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DEVELOPING WEB-ASSISTED SCIENCE MATERIAL BASED ON GUIDED INQUIRY APPROACH: BONES[1]

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ABSTRACT

In Turkey, inquiry-based learning approach and technology integration has started to gain importance in science education programs. This study aimed to develop a web-assisted science material based on guided inquiry approach related to the concept of bones under the systems in our body unit in the 6th grade. For this purpose, case study method was used. The material was prepared in accordance with the inquiry cycle put forward by Llewellyn (2014) and then the material was supported by web technology. Then, the material was applied in 3 schools with 3 teachers and 71 students in their classrooms. Data were collected through observations and interviews with teachers and students. The findings showed that the web-assisted science teaching material was an effective tool. In addition, the material was applied successfully and smoothly and liked by the teachers and students. It is suggested that similar materials can be prepared in science subjects.
Keywords: guided inquiry, web-assisted teaching, secondary school, science education, bones.

REHBERLİ ARAŞTIRMA-SORGULAMA YAKLAŞIMINA UYGUN WEB DESTEKLİ FEN MATERYALİ GELİŞTİRİLMESİ: KEMİKLER

ÖZ

Ülkemizde fen bilimleri öğretim programlarında araştırma-sorgulama yaklaşımı temel alınmaya ve derslerde teknoloji entegrasyonu önem kazanmaya başlamıştır. Bu bağlamda rehberli araştırma-sorgulama yaklaşımına uygun web destekli fen materyali geliştirilmesinin alanyazın açısından önemli olacağı düşünülmektedir. Yapılan çalışmada ortaokul 6. sınıf vücudumuzdaki sistemler ünitesinde yer alan kemik kavramına ilişkin rehberli araştırma-sorgulama yaklaşımına uygun web destekli fen materyali geliştirilmesi amaçlanmıştır. Bu amaçla çalışmada örnek olay yöntemi kullanılmıştır. Çalışmada materyal Llewellyn (2014) tarafından ortaya konan araştırma döngüsünün basamaklarına uygun olarak hazırlanmış ve web ile desteklenerek zenginleştirilmiştir. Ardından materyal 3 okulda 3 öğretmen ve onların sınıflarında 71 altıncı sınıf öğrencisi ile uygulanmıştır. Veriler öğretmen ve öğrenciler ile yapılan görüşmeler ile gözlemler yardımıyla toplanmıştır. Yapılan çalışma sonucunda, rehberli araştırma-sorgulama yaklaşımına uygun web destekli fen öğretim materyalinin etkili bir araç olduğu anlaşılmıştır. Ayrıca materyalin sınıflarda başarılı ve sorunsuz bir şekilde uygulandığı, öğretmen ve öğrenciler tarafından beğenildiği belirlenmiştir. Bu bağlamda fen konularında benzer materyallerin hazırlanabileceği önerisinde bulunulabilir.
Anahtar kelimeler: rehberli araştırma-sorgulama, web destekli öğretim, ortaokul, fen eğitimi, kemikler.

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INTRODUCTION

Students are expected to understand the basic concepts and topics of science courses, as well as have critical thinking, problem solving, creativity, and scientific process skills that they will use throughout their lives. For this purpose, the Ministry of National Education (MoNE) in Turkey made changes in science education programs in 2005, 2013, and 2018. In the current curriculum, inquiry based learning, which is an approach in which the student constructs knowledge in his own mind and is responsible for his own learning, is adopted (MoNE, 2013, 2018).

Inquiry is a way of learning new knowledge and skills for understanding and creating the subject within technological changes (Kuhlthau, 2010). Inquiry based learning is a student-centered learning process in which students learn to inquiry and know the scientific and mathematical ways of inquiry (Maaß & Artigue, 2013). The process of inquiry based learning is similar to the scientific investigations and studies of scientists (Capps & Crawford, 2013). As Kubicek (2005) states, the inquiry process requires understanding of the basic skills of scientific research as well as how scientists work. In this context inquiry based learning, being a constructivist approach, is a method that enables learners to construct concepts by using experiences and verbal interactions (Schmid, 2015). Inquiry based learning begins with an interesting problem or question, the process of inquiry continues with efforts to solve this problem situation and in this experience, scientific research processes are used effectively.

