Design and development of e-learning websites

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Abstract

E-learning is an integral part of smart education. There are many e-learning systems widely available for educational institutions. The challenge is to easily integrate the e-learning system into an intelligent educational environment based on user requirements. The e-learning services rely on a software system that allows access to all materials for the educational process and makes them available electronically to all students on the Internet whenever they need it and wherever they are. The design and development of the e-learning system is a critical part of the educational process as it reflects on the use of the system. This work describes the design and implementation of e-learning systems where different techniques are explored and compared. The proposed e-learning system is designed using off-the-shelf and open-source software engineering model and programming tools and database models. The system is tested to prove new concepts and design features. The method used in the back-end and front-end design and implementation allows flexible use and integration of e-learning systems by educational institutions in smart cities.

Elektron təhsil ağıllı təhsilin ayrılmaz hissəsidir. Təhsil müəssisələri üçün geniş yayılmış bir çox e-tədris sistemləri mövcuddur. Çətin olan istifadəçi tələblərinə əsaslanan elektron təhsil sistemini intellektual təhsil mühitinə asanlıqla inteqrasiya etməkdir. Elektron təhsil xidmətləri tədris prosesi üçün bütün materiallara çıxış imkanı verən proqram təminatı sisteminə əsaslanır və onları bütün tələbələrə ehtiyac duyduqları zaman və harada olmalarından asılı olmayaraq elektron şəkildə İnternetdə təqdim edir. Elektron təhsil sisteminin dizaynı və inkişafı sistemin istifadəsini əks etdirdiyi üçün təhsil prosesinin mühüm hissəsidir. Bu iş müxtəlif texnikaların tədqiq edildiyi və müqayisə edildiyi elektron təhsil sistemlərinin dizaynını və tətbiqini təsvir edir. Təklif olunan e-tədris sistemi hazır və açıq mənbəli proqram mühəndisliyi modeli və proqramlaşdırma alətləri və verilənlər bazası modellərindən istifadə etməklə tərtib edilmişdir. Sistem yeni konsepsiyaları və dizayn xüsusiyyətlərini sübut etmək üçün sınaqdan keçirilir. Back-end və front-end dizaynında və tətbiqində istifadə olunan metod ağıllı şəhərlərdəki təhsil müəssisələri tərəfindən elektron təhsil sistemlərinin çevik istifadəsinə və inteqrasiyasına imkan verir.

Introduction

Web programming is one of the most applied sectors today. Because, we cannot perceive any sector without web computer engineering. When the findings of the majority of educational research today are examined and evaluated, it turns out that the findings have little effect on practice and the formation of theories (Haertel and Means, 2003; Lagemann, 2002). From time to time, researchers may choose research problems from topics that attempt to reprove a theory that is weakly linked to practice; such studies are of little use in practice. In this case, it is important that the priorities of the academicians and the research methods they use are not focused on practice and results.

Innovations brought by the design-based research method, which emerged to be used in cases where other research methods are insufficient;

It helps to embody the theories related to teaching-learning and to understand the relationship between theory, design and practice.

Design, in general, is a planning and development process. The design expression in the design-based research method is the planning and development of new environments or new theories in teaching-learning issues. According to Brown (1992) and Collins (1992), design-based research is a new approach that deals with learning within the context of the systematic design of instructional strategies and tools. According to Collins (1992), this approach also helps to create, develop, accept and maintain knowledge in learning environments. [1, 4]

Another situation where design-based research can be used effectively is research in which e-learning materials and environments are developed. E-learning environment production includes a design and development process. The most 6important feature of design-based research is that it is used to produce an innovation (a new learning environment, a new educational practice, a new theory). In this context, it can be said that e-learning production and design-based research overlap. Today, in e-learning research, an e-learning environment is generally e-designed, developed and its effectiveness is examined. Researchers often do not question the quality of the developed environment. E.g; A researcher who studies the effect of user control in e-learning environments usually prepares two separate e-learning materials in which there is a lot and little user control. He then applies these materials to the

students with the experimental research method and tries to examine which one is more effective. This researcher mostly does not question the design and development processes of the e-learning environment he has developed. However, a researcher working with a design-based research method focuses on design problems of how user control should be in e-learning environments, rather than making empirical comparisons. The researcher tries to find the best case for how user control affects learning by making changes to the design in a iterative fashion. Considering these two examples, it can be said that design-based research will contribute more in practice. Design-based research brings a different perspective to research in which e-learning environments are developed and fills the gap in this regard.

In the context of design-based research as a new method, it cannot be said that it is fully recognized and accepted in the educational research community. The fact that it is not well known and the difficulties of doing design-based research have caused the number of publications published with this research method to be low. According to Collins, Joseph, and Bielaczyc (2004), the educational research community should assume the necessary responsibility for setting the standards for this method in order for design-based research to be recognized and accessible to other researchers.

1. Literature review

1.1 General

While e-learning is a new concept, unified e-learning is also a very new concept. In this process, the field of instructional design and technology focuses on skills deemed necessary by instructional designers and technologists. These professionals should be able to clearly define the nature, historical development and current state of the field, as well as realize skills in the field. These issues and trends greatly affect future learning situations (Reiser & Dempsey, 2007). New approaches are needed for the organization of the definition and solution of individual problems of information communication technologies for unified e-learning systems. E-learning topics include complex cognitive skills, changeable learning concepts and realistic learning tasks. These concepts are related to unified e-learning. These relationships are crucial for changes to occur in the workplace. The concept of complex learning expresses a new view. While this can be a type of skill, it sometimes refers to a complex skill (Van Merriénboer, Clark, & De Crook, 2002). [7]

1.2 What is E-learning and design Based Research?

E-learning and Design-based research; It is a research method that emerged as a result of the need to investigate theoretically-based educational designs as formative (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Collins et al., 2004) and to take the interaction of design, theory, and practice to a higher level. Design-based research was first introduced by Brown (1992) and Collins (1992) as design experiments. Design experiments; It is a research method in which scientific processes such as discovery, exposition, verification and dissemination and the active participation of the researcher in teaching-learning activities are in question (Kelly, 2003). [2]

E-learning-design-based research was defined by Wang and Hannafin (2005) as: design-based research; It is a systematic and flexible research method for the development of context-sensitive design principles and theories, in which cyclical analysis, design, development and implementation processes are carried out in collaboration with researchers and participants and in a real application environment, with the aim of improving educational practices. According to Collins et al. (2004), design-based research enhances educational development by bringing together two

critical elements. These elements are the focus on design and the evaluation of critical design elements. It may be necessary to use different research methods for different design-based studies. E.g; In cultural studies, qualitative research methods are carefully used to examine how design plays a role in practice. In order to examine the effect of design in large-scale studies, it may be necessary to use quantitative methods that measure the effects of independent variables on dependent variables. [2, 11]

The E-learning-E-Design Based Research Collective (2003) highlighted five characteristics of good design-based research.

• The objectives set for designing learning environments and developing learning theories are intertwined.

• In the development and research process; Design, decision making, analysis and redesign actions are repeated cyclically.

• Research focuses on designs that produce conclusions, inferences or theories that can be shared with other practitioners or designers.

• In the research, how the design works in the natural environment is evaluated. It focuses not only on success or failure, but also on the interactions that take place in the environment that increase our knowledge of learning.

• Methods that document the process and associate it with the results are preferred.

Wang and Hannafin (2005), on the other hand, stated that design-based research has five characteristics from a different perspective: utilitarian; with a specific basis; interactive, repetitive, flexible; integral; contextual. These features are summarized in Figure 1. [3]

According to Cobb et al. (2003); design-based research guides theory, contributes to the development of instructional design, and reveals new design possibilities.

In e-design-based research, the researcher conducts the research together with the participants and is an important part of the research process (Cobb et al., 2003). The researcher systematically designs and implements interventions, revises the initial design according to the results of the application, develops and re-applies it, and

continues this process cyclically until it reaches the conclusion that the application with a utilitarian perspective improves the application sufficiently.

The main purpose of design-based research is to reveal new theories and practices that will affect teaching-learning under natural conditions (Brown, 1992; Collins, 1992). This method requires designing and studying different learning styles. The designed structure is constantly subjected to repeated testing and re-evaluation. For this reason, it can be said that design-based researches have an organic structure and renew themselves according to the situation. With this structure, the design-based research method differs from the classical design methods. In classical design methods, after the design of a product is revealed and developed, it is tested, presented to the users and the design is finished. [1, 2]

Features	Description
Utilitarian	• Design-based research separates theory and practise • The value of theory is determined by its contribution to practice (Cobb et al., 2003).
With a specific basis	• Design is theory-based and has relevant research, theory and practice.(Cobb et al., 2003).
Interactive, repetitive, flexible	• Designers are involved in the design process and work with the participants. • There are iterative processes of analysis, design, implementation and redesign. • The master plan is not detailed enough so that the designers can make changes.
Integral	• Mixed research methods are used to increase the reliability of the research. • The research method used at different stages of the research may change according to the need that may arise.
Contextual	• The research process, the findings of the research and the changes made on the master plan are documented.

• Research results are linked to the design process.
• Guidance is needed in the implementation of the developed principles.

Figure 1 General Characteristics of Design Based Research

E-Design-based research is used to design learning environments and generate theories, and it has a continuous cycle of design, decision making, analysis, and design review throughout the research process (Cobb, 2001; Collins, 1992). Research using the design-based research method focuses not only on success or failure, but also on the interactions in which learning occurs. The design-based research method combines various research methods to develop new products rather than testing existing theories (Edelson, 2001). It is possible to design and develop three different types of products with the design-based research method (Design Based Research Collective, 2003): [1, 3] Developing innovative learning environments, Development of new classroom applications and Development of new learning theories.

1.3 Why E-Design Based Research?

According to Levin and O'Donnell (1999), most of the research methods commonly used in educational research fail to produce convincing empirical evidence. This situation causes a loss of confidence in educational research. Levin and O'Donnell (1999) see the design-based research method as one of the efforts to eliminate the loss of trust in educational research. Lagemann and Shulman (1999), on the other hand, see that the reason for the loss of trust in educational research is the divergence of research from real life applications. Educational research that moves away from practice will have a very limited effect on real-life practices and will be insufficient in guiding and guiding educational practices. In this context, it can be thought that design-based research, one of the most important features of which is to contribute to the application, will fill the gap in this regard.

