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Design of Personalized Blended Learning Environments Based on Web-Assisted Modelling in Science Education

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ABSTRACT

Positive results of science teaching studies supported with the means provided by technology require the enrichment of the content of blended learning environments to provide more benefits. Within this context, it is thought that preparing a web-assisted model-based teaching, which is frequently used in science teaching, based on the "Matter and Heat" unit will be useful. A great number of studies on "Matter and Heat" unit have reported that many students have conceptual errors. It has been found that students have difficulties in associating concepts such as matter, heat, temperature and change of state with daily life. Studies have shown the necessity of designing and using effective teaching methods in solving such problems. It is thought that the modeling based web materials developed for the unit of matter and heat will be effective in decreasing students' conceptual errors and their learning difficulties. Assure teaching design model, which aims to increase the efficiency of material choice and use with systematic prior planning of teaching, was used in creating the materials which were prepared based on web-assisted modeling. The purpose of this study is to design of personalized blended learning environments which are designed based on web-assisted modeling for "Matter and Heat" unit.

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1. INTRODUCTION

Rapid change in information technologies have brought about important changes about the spread of information and about how to reach information. This change has also influenced attitudes to individual's learning. A great number of countries have changed their traditional learning environment to student centered learning and they have begun to prioritize organizations in which active learning methods can be applied [1]. When education reforms from past to present are examined, it can be seen that every country conducts studies which question the country's education system and which aim to solve the problems in order to increase the quality of education [2]. Within the context of search for quality education, a process in which learning occurs by doing, experiencing and researching has begun to gain importance during the studies of structuring science education programs.

Students should be able to make connections while structuring abstract concepts they learn at schools in their minds. It is thought that it will be useful to present students with environments inside and outside school that will help them to structure these kind of abstract concepts mentally. In order for science education to cause any changes in students' lives, it should occur within students' experiences [3]. Finding out students' perspectives is necessary to plan interesting activities to help them consider things from different aspects. This situation requires the teacher to ask questions, to start discussions and to listen to what

the students say [4]. It can be seen that it is not possible for teachers to give special attention to students to find out the perceptions of each student considering the limited hours of lessons.

Personalized blended learning environments can help teachers to make up this deficiency for the sake of saving teachers time. Blended learning is a learning environment in which every kind of technology can be used and which is organized by bringing together different models of face to face learning and distance learning [5]. Blended learning is a combination of face to face traditional teaching methods and technology based teaching methods. While teachers and students interact face to face in school environment, they can also interact with students through directions and materials without needing to be in the same environment with the help of communication technologies [6]-[7].

Positive outcomes of science education supported through the opportunities provided by technology make it imperative to make blended learning environments more useful by enriching their content. Learning environments which combine web-assisted learning and face-to-face learning are found frequently in literature [8]-[10]. Enriching the content of such presented blended learning environments to make them more useful has become important. Blended learning environments give students the opportunity to learn at the right time and in the right place [11]. Creating web-assisted environments which provide students with the opportunity to reach the lesson content wherever they want and at their own speed is a very important opportunity for students [12]. In addition, giving students the opportunity to review the subject face-to-face in the classroom and providing them the environment to question their learning will make positive contributions to their learning levels.

Education environments which are dynamized based on web-assisted modelling without any limits of time and place can carry education to every environment outside the classroom in which computers exist. Lesson materials which are developed by taking into consideration such conditions and needs will be effective resources for teachers and students. In addition to teachers' using web-assisted lesson materials during the lesson, such materials' being used by students after lesson to repeat what they learned will make positive contributions to their learning [13].

It is important for students who want to use blended learning environments individually to have ideas about their own learning. In creating personalized blended learning environments, students should be given opportunities to question their own learning. Students should know how effective activities prepared for blended learning environments are in students' learning. Measuring a student's learning has an important role in science education. Written examinations which are compulsory do not give information about how much and how students learn. In order to be able to reach qualified assessments, educators should find out the purpose of the assessment, criteria of the assessment and the planned outcome [14]-[15].

With traditional assessment tools, it is mostly possible to assess the extent of characteristics students have in cognitive learning domain. However, it is not possible to assess the knowledge, attitude, ability and skills of students in three learning areas effectively with assessment tools, methods and techniques except traditional assessment tools. The way to ensure this is to use materials which have alternative assessment characteristics in blended learning environments. Alternative assessment and evaluation tools, methods and techniques can meet this need [16]--[18]. The most important characteristic of this study about designing personalized blended learning environments is the fact that it motivates students according to the results of learning. With these motivations, the aim is to reach top level learning with activities that are based on modelling.