Science educators classified research processes at different levels from structured inquiry to open inquiry (Alake-Tuenter et al., 2012). According to guided inquiry, the approach used in the current study, the teacher gives only the problem and materials to be investigated, and the students apply the appropriate and desired procedures to solve the problem (Colburn, 2000; Colburn, 2004; Nivalainen, Asikainen, & Hirvonen, 2013). In other words, guided inquiry experiments are generally the type of inquiry which does not specify the result but allows students to test the procedures they have determined beforehand (Gaddis & Schoffstall, 2007). In this process, the teacher guides the students in the selection of materials, the information that they will gather and the use of discussion techniques (Çalışkan, 2008).

Guided inquiry is preferred in cases where the teacher determines the inquiry question and the teachers and students decide the application stages together (Akpullukçu & Günay, 2013). In addition, guided inquiry focuses on concept understanding as opposed to concept implementation and uses student discovery through inquiry as a key element of learning (Jin & Bierma, 2011). Guided inquiry is preferred when it is aimed to understand the concepts and when the necessary inquiry processes are decided together with the teacher. In addition, as Tatar (2006) states, when students are not completely ready for conducting their own research, guided inquiry can be applied as an intermediate step in the transition from validation experiments to open inquiry. In this study, guided inquiry was used in parallel to the fact that material was developed for middle school students and that it was difficult for the students to perform all stages of the research themselves. In addition, according to Piaget, sixth grade students are in the middle of the concrete operational stage (Karamustafaoğlu & Kaya, 2013) and it might be difficult to carry out all the research stages themselves, therefore guided inquiry was preferred.

Although inquiry based learning is a process, this process proceeds as a cycle. As Werner (2007) states, students present the problem in this cycle, plan how to solve the problem, collect information, evaluate the quality of resources, analyze, and write the results. The cycle that the current study based on is the inquiry cycle put forward by Llewellyn (2014). This inquiry cycle includes the following steps: inquisition, acquisition, supposition, implementation, summation, and exhibition.

One of the most important changes that need to be made for students to understand science and acquire 21st century skills can be said to be the integration of information and communication technologies (ICT) into the school curriculum. At this point, it can be said that ICT integration is given importance in the 2013 and 2018 science curricula in Turkey (MoNE, 2013, 2018). Thanks to the development and accessibility of the internet, web-assisted learning environments have reached an

important point to complement traditional teaching and support lifelong learning (Melis et al., 2001). In parallel with this situation, it can be said that computer and internet use is effective in inquiry based learning and has an increasing interest in the scientific world (Hill, 2008). As Hakverdi-Can and Sönmez (2012) stated, with the integration of technology into teaching environments, there has been an increase in teachers' use of different applications including internet in inquiry classes. There are many different ways of supporting inquiry with technology such as general information tools (word processor, graphics, tables, etc.), real-time data collection, simulation, multimedia, educational games, cognitive tools, intelligent resources, constructivist environments, virtual communities, information access environments, information construction environments, and computer-assisted teaching-integrated learning systems (Rubin, 1996). In the process of inquiry based learning, students use digital technology to interact with their peers and teachers, collect information, produce and share outcomes (Levy, Aiyegbayo, & Little, 2009). Similarly, technology support and integration at different stages of the inquiry cycle were included in the current study.

It is known that students have difficulty in understanding science subjects in parallel with the fact that science subjects contain abstract concepts (Çepni, Akdeniz, & Keser, 2000; Treagust, 1988). Therefore, it is considered necessary to develop a material for web-assisted guided inquiry approach in parallel with the inquiry approach taken in science curricula in our country. In the web-assisted guided inquiry situations related to daily life take place, students solve existing problems themselves, and inquiry process is supported by technology. In this way, students can structure information throughout the process, as well as have the opportunity to use skills such as creative thinking, analytical thinking, and problem solving. In this context in science education, it can be said that the development of a material for guided inquiry approach will be important both in terms of literature and teachers and students who are practitioners. The main purpose of this study is to provide a sample of web-assisted science material appropriate for the guided inquiry approach and to gain in-depth knowledge about the application process.

METHOD

In the study, the case study method was used in the development and implementation of the activity process. The case study method allows the study of one aspect of the problem being investigated in depth and in a short time (Çepni, 2018). In this study, since it was aimed to present a sample of web-assisted science material appropriate to the guided inquiry approach in science lessons and to investigate in depth how it was applied, it is deemed appropriate to use the case study method.

Participants

The prepared material was applied by three teachers in three different middle schools in Bursa, Turkey. While selecting the schools in the study, physical conditions of schools were taken into consideration as a web-assisted science material was developed and interactive whiteboard and internet were needed during the application process. A total of 71 sixth grade students from three schools participated in the study and the implementation process lasted 3 lesson hours. Ethical committee and all necessary official permissions were obtained for the study.