Collins et al. (2004) stated the reason for the emergence of the design-based research method as follows:

• The need to seek answers to theoretical questions about the nature of learning contextually

• The need to study the learning phenomenon in the real world rather than in a laboratory setting

• The need to go beyond narrow learning measures

• The need to reach research results by making formal evaluation

Collins et al. (2004) stated that design-based research brings together two important parts in improving educational environments. These pieces are the design focus and the evaluation of critical design elements. Design-based research can benefit from qualitative and quantitative research methods for this purpose.

1.4 How is E-Design Based Research Applied?

The application steps of design-based research are not as clear as quantitative research. Depending on the context, research processes can differ greatly. However, the general route is as follows: first, the designer develops and implements the first version of his design. It looks at how design works in practice. As a result of the experience gained from the application, the designer regularly reviews his design and makes corrections. Design made over time; it turns into a solid, defect-free and efficient. [22, 23]

Finally, the research report is written. There are many variables that need to be controlled in learning environments and it is often not possible to control all of these variables. Therefore, in design-based research, researchers have to carefully observe the variables directly related to the design as much as possible. In cases where an element of the design does not work, the design team looks for ways to improve the design, taking into account the relevant variables. How changing one element of the design affects other parts of the design must also be considered. Designs are mostly holistic systems and a change in one part can affect the whole and other parts of the whole (Brown and Campione, 1996). Therefore, the evaluation of designs is a continuous process and as the design changes, the evaluation process also changes.

According to Collins et al. (2004), there are differences in each application of an educational design. Therefore, the critical elements of the design and the relationships between these elements should be well defined. When evaluating an application of the design, these critical elements and their interrelationships should be analyzed. Some elements of the design may not be used at all in some applications, while others may

be used very little. The same design elements can also be used extensively in another application. The important thing here is to develop a profile about these design elements and the whole design and to examine how the design elements interact with each other. Brown and Campione (1996) state that these critical design elements will turn into design principles at the end of the research. [11]

The purpose of e-design-based research is to improve the functioning of a design in practice. Therefore, as the research progresses, changes and corrections are made in the design to improve the operation in practice. When it is determined that an element of the design is not working, it is important to analyze why it is not working. Thus, fixes for the non-working element of the design are developed and put back into practice. Similarly, at the end of these fixes, the same design element is tested again whether it works in the application. Corrections continue to be made in the same design element until it is seen that it works stably. Alongside documentation of the result design, all failures and remediation efforts that occur in the process should be documented. Presenting a detailed biography of the design in the research report will contribute to the credibility of the decisions made. [2]

According to Collins et al. (2004), there are various perspectives that can be used when evaluating the success of design. While examining the application of the design, the environment can be examined according to these perspectives. These perspectives are:

Cognitive level: What is the level of understanding of the learners before the application and how does their understanding change during the application process? In order to reach this information, the actions of learners such as reflecting and explaining their thoughts can be observed. The researcher can also ask the learners questions to reveal their thinking processes. [4]

Interpersonal level: For this perspective, it may be necessary to seek answers to questions such as: How is the communication between the teacher and the learner? Is there information sharing in the communications established? Do learners establish a bond among themselves and help each other? The researcher can use the ethnography method to search for answers to these questions. Group or class level: This perspective requires examining situations such as learners' participation status, group identity, and

authoritarian relations. Ethnography method can be used effectively to reach this information.

Resource level: This perspective requires an evaluation of the resources available to learners. For this, it may be necessary to seek answers to questions such as: What resources are provided to learners? Are the resources provided easy to understand and use? How do the resources used relate to the activities?

Institution or school level: In this perspective, the level of support of the institution or school and communications with other institutions and individuals are evaluated. For this, it may be necessary to seek answers to questions such as: Are the families satisfied with the work? Does the school support the work done? Are there political situations that may affect the work?

It cannot be said that these perspectives, which should be considered while evaluating the implementation processes of design-based research, are independent of each other. In addition, many experts can be used in the process of creating and evaluating the design. People with different specialties such as academicians, teachers, psychologists, anthropologists, multimedia developers, graphic designers and software developers can work in a design-based research. According to Collins et al. (2004), the academic achievement variable alone is not sufficient in the evaluation of a design. Different types of evaluations should be used in the evaluation of the design and the dependent variables given below should be considered in the evaluation process.

• Climatic variables: engagement, cooperation, risk taking, student control, etc.

• Learning variables: content knowledge, abilities, metacognitive strategies, learning strategies, etc.

• Systematic variables: continuity, prevalence, scalability, ease of adaptation, cost, etc.

In e-design-based research, there can be many independent variables that can affect the success of the design. Collins et al. (2004) stated the independent variables that can be evaluated in a design-based research in the following headings to guide researchers.

• **Environment:** The characteristics of the environment where the application is made (home, classroom, school garden, museum, a short school, etc.).

• **Nature of learners:** Variables such as learners' age, socio-economic status, absenteeism.

• **Resources needed and implementation support:** Variables such as implementation materials, technical support, administrative support.

• **Professional development:** Organizing professional development activities such as workshops, seminars, design meetings and lectures for teachers or practitioners.

• **Financial requirements:** Variables such as material and equipment fees, service procurement fees, professional support fees, development fees.

• **Implementation schedule:** Variables such as how innovations are presented, time allotted for implementation.

In each e-design-based research, dependent and independent variables differ due to the nature of the research. The above variables are included only to give an idea to the researchers. Therefore, the dependent and independent variables to be considered at the beginning of each research or during the research process should be determined specifically for that research.

It seems that design-based research reports are traditionally written in four parts: problem, method, findings, and discussion. Collins et al. (2004) stated that this structure is insufficient and a different reporting structure is needed in terms of the fact that design-based research includes an experimental process, and they suggested the following structure.

Purpose and design elements: In design-based research, along with the purpose, it is necessary to provide information about the design, design elements and how these design elements interact. Design elements can take the form of materials, activities, principles, or a mixture of these.

Application environment: The environment in which the application takes place is of great importance in design-based research. Therefore, each environment where the application is made should be described in detail. Thus, the reader will better evaluate the design in the context of the environment.

Description of each stage: Design-based research; implementation of the design, evaluation of the applied design and correction of the design, in which the steps are made cyclically. These stages are also referred to as the evolution of design. Each stage, the decisions taken at this stage, the implementation environment and the

arrangements made in the design should be written in the research report. Findings: The findings obtained at the end of the research should be written in the research report in the form of the design profile.

Lesson learned: This section tries to give a holistic picture of design and how it can be applied in different environments. In addition, the limitations of the design and the factors that may affect its success should be mentioned.

Although design-based research is very powerful, Collins et al. (2004) stated that some difficulties await those who do e-design-based research. These difficulties are:

• Difficulties resulting from the complexity of real-life situations and their resistance to experimental control

• Difficulty in coping with the large amount of data collected as a result of the need for ethnographic and qualitative analysis.

• Difficulties in the process of comparing the designs made.

There may be difficulties arising from conducting design-based research in real learning environments. There are many variables that affect success in these learning environments and it is not possible for researchers to examine all of these variables. In this case, researchers examine the variables they think are closely related to the success of the design. Researchers have to collect a lot of data in order to check in depth how the changes in design are reflected in the learning environment. As a result, researchers may be unable to cope with the collected data and may have difficulty completing analyzes on time. In order to prevent such situations, a large number of researchers, designers and participants who will work in design-based research may be needed and these employees should be provided to work in a very good harmony.

In e-design-based research, there can be great differences between the phenomenon designed by the designer and the realization of this phenomenon. This problem is known as lethal mutation (Collins et al., 2004). During the implementation of the designs, the implementer has to take many decisions that are not evaluated by the designer. Evaluation of every detail is not expected in designs, and according to the behavior of the participants, practitioners may have to make decisions about the design. Therefore, designs may be less or more detailed, but it is not possible to cover all the details. Implementation processes, which may differ greatly, must be taken into

account in the evaluation of designs. A design feature that is effective in one environment may not be effective in another environment.

All these factors show that e-design-based research is a very powerful research and makes important contributions to understanding the relationship between design, theory and practice. In addition to these positive features, design-based research is a very laborious research method, the results obtained are evaluated at the contextual level and do not allow a definite judgment. It can be said that such problems are effective in the limited number of studies and publications in which this method is used, although design-based research is popular. [3, 4]

1.5 Design and Research Issues in Online Learning

Educators' initial enthusiasm for online learning stemmed from the freedoms it provides: the freedom to avoid the typical restrictions of place and time, make learning more interactive, create micro-opportunities for student engagement, increase access to better teaching methods, and embrace technology to record behavior at a fine-grained level, which is impractical for offline learning. However, this enthusiasm ran into several problems inherent in the actual learning environment. Online learning during the pandemic has changed almost every characteristic of the school as people knew it, and has challenged how teachers, students, and families perceive well-established ideas such as attention, engagement, and social connection that are usually promoted school.

The pandemic has also highlighted the fragility of online learning. What online learning means in practice can vary greatly by context and even from class to class (Greenhow et al., 2022/this issue; Heinrich et al., 2019; Lee & Hannafin, 2016) Online learning is very different from computer based individual learning (Fletcher-Flinn & Gravatt, 1995) to asynchronous interactive learning, synchronous interaction (Hiltz & Goldman, 2004) and teleconferencing based models (Finkelstein, 2006). endemic informal social media interactions that support learning in communities of interest (Greenhow, Sonnevend, & Agur, 2016), research communities (Shea et al. and asynchronous but often highly mediated models (Cress et al., 2021) rapid change technology and, more importantly, technology.Taking the educational use of Zoom

before and after COVID-19 for example, the platform itself has evolved rapidly during the pandemic, adding new features such as a self-selection break room and new everything from muting videos to queuing rules, with the advent of etiquette, creating live subtitles as the rules apply for the platform.

In addition, each online learning setting will be combined with face-to-face interaction, making studying these different courses more challenging. Adoption of hybrid (or "blended") education models has been advocated by policymakers, from K-12 schools to universities (Greenhow et al., 2022/this issue; Poirier et al., 2019; Tate & Warschauer, 2022/this issue). But how exactly one goes to such a heterogeneous and ever-changing configuration to draw good conclusions remains the question. For example, what is the relevance of courses conducted on the Internet or attended in person? Have teachers "backup" in the classroom (for example, requiring students to interact with online material before a lesson), thus changing the "timing, structure, and difficulty levels of student learning" (Poirier et al., 2019, p. 4)? The great difference both in the content of the application, and in the ability to create the characteristics of the online learning site as it is used, makes it difficult to know how to extend the results, and/or reposition them in a new context. These different arrangements highlight some of the daunting challenges of creating an online learning experience.