For the design of personalized blended learning environments based on modelling, "Matter and Heat" unit, which is one of the subjects of secondary school 6th grade science lesson, was chosen. It is thought that creating blended learning environments for the "Matter and Heat" unit, which is one of the units of Science lesson that includes important subjects and misconceptions of students, will be useful. A great number of studies have reported misconceptions in students about the subjects of "Matter and Heat" unit [19]-[22]. Studies have mostly reported that students comprehend the concepts of heat and temperature as the same concept and have difficulties in associating concepts such as matter, heat, temperature and change of state with daily life. A great number of studies have reported that modeling technique can be effective in eliminating the misconceptions that occur [22]. These bring the thought to the forefront that students' misconceptions can be eliminated by using web-assisted model based instruction in "Matter and Heat" unit. In teaching the subjects of "Matter and Heat" unit, using analogical models as well as simulation models which make it easy to define concepts or processes will be useful.

Model-based learning can be addressed as a thinking process formed by mental models of a system or an event [23]. The characteristic of model-based learning which makes it different from other learning environments that require use of models is the fact that it stimulates forming mental models by reasoning with structural, functional and causal mechanisms [24]-[25]. Using models and modeling in science teaching is an effective method to develop students' problem solving skills. Modeling has an important function in the development of testing and creating processes besides making great contributions to students' skills of

synthesis and assessment [26]-[27]. During the process of preparing models such as analogy and simulation, which are commonly used in web-assisted science teaching, an elaborate planning should be made while specifying learner analysis, targets, acquisitions, methods and materials. This approach gives opportunities for students to think advanced and to materialize their own thinking on models with reasoning. High level efficiency and effectiveness can be provided through such designed materials. The purpose of this study is to design of personalized blended learning environments organized within the basis of web-assisted modeling for "Matter and Heat" unit.

2. RESEARCH METHOD

This study presents a sample blended learning environment design for researchers. Web-assisted modeling techniques were used in the design of blended learning environments. Especially during the process of creating materials designed as web-assisted, using instruction design models constitutes an important dimension of the study. While preparing the materials, a systematic planning should be made for effective and productive use of technology. One of the most suitable models for such a planning is Assure model. In Assure instructional design model, choosing suitable methods and materials in accordance with teaching targets is planned besides determining students' characteristics. In teaching programs, by using materials designed through the use of this model, students can be made to show high learning performances [28]-[29].

3. DESİGN OF PERSONALİZED BLENDED LEARNİNG ENVİRONMENTS

In teaching environments which are created through the use of technology, the question of for which purposes the material will be used should be answered well. First of all, students with whom the study will be conducted should be analyzed and material design should be discussed starting from this point. At this stage, harmony will be ensured between the material and the student group on whom the study will be conducted. The stages followed for web-assisted modeling designed according to Assure instructional design for 6th graders who make up the target group of our study are given below. Assure model is named by using the initials of the six stages that make up the model (Figure 1).

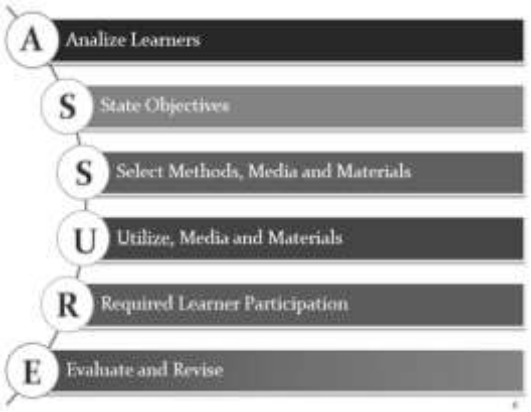

Figure 1. Assure instructional design model

3.1. Analyze Learners

3.1.1. General Characteristics ;

a. Between 11 and 12 years of age,
b. A class size of between 25 and 30,
c. Formal operational stage
   i. Can do mental processes such as deduction and induction,
   ii. Thinks with symbols and can make generalizations.

3.1.2. Input skills ;

a. Studied "Change of State" unit at 5th grade,
b. Positive attitude towards science lessons.

3.1.3. Learning Styles;

a. Visual, verbal mixed,
b. Kinesthetic.

3.2. State objectives

There are a total of 7 objectives in "Matter and heat" unit, 4 for the subject of "Matter and Unit" and 3 for the subject of "Fuels" (Table 1).