Data Collection and Analysis

In the study, unstructured interviews were used to obtain the views of teachers and students regarding the application of web-assisted science material in accordance with the guided inquiry approach. The interviews were conducted with students and teachers at the end of the implementation process. In addition, observations were used to gather more detailed information about the implementation process. Observations were made by the first author during the course. Data obtained from interviews and observations were analyzed descriptively (Çepni, 2018).

ACTIVITY IMPLEMENTATION

The material developed and applied in the study was developed in relation to the concept of bone within the scope of “The Support and Movement System” within “The Body Systems” unit within the sixth grade “Living Things and Life” subject area. The material has been prepared in relation to the standard

"6.2.1.1. Explain the structures of support and movement system with examples (a. Bone types are given as short, long and flat without entering the structure of the bones.)" (MoNE, 2018, p.32) in the science curriculum.

Development of the Activity

In the study, a web-assisted science material was developed in accordance with guided inquiry approach. For this purpose, in order to determine the general situation and to identify deficiencies in the teaching process, classroom observations were conducted throughout the bone-related lessons in a school that was not included in the actual study and interviews were conducted with the teachers. These observations took place 1 year prior to the actual study. The observations performed were unstructured and unattended observations and notes were taken during the process. The main purpose of the observation process was to understand where the students were challenged throughout the unit, how the topics were taught with technology support, how technology was used, and where the deficiencies in multimedia objects were. All the observations were analyzed descriptively and the results were focused on the following points: It was determined that the students had difficulty in understanding the tasks of the structures (such as bone membrane, cartilage). During the teaching process, it was seen that these structures were shown on the figure, their function were expressed only orally, and there were no activities, experiments, or animations. In parallel with this situation, it has been decided to create animation for parts of bones (such as bone membrane, hard bone). In the observations, it was observed that technology was included in the lessons but students did not actively use with technology. Although interactive whiteboard was used in the process, it was understood that students were not active. It was thought that interactive animations should be included in the material developed for this study and in this way, it was aimed to increase students' use of technology effectively.

The data obtained from the interviews were analyzed descriptively. The feedback from teachers on this subject is as follows: Teachers generally stated that students have difficulty in learning micro and macro subjects. This is in parallel with the observations and it is understood that the students find it difficult to learn such subjects as bone parts (bone membrane, hard bone, etc.) that they cannot observe. Teachers stated that the students understood the topics in the systems unit in our body separately, but they had problems in expressing the situation as a whole (for example, not being able to make connections to the circulatory system when learning about red bone marrow). For this purpose, it was decided to pay attention to the relationship between the topics in the animations to be developed.

After the observations and interviews, a general framework was established about how to develop the material and how to use multimedia objects (audio, video, visual animations, simulations, etc.). In parallel with this framework, the steps of the inquiry cycle posed by Llewellyn (2014) used in the study were determined:

Inquisition. In this step, a question is posed and students are asked to start their research with this question. For this purpose, open-ended questions, observation results, or experiments could be used. The inquiry process was started with an animated concept cartoon containing an interesting situation in the developed material. The main goal at this stage is to enable the students to look for the answer to the question of inquiry.

Acquisition. At this stage, students brainstorm based on their existing knowledge for possible solutions to the research question. The material developed for this purpose was designed to create a discussion environment with students' brainstorming and extra questions.

Supposition. At this stage, students make predictions about the research results of the problem they plan to solve. Students can express their predictions in the form of hypotheses.

Implementation. Students design and implement activities/ experiments to solve the problem. For this purpose, in the current study two experiments were designed. The aim and materials of the experiment were prepared by the teacher. The students were given worksheets on which the purpose of the experiment and the materials were written but the other sections were blank for the students to complete. The

students were asked to do the experiment in the form of group work.

Summation. Students record and analyze their observations and results during the activity/ experiments. At this stage, if the students experience a contradiction about the solution of the inquiry question, the students are asked to return to the inquisition stage.

Exhibition. Students are asked to share their findings and new information with their teachers and peers in the form of written reports, posters, or oral presentations. The current study also included a section where the lesson was summarized and the students' learning was evaluated through a diagnostic branched tree activity.

After finalizing the guideline material, it was presented to expert opinion. The lesson plans were reviewed by two science educators, one biologist, and two science teachers. Biology experts examined whether the concepts were used correctly and science teachers examined the material in terms of the scope of the subject. The experts made some minor adjustments to the lesson plans. Two experts, who are science educators, examined the materials, especially in terms of whether there were web-assisted science materials suitable for the guided inquiry approach or not. The experts in the field of science education proposed changes in the question in the inquisition step and suggested that the question is revised to be more thought-provoking and connected with daily life. In line with these suggestions, the researchers reconstructed the question. After this feedback, the material was finalized. Then, in parallel with the lesson plans, materials were prepared for the pilot application.