Several studies on the psychology of online learning at Zoom in 2019 may lead to an advanced understanding of, as Cameron (2006) suggests, "mediatory/psychological variables that link certain situations to specific outcomes," "explanatory models of complex human problems," or use Evidence-Based Strategies for Change (p. 289). Even if such studies could lead to both explanations and evidence pointing to particular strategies for change, researchers and practitioners still would not be prepared for online learning in a pandemic situation because, as Simon (1969) points out, they would attempt to do so. Empirical claims about "systems that, under different conditions, may be very different from what they are" (p. x). Would the models have taken into account the challenges faced by children at home with distracted parents working alongside online, or learners and educators dealing with trauma? What about the microcultures emerging in some online classrooms, which have been heavily influenced by how the teacher has adapted to the rapidly changing

situation of the pandemic? Has the research community been able to understand how interest-driven groups connect outside the formal boundaries of education to further learning and specialisation? It was imperative that any research effort include both the intended components of a designed environment but also the external components such as trauma from the pandemic and inherited, internal and rapidly changing elements such as Zoom interface changes or emerging practices (Tabak, 2004).

The complexities of online learning reveal the flaws in the lack of interchangeability between research and design. On the one hand, online learning is a complex system in a mathematical sense: defining initial variables and conditions in sufficient detail to enable robust overall predictions is impossible. On the other hand, the research challenge of separating enduring psychological phenomena from how they manifest themselves in rapidly changing educational technologies makes it difficult to know whether study findings should be treated as a conclusion about the unchanging nature of human learning or as an assessment. Whoever intervened in a moment in time will never repeat.

In addition, considering how technology evolves, research often focuses on rapid changes in the software itself or on technology-cultural practices. But the third is at least as important however more important than culture or technology: how to make the best use of modern technology? For example, consider the global revolution-time of ice sports such as hunting for online learners in their homes: this activity can have a big impact a lot of how the class feels like it only exists on the screen or feels embedded in real life, and maybe similar to giving some students stress because of their home life is revealed. Advance research is not equipped to predict in the future whether this innovation will work or how to tweak it until it does. Sandoval (2004) sees this as a problem of how the design "embodies" the thinking about the intervention or learning. Design is how the process is learned and this directly affects the goals of general knowledge development (Kali & Hoadley, 2020). As Cuban (2003) noted, when people attach importance to technology, they tend to look at the processes that use technology and other ways of creating learning environments. Neither technology nor human behavior with it, is fixed, and this makes it difficult to find a simple answer to the question "What works?"

2. Research Methodology

2.1 General

E-Design research can be considered as a general name for the following but not limited to design approaches (van den Akker, Gravemeijer, Mckenney, & Nievven, 2006).

- Design studies, Design experiments
- Development/Advanced research
- Formative research, Formative assessment
- Engineering research

Design research is the design and development of an intervention as a solution to a complex educational problem (programs, teaching-learning strategies and materials, products and systems), as well as the processes of designing and developing interventions and, alternatively, designing and developing educational interventions to advance our knowledge of their characteristics. It is a research method created to develop or validate theories to improve (for example, about learning processes, learning environments, etc.) (van den Akker, Bannan, Kelly, Nieveen, & Plomp, 2013).

Many research designs, such as surveys, relational studies, or case studies, typically contain descriptive objectives, whereas the design-based research method has explanatory and advisory objectives to improve and name learning and teaching processes (Bakker & van Eerde, 2015).

E-Design research can be characterized by the following definitions (van den Akker et al., 2006);

Entrepreneur: The research aims to design a real-world intervention;

Iterative: Research involves a cyclical approach to design, evaluation, and revision;

Process oriented: black box input-output measurement model is avoided, the focus is on understanding and improving interventions;

Utility-oriented: The merits of a design are measured, in part, by its applicability to users in real context;

Theory driven: the design is based (at least in part) on theoretical suggestions, and field testing of the design contributes to theory building.

2.2 Types of E-Design Research

Development Studies

For developmental studies, the purpose of educational design research is to develop research-based solutions for complex problems in educational practice. This type of design research is defined and developed as the systematic analysis, design, and evaluation of bilateral educational interventions to generate research-based solutions for complex problems in educational practice and to improve our knowledge of the characteristics and design processes of these interventions (van den Akker et al., 2013).

Validation Studies

In validation studies, the purpose of design research is the development or validation of theory, and this type of design research is defined as the study of educational interventions (such as learning processes, learning environments, and the like) to develop or validate theories about and such processes and how they can be designed (van den Akker et al., 2013).

2.3 Comparison of E-Design Based Research with Other Research Methods

Experimental research is widely used in educational research. In experimental studies, researchers generally try to keep all the variables in the environment under control and examine the effect of independent variables (teaching method, equipment used, etc.) on dependent variables (learning level of the given content or skill, motivation, etc.). In contrast, design-based research has emerged as a way to address the need to develop new strategies that can solve long-standing or complex problems in education (Bakker & van Eerde, 2015). [6]

Design-based research has its roots in Herbert Simon's 1967 classic The Sciences of the Artificial (Collins et al., 2004). Herbert Simon divides sciences into natural

sciences and artificial sciences. Artificial sciences can also be considered as design sciences. According to him, natural sciences (such as physics, biology) strive to explain the phenomena that exist in nature. In design sciences (architecture, engineering, computer science, education, etc.), a new artificial phenomenon is first designed and efforts are made to reveal how this designed artificial phenomenon will behave in different situations. Collins (1992), the author of one of the first articles on design-based research, was influenced by Simon's work and divided the sciences into analytical sciences and design sciences and cited his own work as one of the pioneering studies on "design science in education" in his article on design experiments. .

Experimental research is widely used in educational research. In experimental studies, researchers generally try to keep all the variables in the environment under control and examine the effect of independent variables (teaching method, equipment used, etc.) on dependent variables (learning level of the given content or skill, motivation, etc.). Collins (1999) compared experimental research with design-based research and mentioned seven different situations.

These:

1. Laboratory environment – real-life environment: Experimental research takes place in laboratories or similar environments in order to control all variables that may affect the environment, and the content to be learned is presented in a well-defined and standardized manner. However, design-based research is carried out in real-life environments and many variables that can affect the environment have to be dealt with.

2. A single dependent variable – many dependent variables: In most experimental studies a single dependent variable is used. These dependent variables are; There may be variables such as academic achievement, score obtained from the exam, score obtained from a scale, number of remembered items. In some experimental studies, the number of independent variables may be two or three. In design-based research, it is necessary to examine the effect on a large number of dependent variables in order to determine whether the design is working, and in cases where the number of dependent variables in the environment is too high, researchers may have to ignore some dependent variables according to their importance.

3. Controlling the variables – describing the environment: In experimental research, researchers use a method called controlling variables. The act of making the variables that are thought to affect the environment equal for all participants, it's called controlling variables. For example, the time students spend with an instructional material may affect their learning levels. Therefore, if the researcher is not examining the effect of time, he should take care that all students interact with the teaching material in equal times. Thus, only a few independent and dependent variables are left to be measured by keeping other variables under control in the environment. In design-based research, there is no such thing as fixing the variables. Instead, the researcher identifies all the variables in the environment that may affect the design and the dependent variables and describes their characteristics.

4. A fixed and pre-planned sequence of actions – flexible design adaptations: In experimental research, the researcher plans and documents the process prior to research. In the research process, he strictly adheres to the plans. Thus, other researchers can carry out similar research on the same plan. Design-based research begins with the planned sequence of operations and materials. However, these plans are in draft form and not strictly defined. In line with the data coming from the application, the plans and the materials used change constantly according to the success and failure status.

5. Social isolation – social interaction: Experimental studies are usually in isolated settings takes place. For example, in e-learning experimental studies, students often do not communicate with each other and with teachers. They only communicate with the e-learning environment given to them and try to learn from this environment. Even if there is communication, these communications are standardized. Design-based research, on the other hand, is carried out in complex learning environments. For example, it is carried out in a classroom setting or in the student's own home, where he interacts with his family. In such environments, the student will be in contact with many people socially and all communications will affect their learning processes.

6. Hypothesis testing –Profile development: In experimental research, there are predefined hypotheses that the researcher systematically tests. In design-based research, the aim is to carefully examine the many different aspects of design and develop a qualitative and quantitative profile describing how it works in practice.

7. Individual decisions – participatory design and analysis: Researcher what and how in experimental research. He takes all the decisions himself, such as what to do and how to analyze the data. In design-based research, there is an effort to involve different participants in the design process. Thus, these participants contribute to the development and analysis of the design in line with their field of expertise.

According to Reeves (2006), the differences between design-based research and predictive research are shown in Figure 2. Predictive research tests a new hypothesis in a highly controlled environment. In design-based research, there are self-renewing testing processes in order to create new hypotheses.

Another research method used in educational research is action research. The aim of action research, which has become more widespread in the field of education in recent years, is to systematically understand the facts that emerge in the education process and try to improve them by changing them (Kuzu, 2009). There is also a cyclical process in action research. In action research, first the problem is determined and the problem is examined theoretically. Then, the data collection process related to the problem is planned and data is collected. The collected data is analyzed and interpreted. In line with the findings from the data, an action plan is prepared that includes changes to make the teaching/learning application more effective. The action plan is put to work and again data is collected, analyzed and interpreted. If it is thought that the teaching-learning application has not improved enough, an action plan is prepared again and this process is continued cyclically until the teaching-learning application is considered to be effective (Kuzu, 2005).

As can be seen, the process in action research is similar to the process in design-based research. The most important difference that distinguishes design-based research from action research is that it focuses on design problems for the production of an innovation. In action research, the focus is not on producing an innovation. With action research, studies that increase the effectiveness of existing practices can also be carried out. For example, a teacher is not satisfied with the efficiency of a lesson and. If he wants to make a study on how to make this course more effective, action research will be the most effective method he can use. Another difference between design-based research and action research is that design-based research is usually carried out collaboratively by designers, researchers, and practitioners (such as academics), while

action research is mostly conducted by direct practitioners (such as teachers) (Wang & Hannafin, 2005). Teachers who conduct action research can receive support from researchers. However, this support is only for giving ideas and as a result, action plans are prepared and implemented by teachers.