Table 1. Number of Objectives and Subjects/Concepts of Matter and Heat Unit

Unit subjects	Number of Objectives	Recommended hours of class	Subject/ Concepts
Matter and Heat	4	8	Heat conductivity, heat insulation, heat insulation materials
Fuels	3	8	Solid fuels, liquid fuels, gas fuels

3.3. Select Methods, Media and Materials

When the factors of students' number and their characteristics, contents of objectives, subjects of units and time were considered, web-assisted modeling activities were prepared by Adobe Flash software by thinking that it would be suitable to use "show" and "tell" teaching methods.

3.4. Utilize Media and Materials

It was ensured that the activities in the prepared material could be used during lecture. The teacher will be able to use projector for this. In addition, students can be allowed to use computer laboratory for individual use. In individual use, students are guided to activities when necessary according to questions and answers.

3.5. Required learner participation

In an environment where students will actively participate, question and answer method and web-assisted teaching will be used.

3.6. Evaluate and Revise

To assess the students in terms of objectives, activity based measurement and assessment material will be used. Material content and preparation stages are explained in detail below. Web assisted alternative measurement and assessment material developed and designed for blended learning environments can also teach besides measuring. The algorithm of web-assisted measurement and assessment material is presented below.

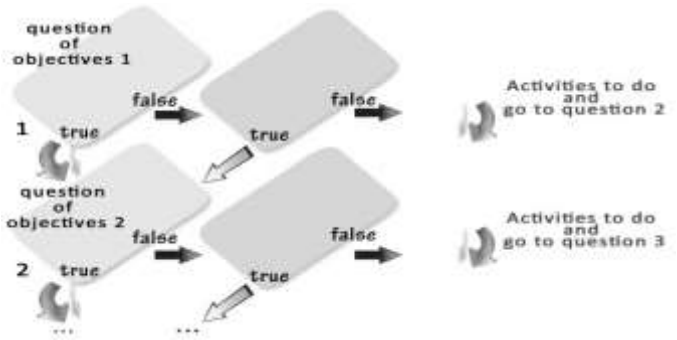

Figure 2. Questions and activities plan prepared for measurement and assessment material

The students are asked to answer questions prepared at the level of objectives as "agree" or "disagree". When the answer given by the student is not correct, the student is expected to answer again a different question that belongs to the same objective (Figure 3). The student moves on to the next objective when he/she answers the questions correctly.

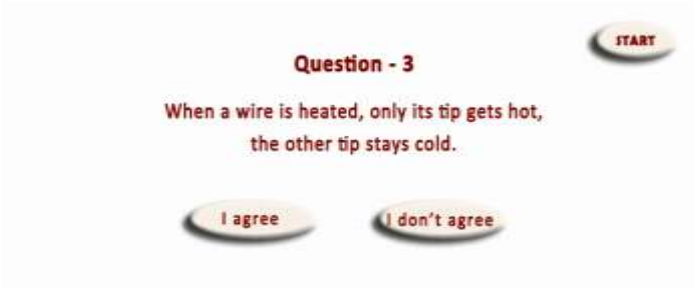

Figure 3. Sample questions for measurement and assessment material

When the answers are not correct, the student is directed to web-assisted modeling activities and expected to complete the activity. There are 7 different activities and 14 questions for a total of 7 objectives of the Matter and heat unit. By this way, all the objectives are checked and the students are made to complete the objectives that they are short of.

All the activities which are prepared based on modeling are presented in a web page and the students are given the chance to do the activity they want whenever they want. The student can use the web-assisted alternative measurement and assessment application whenever he/she wants and as much as he/she wants in order to measure his/her own learning. Below is a sample question and an activity which was prepared based on modeling (Figure 4).

In the activity in Figure 4, a glass bar and a metal bar are started to be heated at the same moment. Here, the students are given information about which bar will be heated first and why this heating takes place in different rates in the bars. In this activity, analogical modeling, which is very effective in terms of turning an abstract event into a concrete event, was used. Degrading the event of the occurrence of heat transmission through the collision of faster moving particles which make up matter with the particles that move slower will make learning and comprehending the concept easier. Activities prepared which are based on this modeling and similar modeling's are used as web sites as well as being used in measurement and assessment dimension (Figure 5).

