEN SANS
KAYDET
Yardım Listesi
Sıra
Yardım Adı
Yardım Req
İşlemler
1
Anasayfa
DÜZENLE
SİL
2
Ders Güncelleme Ekranı
ders_guncelle
DÜZENLE
SİL


ADCODE
? Yardım
Yıldız ÖZAYDIN AYDOĞDU
Anasayfa
Ders Yönetimi
Ayarlar
Yönetim İşlemleri
Güvenli Çıkış
Kuralları Yönet
Kural Ekleme
Özellik Adı
Özellik Adı
Özellik Bileşenleri
Her bir özellik bileşenini aralara , (virgül) ekleyerek belirtiniz.
Özellik XML Tag
Özellik XML Tag
KAYDET
Kural Listesi
Sıra
Özellik Adı
Özellik XML Tag
İşlemler
1
Öğrenci Bilgi Düzeyi
obd
DÜZENLE
SİL
2
Öğrenme Stili
stil
DÜZENLE
SİL