Action research, whose focus is not on innovation, is a flexible research method that can be used in studies that require innovation production. Therefore, it can be said that action research is broader in scope than design-based research. From this point of view, it would not be wrong to consider design-based research as an adaptation of action research focused on design problems.

2.4 E-Design Based Research in the Process of Developing E-learning Environments

In recent years, with the rapid development of new technologies such as computers, internet, tablet computers and smart phones, the need for e-learning environments that can be used on such platforms has increased. In recent years, there have been many publications in the literature on the design and use of e-learning environments. However, despite the large number of studies in this area, it cannot be said that these studies have contributed much to the practice. In general, it is difficult to say that e-learning environments are widely used by students and teachers (Wang & Hannafin, 2005).

According to Hannafin et al. (1997), the majority of e-learning environments developed are based on inappropriate or contradictory theoretical or epistemological foundations. Considering this situation and considering the characteristics of design-based research, the potential of this research method in developing e-learning environments is clearly seen.

E-Design-based research allows the discovery and development of knowledge and the sustainability of innovative learning environments (Design Based Research Collective, 2003). Design-based research incorporates design criteria of e-learning environments with many aspects such as self-renewing design process and collaboration with participants.

E-Design-based research is defined as an interdisciplinary mixed research approach. Design-based research is a promising approach in terms of developing e-

learning environments, thanks to its ability to bring together people from different disciplines and different fields of expertise and to benefit from different research methods in accordance with its purpose. Studies of researchers who have adopted design-based research methods clearly show the contribution of this research method to learning (Barab & Squire, 2004; Kelly, 2003; Sandoval & Bell, 2004).

The design process is one of the most complex problems for individuals. Thanks to the design, an original human-made product that is resistant to many external factors emerges (Jonassen, 2000). Since design problems have multiple solutions and causes, designers must develop advanced decision-making skills in the process of generating logical solutions. If a designer wants to win the admiration of the target audience with what he does, he must know for whom he is designing and understand the needs of these people (Ireland, 2000). Designers of educational software should not only consider the latest developments in education and training, but also take into account a wide variety of factors, such as teachers and students, who are likely to influence the design.

Although the stages of design-based research differ according to the subject and method to be researched, it is generally built on three stages (van den Akker et al., 2013).

Preliminary research phase: needs and context analysis, literature review, drawing the theoretical and conceptual framework of the study.

Development and prototyping phase: iterative design phase consisting of iterations, each a research cycle that includes formative evaluation as the most important research activity to develop and refine the intervention.

Evaluation phase: Final evaluation to decide whether the solution or intervention conforms to predetermined specifications. Since this phase also results in recommendations for improvement of the intervention, we call this phase half-result.

According to Bakker & van Eerde (2015), TTA consists of three phases that cycle with each other;

Preparation and design phase: For the specified training it is recommended to collect and invent a number of tasks that can be useful with colleagues experienced in design.

Teaching experience: Data collection typically includes student work, pre- and post-lesson tests, field notes, audio recordings of all class discussions, and video recordings of each lesson and final interviews with students and teachers.

Retrospective analysis stage: At this stage, everything that happens in the teaching experience process is evaluated retrospectively and it is determined which arrangements will be made in the life cycle.

According to GRAVEMEIJER, COBB, & COBB (2006), e-design research consists of three parts.

Experiment preparation phase: From a design perspective, the aim of the preliminary phase of a design research essay is to establish a local teaching theory that can be elaborated and refined while performing the experiment. From a research perspective, a critical issue is to clarify the theoretical purpose of the study.

Design experiment phase: The second phase consists of performing the design experiment. When all preparations are complete, general endpoints, defined starting points, and a formulated predicted local teaching theory are defined, the design experiment can begin. The research group will take responsibility for the learning process of a group of students, even for 5 weeks, 3 months, or even a school year.

Retrospective analysis phase: Another aspect of the methodology concerns the retrospective. Analyzes performed on the entire data set collected during the experiment. The purpose of the retrospective analysis will, of course, depend on the theoretical purpose of the design experiment. However, one of the primary purposes is typically to contribute to the development of a local teaching theory. Other objectives may relate to broader issues or ontological innovations. Although differences in theoretical objectives are reflected in differences in retrospective analysis, the form of analysis will necessarily involve an iterative process to analyze the entire dataset.

Characteristics of design research are nicely captured by the name Generic Design Research Model (Figure 1) (Wademan, 2005). His model clearly demonstrates that the "sequential approach of practical products" (called "interventions") works together with the "consecutive theory approach" (what he calls "design principles") (van den Akker et al., 2013).

2.5 Example Problem Statements and Example Life Cycle in Design Based Research

Sample problem statements related to design research are given below.

What are the characteristics of the intervention to support academic research writing that will best support graduates training in a research proposal? (Plomp & Nieveen, 2013)

What are the characteristics of micro-scale chemistry teaching materials to contribute to the application of effective practical work in teaching chemistry in schools in Tanzania? (Plomp & Nieveen, 2013)

How can students with little statistical background develop the concept of distribution? (Bakker & van Eerde, 2015)

3. Implementation

3.1 General

The acceleration of technological change and development has revealed design and infrastructure differences in e-learning environments. Among the innovative approaches, this change from the emphasis on "teaching" to the emphasis on "learning", in particular for e-learning projects; dynamic services such as active participation, interaction between individuals, sharing and interaction between programs and second generation development processes (Kaldoid, Konstantinidis, & Bamidis, 2010). Accordingly, expectations from design and development specialists of electronic learning environments are changing day by day and new items are added to the list of needs. In e-learning projects, the design and development process, which are two intertwined work areas, can be explained under different headings in the literature.

Together with the designer support in each layer listed in Figure 1, the communication between the designers in each layer and those in other layers constitutes the main point of media and output efficiency. In the application process divided into these layers; content providers, instructional design specialists,

instructional technologists and software specialists stand out as the roles that take responsibility for design at every stage. Ghirardini (2011) considered e-learning design as a process starting from object design and listed the design stages as follows:

• Learning objects design

• Creation of rankings

• Design of instructional strategies

• Design of distribution strategies

• Design of assessment strategies

This process, which starts with learning objects and progresses to the evaluation step, is discussed under similar subheadings in the literature. For example, Elkins and Pinder (2015) discussed the e-learning design process under 8 headings:

• Designing learning objects

• Determination of pre-qualifications

• Content drafting

• Determination of instructional strategies for content presentation, activities and assessments

• Selection of the appropriate distribution system

• Preparation of test questions

• Deciding on course features, functions and design

Considering the common points of the listed work packages, the basic features expected to be possessed by the design and development stakeholders involved in the production of e-learning environments can be clarified. In this context, the main objective of this study is to question the qualifications of individuals who will take part in e-learning projects and to express them in a general framework. In the study, which was created with the characteristics of a scientific literature review, academic texts and company reviews based on sectorial analyzes were used together and a general framework was tried to be created for the characteristics of the stakeholders involved in the e-learning design and development processes.

An e-learning environment consists of interactive design layers. The involvement of design experts specific to the relevant field for each layer is considered important for the process, which can be thought of as the links of a chain, to progress efficiently to the last point. When the design and development roles expressed in academic studies on e-learning professionals are examined, it is seen that separate design and development stakeholders are listed for the teaching field and the technology field. For example; Ghirardini (2011), design experts; instructional design specialists, content specialists, multimedia editors, and web developers. Horseley (2012), while detailing the stakeholders in each title, defines two groups as mandatory and optional roles, and includes mandatory roles; instructional designer, content specialist, script writer, graphic designer, learning management system specialist, and sound and animation developers. Wagner , Hassanein and Head (2006) used two different titles as content providers and technology providers.

In particular, considering that the development process cannot be handled only within the scope of software development, in this study, it is thought to distinguish between pedagogy and technology in order to detail the design and development expertise, although no definite lines are revealed. In this context, the stakeholder reviews that took part in e-learning projects, based on literature reviews, were tried to be presented under the following 3 headings:

- Pedagogical field design and development experts,
- Technological field design and development experts,
- Instructional technologists.

The relations of these titles with each other; It includes sub-dimensions that need to be examined and evaluated from a holistic perspective.

3.2 Pedagogical Field E-Design and Development Specialists

“What is e-learning?” Clark and Mayer (2011), “What?”, “How?”, “Why?” They tried to get answers with sub-titles. First, “What?” With the question, the course contents used in e-learning environments and the means by which these contents will be taught are investigated. "How?" With the question, the distribution types of learning content, which tools and technologies will be distributed, and synchronous or

asynchronous application forms are examined. Finally, the purposes of individuals to use an e-learning environment are questioned, personal development goals or increasing job performance, "How?" It provides possible answers to the question. When the job descriptions in these basic three dimensions are examined, it is seen that there are processes that require pedagogical and technological expertise.

In general, the stages of the pedagogical field design and development process point to similar characteristics defined by different names. In this context, clear lines about who will be the stakeholders of the process can be formed in our minds. Information on the relevant roles is presented under the following two headings:

• Instructional design experts,

• Content experts.

Experts working in these roles are expected to have high-level pedagogical competencies according to the content type and the size of the design process.

Instructional Design Professionals. Although different perspectives can be seen in the literature on who the design and development stakeholders are, instructional design experts stand out as unchanging design stakeholders. Gustafson and Branch (2002), instructional design; It defines it as a system of appropriate and reliable procedures for developing a training program. In this context, an instructional design specialist; should have knowledge about learning theories and instructional design models associated with these theories and be able to construct how theoretical knowledge can be used in practical applications. These experts are responsible for designing the basic principles regarding the teaching and learning layers followed in the instructional design process (Yusoff & Salim, 2011). The learning process

How materials, activities, evaluation studies, feedback and course outputs can be designed as parts of a whole at every stage can be done under the control of an instructional design specialist or a team of experts. The International Education, Performance and Instructional Standards Board (IBSTPI) published a detailed booklet in 2012 on what the basic competencies of instructional design professionals should be. In this booklet, the skills expressed at the requirement level are:

• Having effective communication skills in visual, audio or written forms,

• Continuously updating and developing knowledge, skills and attitudes regarding the instructional design process,

• In the working environment, the design; determining its ethical, legal and political implications,

• Defining and explaining the target audience and the characteristics of the environment,

• Selecting and using analysis techniques to identify the didactic content,

• Existing and analyzing the use potentials of emerging technologies,

• Using an instructional design and development process suitable for the given project,

• Organizing the curriculum or products to be designed, developed and evaluated,

• Designing instructional interventions,

• Selecting or modifying existing teaching materials,

• Developing teaching materials,

• In accordance with the data obtained; revising didactic or non-teaching solutions (IBSTPI, 2012).