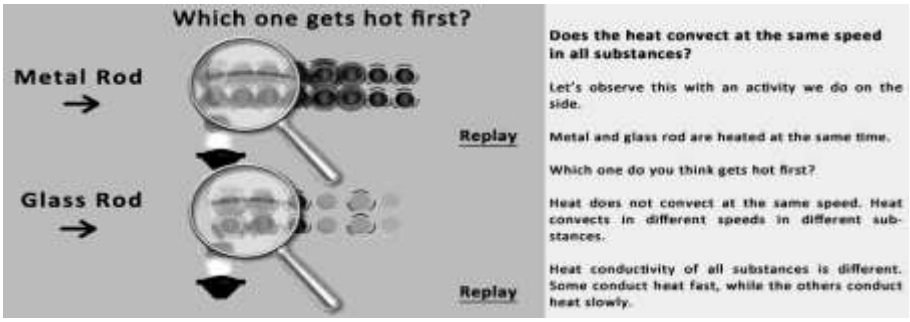

Figure 4. A sample activity

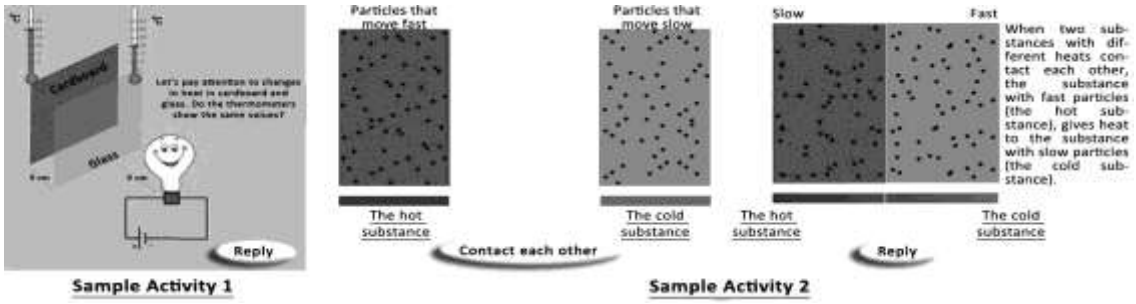

Figure 5. Sample activities for based on modelling

This web-assisted environment which allows the students to work individually can also be used by the teacher during face-to-face education. Especially while teaching abstract concepts, activities based on modeling will provide great convenience to the teacher. Within the classroom, the teacher will give the students a chance to discuss the subject by making them watch the activities while teaching the subject.

4. DISCUSSION

When students' individual differences are taken into consideration, they may need more time or examples under some circumstances. In such circumstances, when the limited hours of classes are considered, only face-to-face education in the classroom cannot meet students' individual needs. Presenting students with individual studying environments outside the classroom will give them an important opportunity for such needs. Positive attitudes of students towards technology are an important detail in designing such environments. Blended learning environments which are prepared based on web-assisted modeling come to the forefront at this point. While designing blended learning environments, when the dimension of teaching and learning are considered, features which may prevent students from misunderstanding should be paid attention to. That is, students' misconceptions or lack of knowledge can be measured by their answers to the questions. When such an assessment is made, the student can immediately be directed to the related activity and made to cover this lack. Our study, which was prepared by taking such needs and situations into consideration, comes to the forefront with its web-assisted teaching and measuring dimension.

Environments based on blended learning approach which uses technology effectively will help students to form their theoretical background. Such environments will help students to get ready to participate in interactive activities such as problem solving and group discussions. Teachers should use web-assisted blended learning environments not only to support their teaching methods but also to help students to form their own learning by using communication technologies [30]. Web-assisted activities should not be interpreted as uploading online lesson materials for students to read. They should function as a tool to help students to present what they learn through web and to develop the design of subjects which are discussed [3]. Based on this perspective, teachers should organize individual and group works based on structuralist approach in their in-class teaching-learning activities.

5. CONCLUSION

Besides the effective characteristics of interactive teaching, it is also possible to meet situations which can be negative in terms of students. The student can need an effect that he/she may realize a misconception or the consequences this misconception during self-learning. Under such a circumstance, web-assisted content that is presented only based on modeling may not be effective. Web-assisted measuring and assessment is important in solving the problems that may arise. Web-assisted alternative measuring and assessment dimension, which is one of the effective sides of this study, has characteristics which may guide the students in such circumstances. It is thought that using such activities in blended learning studies will be useful.

Activities based on modeling which were prepared for this study can also be used by the teacher during face-to-face education within the classroom. When the advantages of face-to-face education in the classroom and web-assisted teaching are assessed together, the design of such environments becomes more important. Such environments can be created in other subjects of science lessons and their influences can be researched. While this study is intended for science lesson, it can also be applied to all other disciplines.

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