As can be seen, instructional design experts support the process with their theoretical and practical knowledge at many stages of instruction, from designing the instructional content to evaluating the outputs.

Content Experts. No matter how advanced technologies are used, the purpose of an e-learning environment, as in every learning process, is to create an existing content; ensure that it is shared in a meaningful, efficient and permanent way. However, in e-learning environments where effective design practices and technological support tools are used.

Even, incomplete or incorrect content may prevent the completion of the design. The main task of content experts within the e-learning team is to provide the content and resources to be used, as well as to check the relevance of the materials prepared by other team members (Nasta, 2012). Content providers or experts are motivated to provide appropriate content for effective learning outcomes, especially considering

that content type is one of the important factors that can affect learning in e-learning environments.

Since the beginning of the 2000s, the importance of teaching technologists who can work in interaction with content experts, among other project roles, has started to increase. Increasing diversity in technology integration applications and electronic learning objects used; It has revealed the need for e-learning project stakeholders, who can provide the link between the designer, content specialist and software developer, who have pedagogical knowledge as well as technological competencies at certain levels.

In this sense, it was thought that it would be appropriate to consider the role of teachers in teaching skills related to the subject in a separate paragraph. The impact of instructional design on learners and designers (supervisors) is described. Since the design model does not only refer to their theoretical basis, but seems to have a strong influence on the design and content, the relationship between the model and the actors' things have been explained. It will be noted that changes in the nature and work of teaching design call for appropriate measures to improve learning efficiency and effectiveness. This perspective will lead us to identify the conditions that must be met by teachers to understand the relationship between students and their environment. In fact, it is this interactive perspective that tends to create a powerful learning experience. The introduction of computers in schools in the early 1980s created high expectations about its potential for enhancing individualized learning. The design of that personal computer environments encompassed three different types: (a) computer programming, (b) computer-assisted learning, and (c) use of computer.

Learning to use a computer is one of the most important applications in the early days of teaching computers in education, being considered an important part of the so-called computer literacy. Education for computer programs is based on the argument of "knowledge of emotional effects". Learning the importance of work is expected to lead to the acquisition of general ideas that will then be transferred to other topics. It seems to be expected from the study of Latin and Greek in secondary education. Along with BASIC, the study of Logo was very popular in the eighties. Logo will facilitate learning in the construction and self-discovery, often called "learning without the curriculum" or even "learning across the curriculum." Despite initial interest, research

on the impact of computer programming on academic outcomes has not supported cognitive outcomes. One of the downsides of the open source is the lack of guidance and support. Indeed, Logo in itself does not seem to be useful for the desired, but it should be placed in a strong learning environment that clearly shows the transfer of skills. . This support can be provided by a person in charge of teaching, like a teacher, but it can also be part of the Logo software itself. Logo software is supported with computer tools and training tools that support the development of problem solving skills. These developments can be considered as an indication of the integration of various computer-based learning methods, such as computer-assisted instruction, artificial intelligence, and the use of open source tools.

The most common use of computers is computer-assisted learning (CAL), and in particular the use of computers to practice-and-develop specific content and skills in a content area always include math, language, and physics. The computer generates assignments, requires student responses, provides immediate feedback, and provides reminders for further progress in the program. It is based on the principle of programmed teaching, aiming at the automation of knowledge and skills. The driving principle is individualization, since each student can complete the program in his own strength and rhythm, ultimately guided by the efficient and content-driven branches. The computer seems to take the role of the teacher. Although some reviews of the effects of CAL on learning seem to show positive results (Kulik & Kulik, 1991), many other studies show less results. Dissatisfied with the limited results of traditional CAL, a new generation of programs has been created, called intelligent tutoring systems (ITS). In this way, programs are not created from static, predetermined processes, but the computer creates problems, tasks, content as well as when and how to deal with the interaction of the skills of (a) the professional skills embedded in the program (the professional model), (b) the registration of the student's knowledge and skills (the student model), (c) the teaching or learning process contained in the curriculum model), and (d) the knowledge of the setting establish communication with the student (communication model). Intelligence lessons have been developed for many topics, such as mechanics, geometric optics, economics, algebra, grammar, computer programming (see Wenger, 1987). Although research and development of ITS continue some criticisms have gained importance. First, the actual simulation of the student model seems problematic. In fact, the system must understand all the activities

and processes of the students, including negative thoughts or negative actions. Second, the question is asked whether the system will create a perfect model and detailed information on the students' knowledge and skills because this is easy to do in the process effective learning and instruction that is not independent enough for learning to work and design. In this line of criticism, Kintsch (1991) spoke about unintelligent teaching: "The teacher should not provide the skills to teach, he should not do all the planning and monitor student progress, because these are important tasks that students need to do. What a teacher should do is to provide periodic support to students which allows them to achieve what they are capable of now" (p. 245).

Third, the objectives, content, learning, and content taught in most courses are dated. Computers are often used to create or reconstruct traditional, mechanized processes of basic concepts, such as arithmetic where a person absorbs and remembers a fixed body of decontextualized content. and fragmented and skill sets are transferred. This contrasts with recent theories of the mathematics of reality, real life and context (see Kaput, 1992). Therefore, many authors have applied for the use of technology based on the goals of reform, the content of the content, and active learning and development. This criticism made the use of computers more open.

Computers can be tools for students to support and develop academic or creative goals. For example: using word processors, calculators, spreadsheets, database programs, drawing, and music composition programs. These courses, created from outside education, are often expected to be useful in supporting the educational process in schools, such as knowledge acquisition, creative teaching, and communication. The idea behind this is that this tool frees students from low-level tasks, tracking processes and states, and thus allows them to focus on thinking and learning. again. A good example of this open use is the word processor. Based on the interest of professional writers about the potential of writing words compared to writing work with paper and pencil, it began to be thought that processing words as an open tool would make students' writing skills better (Cochran-Smith, 1991). However, there is almost no evidence that word processing has a positive effect on text quality, text length, cost and editing quality, and overall writing improvement. . It is clear that the effectiveness of word processing tools depends on the quality of support available in a particular context. Therefore, the question is no longer how effective language processing is, but how language processing is related to

instructional goals, student characteristics, curriculum, teachers, and content. It is evident that, in order to make the tool powerful for learning, support from teachers, peers, and/or additional computers is needed.

One of the important guidelines for curriculum design that follows from the analysis of large studies on the use of personal computers in education, is that there are no lines or direct benefits of computer use in schools. Effectiveness depends on the student's characteristics, the quality of support from teachers, peers and software, the content of the study, the relationship with the curriculum, or in short, the integration of computers in a dynamic learning environment.

In addition, the understanding of learning as a separate, all-individual process is being questioned because of the new understanding in cooperative learning as an important part of learning a round.

As mentioned above, all the design shows are based on the knowledge that the results of the research are representative of the time and place of the Zeitgeist. It should be noted that the state-of-the-art of such knowledge registers is changing rapidly, and all meta-analyses show severe limitations. It seems interesting, for example, to look back to the Handbook of cooperative learning and computers about ten years ago (see Mevarech & Light, 1992). They focus on the intersection of peer learning in the classroom and learning with computers. Their conclusion is in line with the analysis as they argue "It is clear, therefore, that the results of peer relationships are likely to depend on the type of software used" (p. 157). The new generation of electronic learning environments or technological tools, such as the Internet, can change the conclusion. For more information on changes in cooperative learning and computer-based cooperative learning (CSCW) see Collis (1994). The Importance of Cooperative Learning. The recent discussion of communication in education (E-learning) as well as the changes in the educational culture in the society have stimulated interest in cooperation or exchange to cooperate. The following reasons are suggested to understand the importance of cooperative learning.

1. Education is social, involved in culture and reflects the knowledge, thinking and values of society. The basis for cooperative learning is knowledge sharing, or the sharing of knowledge. Until now, schools, homes, and workplaces are separated from each other and they often work because they are connected or connected by accident

or accident, but not less purposeful and cooperative work (CTL, SRI, 1994). Intensive electronic communication can provide added value to existing networks and cooperatives, because schools can connect electronically with the wider community. This will undoubtedly require new and powerful forms of organization, redefinition of roles, in-depth analysis of the tasks to be completed, and management of intensive flow of materials paper.

2. Self-awareness arises from the process of internalization of information from the surrounding culture, as it was taught by Vygotsky (see Dillenbourg, 1994; Davydov, 1995). This internal perspective shows that the behavior in the intellect gradually emerges from the external behavior. In this way, communication and cooperation precede knowledge work. Students gain new knowledge through their social interactions.

3. Learning in good contact can help to improve the relationship between self-ships, which has a positive impact on the relationship, such as student motivation and respect (Nastasi & Clements, 1991).

4. Recently, the theory of distributed cognition attracted a lot of research. In contrast to the common view that knowledge and experience reside in the head of each person, he asserted that knowledge is distributed to both individuals and their environment (Hewitt & Scardamalia, 1996). All human activities are influenced by the payment terms that include people and cultural objects. Knowledge is, therefore, not only living, but also distributed. Distribution of knowledge becomes important in many areas of media and communication, where information is often divided into different types of (re)sources. E-learning offers many opportunities for students to collaborate with everyone: peers, teachers, professionals, professionals, and parents. Therefore, it seems that it should not affect the difficulty of cooperative learning, finding the best group in the work of activities to be successful. With communication, the information contained in the document can be organized at different levels of complexity, such as knowledge of new information. This analysis questions the statement that "data is now available to everyone" because interpreting and filtering data is still necessary for learning. This is about the complex issues of data management.

5. The results of educational research show that in some cases, learning can be more effective in cooperative settings than in individual or instructor-led learning and text-student-interaction (Webb, 1982). One of the conditions is that group work is efficient and goal-oriented: "Typical group work, where students are encouraged to work together but received small samples and few incentives to perform, have again been found to have little or no.-existent effect on student learning" (Slavin, 1990, pp. 30-31). This observation is very important for the study of participation in electronic communication. He points out the dangers of communication only in which participant's free-wheel when they interact. A second condition is the strictness of group work based on (a) clear group goals, (b) individual responsibilities, (c) specific tasks for team members group, (d) adjusted according to individual needs, (e) equal opportunities for all participants to succeed, and (f) competition within the group. The third condition is the selection of a good group of workers. In fact, the added value of cooperative learning is expected from the intense competition between the participants.

This means that the work must be (a) multi-faceted, allowing all partners to work together, (b) sufficiently functional that allows the group to share expertise more than single people, (c) oriented toward social goals to support relationships and behaviors, and (d) uncertainty about fostering collaboration. Here, the issue of group or network management is important. Arguments for Education in and by Groups. The positive effects of cooperative learning can be attributed to several factors. First, learners can benefit from the fact that they have to cooperate with them (collaboration) to make both their thinking clear and to understand others the theory or argument. Second, participation can affect the conflict of social cognition, which forces learners to revise their knowledge when faced with unfamiliar or conflicting information mediated by partners (see Vermunt & Verloop, 1999). Third, cooperation challenges the thinking process, since one has to defend his opinion, provide arguments, adjust personal information to partners, and evaluate the Solve problems for problems. In short, a lot of people think about going in the cooperation areas. Finally, the knowledge of social relations in the group promotes clear and precise words because one must always speak for his own knowledge. These cooperative features lead to the problem of language use in a multilingual (networked) environment. Not only the grammatical and lexicographical problems, but the accessibility of the cultural background is

important for all the definitions of the meaning (see Chapter 26 in this Book). If the transnational interaction between native and non-native speakers is going on, the question of clear understanding of communication in that language becomes an important topic of concern.

Collaborative learning affects both academic achievement and student motivation in terms of student self-efficacy, learning goals, and positive attitudes of the learning task (Nichols & Miller, 1994). The first factor that accounts for these effects is the positive influence of peer support on learning (Slavin, 1990). When peers realize that academic success depends on their peers, they are able to provide feedback and support for learning. A second important factor is the support of the team to face the difficult task that is seen. Collaborative teams have greater self-efficacy in terms of task completion because they are challenged by members to solve problems and persevere. A third important factor is that group activities encourage students to see more meaningful aspects of content or tasks to be completed (Nichols & Miller, 1994). Crook (1987) mentions two important aspects of group work: allowing problem solving and discussion of competing viewpoints. The fourth is the need to be self-focused and therefore conflicted by other members of the group. Increased motivation may also lead to increased work time, one of the variables clearly affecting learning outcomes. It is evident that in order to use the potential of collaborative learning, many things need to be done. Salomon (1996), for example, mentions the conditions to increase cooperation in cooperative learning, such as participation in joint problem solving, using members' resources, help and guidance from partners, and shared goals. Back to Gagne's status of education? Through the division of cognitive theory, Hewitt and Scardamalia (1996) provide the following general strategies that will make collaborative communication more effective: (1) provide communication support correct, (2) focus students on social issues of understanding, (3) encourage inquiry, (4) encourage connections to prevent learners from simply following their own thoughts, and (5) emphasize social work beyond personal work. These strategies all point to a significant shift from individual learning to group learning based on projects. A preliminary design may be one of the problems based on findings or findings in negative experiences (see Gros, Garcia, & Ruiz, 1998). Students will be given a variety of tasks and tools to complete those tasks. Technology Cooperative Environment. Interactive tools are technologies that provide communication with

different participants in the learning environment. The unique properties of technology determine both the types of information that can be exchanged and the ease of the communication process. This product is not guaranteed to be effective or effective in communication. Efficiency and effectiveness depend on how these items are actually used (eg, Spitzer & Wedding, 1995).

In general, he thinks that communication in computer-mediated technologies has the potential for processes such as relationships, information exchange, and various support for learners. This process can facilitate the acquisition of knowledge and deeper knowledge and improve relationships (Hiltz & Turoff, 1993). A number of studies have been conducted that investigate the potential for environmental interactions and conditions for effective use (for review: Wells, 1992). Effectiveness depends on the learning level of the students, the time needed to participate in the interaction, and where the environment is perceived to be interactive. Especially when tele-participation is aimed at, pacing the job becomes very important. Wells (1992) mentions three ways to make students work: (a) group work, (b) access to (access to information only provides the means prior requirements have been met), and (c) provide access to information during limited periods only. The benefits and problems associated with computer-mediated communication (CMC) have been well documented by Matttunen (1996). note: (a) learning in a CMC environment is mainly based on student activities and therefore will be effective in improving the personal behavior of students, and (b) CMC by forcing students to clarify and argue about their own ideas promotes intellectual development. In addition, by confronting in a CMC environment with learners, various ideas and arguments they are encouraged to be more reflective and clarify their ideas (Milheim, 1996). So far, the argument compares the problem of cooperation between education (see above). These results are actually stressed by Scardamalia and Bereiter (1993) when they argue that the conversation in a deep conversational environment is the result of a more visible view of the different ideas. This increased visibility makes ideas more negotiable. Moreover, groups of students can see that they understand a particular problem or change in reality. In other words, the study will be more visible. For more information on communication technology see Chapter 3 in this Guide. In more detail, Internet education has been described for various categories, activities, functions, and topics. Because of the openness of this site, each designer can create a unique site, using the Internet as

building blocks. However, according to Siegel and Kirkley (1997), information is not knowledge. Internet-based training should move beyond content to help students solve problems and make information useful (see van Merrienboer, 1999). The advantage of the Internet for education depends on the design and management of complex man-machine-man-interaction aimed at higher intelligence. Besides the open Internet, many cooperative goals have been established. These platforms are aimed directly at specific tasks, using specific models and users' interface. These areas can be divided into some important areas, such as (a) educational theory, (b) functional education, (c) content or skills, (d) technical social and quantitative, (e) cooperation, (f) position, and (g) technological characteristics (see Santoro, Borges, & Santos, 1999). If we take the example of CSILE and Knowledge Forum (see Verschaffel et al., 2000), the following characteristics can be described: (a) constructivist, (b) knowledge creation, (c) general , variety, (d) asynchronous / neutral, (e) representation and communication of knowledge, (f) open, and (g) Maclntosh, Unix. An important link between the environment and the user is the interface. O'Malley (1992) mentions three different levels of representation: (a) the manager himself, composed of ideas and processes, (b) tasks or activities to acquire knowledge or skills, and (c) the connection itself, embodying the input, throughput and output that users can complete tasks. More research is needed on the impact of interface design on the effectiveness and efficiency of learning in collaborative environments.

3.3 Technological Field Design and Development Specialists

The efficiency of an e-learning project can be achieved by developing the designed application forms with appropriate technologies. In this context, technological field design and development specialists are people who make the content and guidance they receive from pedagogical field experts functional by using their expertise in current technological fields. In the process of developing e-learning environments, content development and software development experts work together, while instructional design experts are seen as active participants in the software development phase. The interface development process of an e-learning system includes many different development areas, from the use of images to guidance, from text formats to data entry forms. Good interface design in e-learning environments; With controls, images and informative objects that keep students' interest in mind, they can support increasing their learning motivation, help them find where they are, and help integrate

new content with old concepts in the mind in the process of obtaining complex information (Cho, Cheng & Lai, 2009). Since the interface is the part where the user and the system interact directly, the interface design can play a key role in the success of the teaching given in the electronic environment. Bhuasiri, Xaymoungkhoun, Zo, Rho, and Ciganek (2012) define the success factors of an e-learning environment as seen in 5 in their study:

- Individual dimensions
- Learner characteristics
- Tutorial characteristic
- Extrinsic motivation
- Environmental dimensions

Includes qualifications such as In this sense, it is seen that e-learning interface developers have an important role in ensuring the success of the environment. In addition to its technological impact, the determination of software developers who will work in a development process whose pedagogical characteristics are extremely important, among those who have worked with instructional technology experts or who have instructional technology qualifications, is a point that directly affects product efficiency and needs attention. Since interface developers need to work in collaboration with other stakeholders, communication skills are as important as programming skills in project development processes. In line with the guidance of instructional design experts, instructional technologists and content specialists, interface development styles may change. Among the interface development specialists, there may be web development specialists, graphic design / development specialists, multimedia development specialists and mobile interface development specialists in parallel with the objectives. A graphic designer is the person responsible for the creation and editing of graphics during the development process, and is in contact with other stakeholders during the development process (Horsley, 2012). Depending on the goals of creating a synchronous or asynchronous e-learning platform, differences in interface design and diversity of authoring languages may be required.

4. Results

4.1 General

In general, our work was related to the establishment of an e-learning system. In the theoretical context, we studied the topics of methodological, bibliography. Here, we analyzed the current methods in the world, international experience in this field. Based on this, we applied what we learned in the practical part of building our own website. We can summarize what we have done in this regard below.

When evaluated in general, separating the stakeholders involved in the design and development process of an e-learning environment with clear lines reveals a distinction of roles that should be examined in detail. Because in these intertwined design and development processes, there is a constant communication and interaction of different roles with each other. In addition to its technological impact, the determination of software developers who will work in a development process whose pedagogical characteristics are extremely important, among those who have worked with instructional technology experts or who have instructional technology qualifications, is a point that directly affects product efficiency and needs attention. An instructional technologist; (a) within the scope of social competences; contributing to the cooperation in group work and working with different experts within the institution, (b) within the scope of educational qualifications; to have knowledge about the psychological dimension of child and adult education, and finally, (c) within the scope of technological competencies; It is expected that they can use the latest technologies in case of need by following them (İzmirli & Kurt, 2009).

Since they need to work in cooperation with stakeholders, communication skills are as important as programming skills in project development processes. On the other hand, it is considered important that content experts, who are a part of the entire e-learning design and development process, interact with other experts and especially with instructional design experts. According to Yusoff and Salim (2011), some of the problems that may arise for content experts in providing this interaction are as follows:

• After the review process, they can refuse to make changes to the content they have prepared.

• Since they do not fully understand their role in scenario design, they leave all the task to the instructional designer and think that the instructional designer will correct the scenario. Scenario design review of an e-learning environment; should be done together with a content specialist, instructional designer, multimedia specialist and graphic specialist.

• Communication difficulties may arise as they generally work in different institutions. (Yusoff & Salim, 2011)

It would be appropriate to point out two important points that Horton (2011) made for design professionals: [1] Designers should insist on applying the basic instructional design at every stage, and should not see the process as just cramming content into a language of authorship. Every choice will have two questions to ask themselves: Why am I doing this? How will this help students learn? (2) Designers should accept social learning, mobile learning and the use of games in learning as valid e-learning applications and should prefer these applications where they can be used best, and should strive to be designed in the best way. They should be open to innovations, avoiding chasing quirks in design.

In this context, no matter how the roles are grouped, it should be considered important that all stakeholders contribute to the process, within an understanding of practice that prioritizes the pedagogical approach towards learning objectives. Today, in e-learning applications that are developing rapidly at the national and international level, the design and development stakeholders involved in the projects, the attraction power of technology.

Being caught in their high trajectory and moving away from their teaching goals may lead to the development of e-learning environments with high technological competencies but pedagogically inefficient.

4.1 Experimental Results

An important part of the web-based laboratories, which include remote access e-educational experimental set in the literature, consists of studies in which access is provided to only one experimental setup. Those who have more than one experimental setup allow only one experiment to be performed at the same time, that is, only one person to use the system at the same time. When it is desired to replicate the experimental setups, a new server or control element is needed. This situation prevents

the widespread and usefulness of web-based systems and increases the cost. In this study, a web site that can be accessed simultaneously through only one server and one control element.

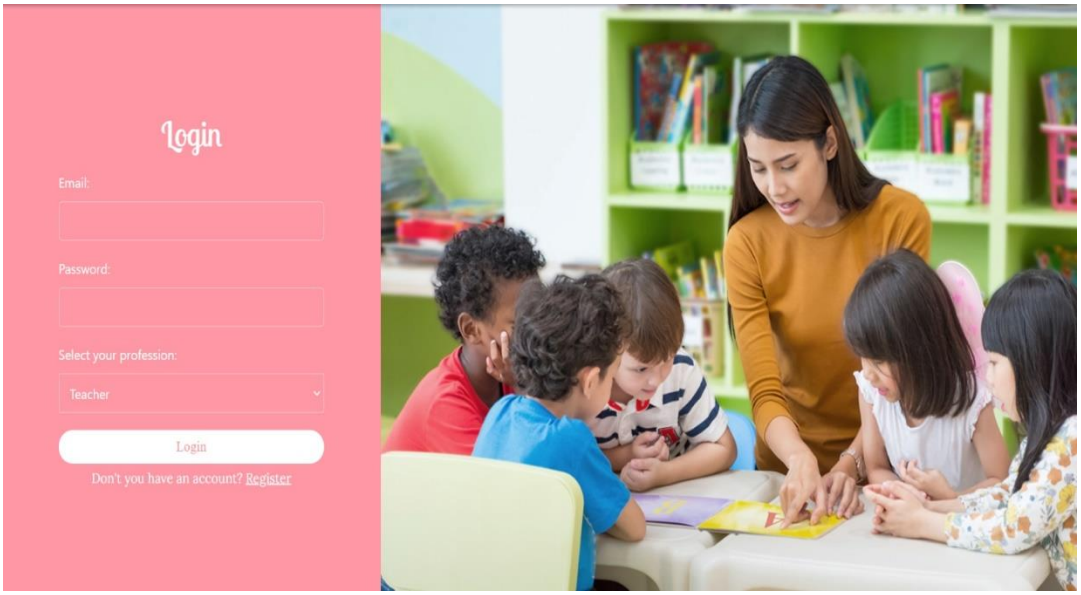

Figure 2 Login User page

It has been developed. It is possible to test the system by logging into the site and testing it. Although three experiments are selected to show the multi-experiment feature of the platform for multiple users, it is possible to increase this number. (Digital positioning, students' own department, teacher's department, distant test belong to these functions). This has increased the functionality and usability of the system. Users can monitor the process of the experiment by the server, thanks to the cameras placed separately for each experiment set on the platform. In addition to the experimental worksheets, theoretical knowledge and interactive learning materials are also provided.

Pages describing the procedure for conducting the experiment were also designed. The fact that both the theoretical pages and the experiment pages are simple, understandable and visual makes the experimental experiences more memorable.

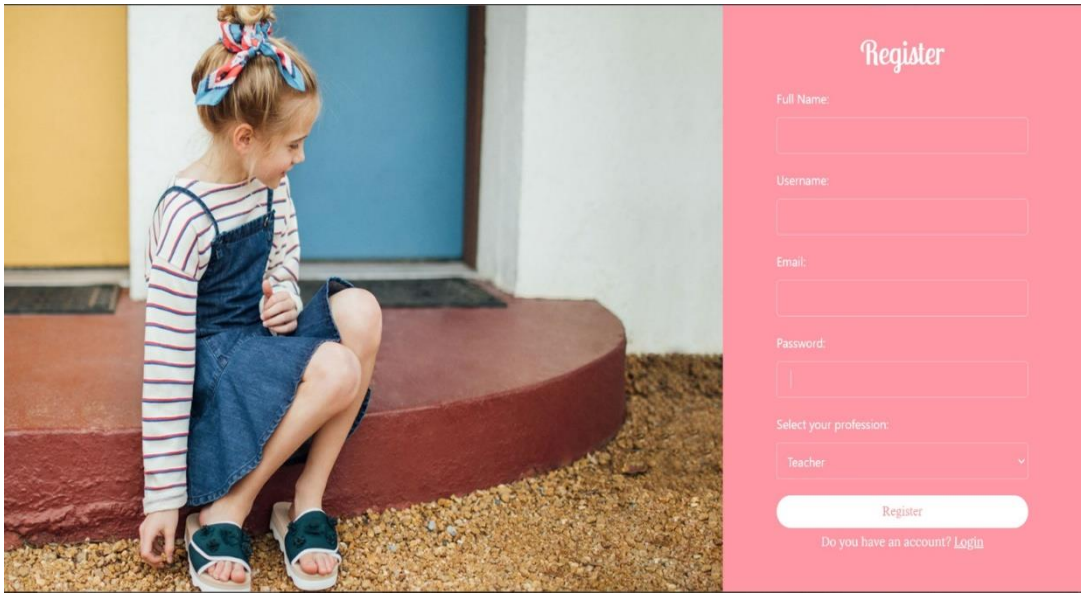

Figure 3 Register page

4.2 Simulation Results

E-Design-based research and teaching experiment methods differ from classical experimental research depending on the way the research process is conducted and whether the interactions of variables with external factors in their natural environment are included in the research setup.

E-Design-based research and teaching experiment methods are dynamic and flexible in the way they are constructed, and they deal with situations that we may encounter in a real classroom environment, taking into account certain limitations. It deals with the examined situations not in an isolated approach, but with their interaction with the factors in their natural environment (Cobb et al. 2003; Cobb et al. 2011; Steffe and Thompson 2000; Steffe and Ulrich 2014). This approach ensures that the intervention and design performed in both methods take place in an environment closest to the natural environment (Cobb et al. 2003; Steffe and Thompson 2000). The method followed in experimental research is exactly the opposite. The research process is carried out in the most isolated environment possible by controlling external variables (Fraenkel, Wallen, and Hyun 2015).

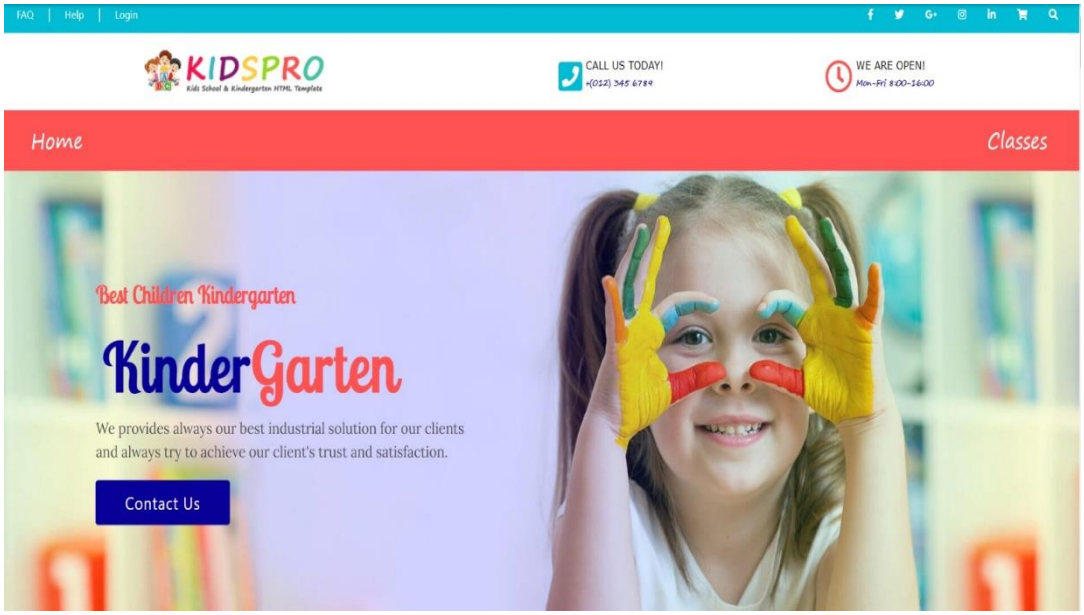

Figure 4 Home page

Another feature of experimental research is that the variables to be examined are determined before the study and these variables cannot be changed during the study or new ones cannot be included in the study (Creswell 2012; Fraenkel, Wallen, and Hyun 2015; Steffe and Thompson 2000). Before the research is carried out, hypotheses are established in the context of the variables and either rejected or accepted in line with the research results. The functionality of the research process, on the other hand, is designed in advance and does not change during the process (Fraenkel, Wallen, and Hyun 2015). In the e-design and teaching experiment, although the variables to be examined are predetermined, the variables that are revealed in the analyzes during the process and that are deemed necessary to be examined can be included in the research (Steffe and Thompson 2000; Collins et al. 2004) The aim in e-design is beyond just accepting or rejecting a hypothesis it is also to put forward hypotheses to be tested (Steffe and Thompson 2000). New hypotheses may emerge as a result of the analysis of the previous application cycle and can be tested in the next application (Steffe and Thompson 2000; Steffe and Ulrich 2014). In connection with this situation, in both research methods, the implementation of the intervention that the researchers have designed can be changed during the study or certain steps can be removed from the application as a result of ongoing reflections and analyzes.

Conclusion

Within the scope of this study, e-design and teaching experiment methods were examined in the theoretical context, and the similar and different aspects of the two research methods and their distinguishing features from experimental and action research methods were explained.

Researcher Role: The researcher can be in the role of a teacher in both approaches. The researcher is responsible for asking questions that will encourage students to think actively and reflectively during the teaching process.

Teacher Role: In e-design, unlike the teaching experiment, the teacher has to be a part of the research process. The researcher himself can perform the teaching experiment by assuming the role of the teacher.

Consecutive Application: Consecutive practices in the teaching experiment followed successive teaching periods. whereas in design-based research, it refers to successive design experiments such as the first cycle and the second cycle. In both methods, the researched subject is examined in depth with a circular approach.

Reflection: In both methods, the reflection that shapes the applications in the process is a very important element. While the prospective and retrospective analyzes included in the conceptual analysis shape the next teaching period in the teaching experiment, they also shape the next design together with the next teaching practice in e-design.

Research Group: In order to carry out design-based research, different from the teaching experiment, it is necessary to have a research group. Depending on the complexity of the situation covered in the research, different field experts may be a part of this research group. Although it is possible to work with a research group in the teaching experiment, this is not a necessity. The researcher teacher can conduct the teaching experiment in accordance with the characteristics of the process.

Process Output: While the teaching experiment reveals the model of how students learn, the main product targeted by e-design is testable theories. While the teaching experiment reveals which aspects of an existing teaching approach work better and which do not, the design of e-systems aims to develop a new teaching approach/theory for researchers.

In this study, the theoretical framework of design-based research and teaching experiment methods, which come to the fore as new approaches in educational research, their differences from other research methods and their interactions with each other are explained. Considering the purpose and scope of the study, it tried to explain the methods in a theoretical framework rather than an empirical approach and results. Both methods start from a problem and take steps to solve this problem in its natural environment, taking into account its interactions with other variables. In this direction, it is thought that e-design methods will support new steps to be taken to solve existing problems in education.

Revealing the common and different aspects of design-based research and teaching experiment research will be valuable in terms of presenting a roadmap to researchers who will work using these research methods. Knowing the possible difficulties that may be encountered in studies using these research methods will contribute to the researchers' design of their studies. The performance management system and knowledge-learning management systems of learning tools included in the field of instructional design and technology have made the use of new technologies together in the learning process effective. For example, it covers new instructional design models in practice as a new e-learning model in the development of multimedia learning and online learning system for distance learning. One of them is the design model for multi-learning projects within multi-learning. This model is the DDD-E model and consists of the parts in Figure 2 as Decide, Design, Development, and Evaluate (Ivers & Barron, 2010).

This model explains project planning activities for students and teachers (D-decide). This section covers instructional objectives, standards, brainstorming activities, and co-creation of learning groups. The design (D-design) section includes the design guide of the project and the monitoring evaluation to reveal the deficiencies within the structure and implementation of the project. In this process, students identify topics, create flowcharts, screen design and layout, and storyboards for the software. Development (D-develop) includes the creation and collection of media elements to facilitate the lesson. In this part, the teacher manages media production and multiple teaching activities. In addition, the deficiencies are completed. Students develop the competent program with graphics, animations, audio and visual video. Evaluation (E-evaluate) stage exists for all stages mentioned above. The teacher

provides student assessments and reviews activities for the future. At this stage of the model, the students correct the mistakes, evaluate the small group work and perform the individual evaluation. Evaluation covers every step of the DDD-E model and is done.

As a result, with the help of technologies, e-learning and the principles on which its design is based become reality with the application of communication models. Computer tools and e-learning tools support this. The accuracy of the information flow between the communication channels and the transceiver depends on the instructional design models used, the strategies of rapid instructional design and the correct use of technologies. We can briefly list these points.

• There are computer programs and teaching theories and models on effective e-learning design and use on the Internet and Web systems.

• There is a need to select and implement an instructional design model that can be effective in the process of teaching or learning course topics with unified e-learning technologies.

• Message design in the e-learning process is very important in terms of user-friendliness in the design of audio-visual factors in computer technologies and instructional materials, in short, in the design of an e-learning course combining the power of computer and visual literacy.

• The functionality of multimedia learning topics of e-learning projects with well-defined requirements is based on the effects and practices of instructional design and technology, and e-learning strategies.

• Information technologies and instructional technologies have the function of increasing and maintaining interaction in the teaching environment with computer, teaching with the web, and innovative technologies.

• The design, development and implementation of the teaching framework with computer technologies as a theoretical model is e-learning in classroom environment, internet and multi-learning. Combined e-learning is created by using these technologies together for e-learning design and implementation. Today, it is possible to talk about many different forms of e-learning. One of them is M- and U learning.

• The unified e-learning model in learning subjects and concepts contributes to performance gain and consolidation of knowledge as e-learning and mobile learning techniques.

• It should be noted that the selection, use and evaluation of integrated e-learning technologies for the development of e-lessons is the job of an instructional design team. For this purpose, rapid instructional design and e-learning approaches can be used and retested to include mobile learning.

Appendix

About the coding languages and design used.

For logging in user must register in the site firstly. For registration user must include the information in below:

- Full Name
- Username
- Email
- Password
- Profession

User firstly writes his or her full name. Full name must be written correctly. Because it is one of the information about the user. In second step, user must include the Username. Username identifies the user in the site between the other users. In third step, the user must include email. Email helps the user to login the account easily. In the next step, the user must include password. It is the second important thing that helps user to login the account. In the last step, the user must choose the profession. As we know, two types of the users can use this site. These types are students and teachers. And in this part the user choose one of them, student or teacher. This process is shown in the code, below in Figure 5 Register.

```
function registerUser () {
const mBody = {
 "name" : document.registerForm.name.value,
 "username" : document.registerForm.email.value,
```

```
    "password" : document.registerForm.password.value
  }

  var e = document.getElementById("registerSelection");
  var isTeacher = e.value;
  var url = "";

  alert(isTeacher);
  if (isTeacher === "teacher") {
   url = 'http://localhost:8080/api/1/teacher/create';
  }else{
   url = 'http://localhost:8080/api/1/student/create';
  }
  $.ajax({
      url: url,
      method : 'POST',
      data: JSON.stringify(mBody),
      contentType: "application/json",
      dataType: 'json',
      success: function(result){
        console.log(result);
        window.location.href = "login.html";
      },
      error : function(error){
       window.location.href = "login.html";
      }
    });
  return false;
}
```

Figure 5 Register code

After registration, the next step is logging in. In this page, the user must include own email and password. These email and password must be same with the email and

password which are used in the registration step. After the user includes the information correctly, the user can include the site easily. If someone wants to use this site, firstly the user must register. This process is shown in the code, below in Figure 6 Login User.

```
function loginUser () {
const mBody = {
 "username" : document.loginForm.email.value,
 "password" : document.loginForm.password.value
}

var e = document.getElementById("loginSelection");
var isTeacher = e.value;
var url = "";
var action = "";

if (isTeacher === "teacher") {
 action = "indexTeacher.html";
 url = 'http://localhost:8080/api/1/teacher/login';
}else{
 action = "indexStudent.html";
 url = 'http://localhost:8080/api/1/student/login';
}
$.ajax({
    url: url,
    method : 'POST',
    data: JSON.stringify(mBody),
    contentType: "application/json",
    dataType: 'json',
    success: function(result){
      console.log(result);
      localStorage.setItem("id",result.id);
```

```
        localStorage.setItem("type",isTeacher);
        window.location.href = action;
      },
      error : function(jqXhr, textStatus, errorMessage){
       alert(errorMessage);
      }

    });

  return false;
}
```

Figure 6 Login User code

The teacher makes exam file for students. He/she anounces exam beforehand for students. The teacher notes exam date, name of subject and other information about this exam. This process is shown in the code, below in Figure 7 Exam file.

```
function getAll(){
var url ="http://localhost:8080/api/1/exam/all";

$.ajax({
    url: url,
    method : 'GET',
    contentType: "application/json",
    dataType: 'json',
    success: function(response,request){
      response.forEach(element => {
       $(".exams").append("<div class=\"exam-cards\">"+
       "<div class=\"exam-card\">"+
          "<div class=\"exam-img\">"+
            "<img src=\"img/ourteachers/Vector (1).png\" >"+
```

```
            "</div>"+
            "<div class=\"exam-content\">"+
              "<h2>"+element.science+"</h2>"+
              "<p> <span>"+element.classs+"</span>
 •"+element.date+" </p>"+
            "</div>"+
         "</div>");
       });
     }

   });
}
function saveExam() {
 const mBody = {
  "science" : document.getElementById('science').value,
  "classs" : document.getElementById('classes').value,
  "date" : document.getElementById('date').value,
 }

 var url ="http://localhost:8080/api/1/exam/create";
 $(".exams").text("");
 $.ajax({
     url: url,
     method : 'POST',
     data: JSON.stringify(mBody),
     contentType: "application/json",
     dataType: 'json',
     success: function(result){
       alert('Exam added');
       getAll();
     },
     error: function (params) {
       getAll();
```

```
      }
    });
  return false;
}
 getAll();
```

Figure 7 Exam file code

After the teacher makes the exam file, he/she accommodates the questions and their answers in this file. When the students login their accounts, they see exam anouncement and answer the questions in this file. This process is shown in the code, below in Figure 8 Exam questions.

```
function getAll(){
var url ="http://localhost:8080/api/1/question/all";
$.ajax({
  url: url,
  method : 'GET',
  contentType: "application/json",
  dataType: 'json',
  success: function(response,request){
    response.forEach(element => {
      $(".exam-questions").append(
"<div class=\"exam-question\">"+
"<div class=\"exam-question-condition\">"+
"<p>"+element.body+"</p>"+
"</div>"+
"<div class=\"exam-question-answers\">"+
"<div class=\"exam-answer\">"+
"<input type=\"radio\" name=\"subject\">"+
"<label >"+element.answer+"</label>"+
"</div>"+
"</div>"+
"<div class=\"exam-question-answers\">"+
"<div class=\"exam-answer\">"+
```

```
"<input type=\"radio\" name=\"subject\">"+
"<label >"+element.wrong1+"</label>"+
"</div>"+
"</div>"+
"<div class=\"exam-question-answers\">"+
"<div class=\"exam-answer\">"+
"<input type=\"radio\" name=\"subject\">"+
"<label >"+element.wrong2+"</label>"+
"</div>"+
"</div>"+
"<div class=\"exam-question-answers\">"+
"<div class=\"exam-answer\">"+
"<input type=\"radio\" name=\"subject\">"+
"<label >"+element.wrong3+"</label>"+
"</div>"+
"</div>"+
"</div>");
        });
    }

  });
}
getAll();
```

Figure 8 Exam questions code

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