Pilot Application

In this study, the pilot application of the material was carried out by one teacher. At the end of the application, the teacher was interviewed about the process. In the interview, the teacher stated that the concept cartoons encouraged the students to think scientifically and it was an effective tool for teaching. As a common idea of the researcher and the teacher, it was decided that it would be more effective to transform the concept cartoon into animation and the concept cartoon in the inquisition step was converted into an animated concept cartoon. The teacher also stated that the experiments included in the application were good, however, the lesson would be more organized if a worksheet was used. Aligned with this suggestion, it was decided to prepare worksheets for the experiments. As a result of the pilot application, the material was finalized in parallel with the suggestions from the teacher. The final version of the material was then transferred to the web site. In this way, interactive whiteboard, animation, and animated concept cartoons were included in the material and the material was enriched with information and communication technologies. The final version of the material can be found at http://www.ummuhanormanci.com/zkitap/index.php?do=destekvehareket1&ders=1.

Application

The lesson lasted 3 hours. The application is described below using the steps of the research cycle.

Inquisition. In the inquisition step, the lesson started with an animated concept cartoon (Figure 1). In the animation, two people fall off the couch and four people (characters) express their ideas about this process. The question is "Do you think that the bones of children or the elderly will break more easily? Why?" The students were asked which character they agreed with in the cartoon, and the reasons were questioned to create a discussion environment.

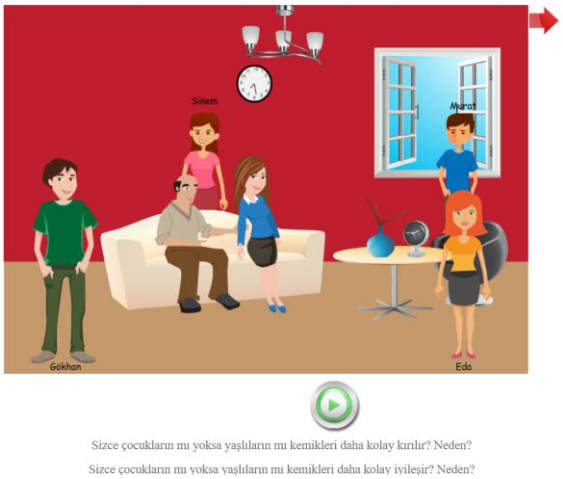

Figure 1. Animated Concept Cartoon

An extra question to ask in the discussion environment could be "Do you think the bones of children or the elderly heal easier? Why?"

The aim is to enable the students to participate in the discussion. It is necessary to avoid directing the answers given by the students such as right or wrong. After having a rich discussion, the lesson continued with sharing the correct answer with the students on the web site (shown in green in Figure 2). However, there is no extra explanation for the reason for the answer. In the bubbles in Figure 2 the following expressions were written: 1. Both the boy and his grandfather broke their legs. 2. I think neither of them has a broken leg. 3. I think the child's leg was broken; his grandfather's leg was not broken. 4. Really! I think the child's leg was not broken; his grandfather's leg was broken. The last expression is the correct response.

Figure 2. Animated Concept Cartoon Answer

In this process, it was seen that the students actively participated in the lesson and liked the animated concept cartoon. The students tried to express with which character they agreed and their reasons. Although the students were not very successful in expressing their opinions directly, it was understood that they were more effective in agreeing with the existing characters. At this point, it was understood that the students completed the inquisition step successfully. However, at this stage, it was observed that some teachers gave directive feedback to the answers given by the students. In this context, it can be said that this stage is a step that should be taken into consideration for teachers. In addition, one of the most important points at this stage is the preparation of the inquiry question. When developing material in different units / subjects, care must be taken to ensure that the problem is appropriate for research. The inquiry question developed in the material was liked by the teachers and it was stated that it was related to daily life. At the end of the discussion, the main problem question "Why the bones of children are broken more difficult and the bones of the elderly are broken more quickly" is directed to the students. The students were told that they would investigate the answer to this question throughout the lesson.

Acquisition. The teacher asked questions about what the students know related to the support and movement system, especially about the inquiry question. The aim is to remind students of the subjects learned in previous classes and to question what the students know. For this purpose, questions such as "which parts of the bones are formed?", "Are all of our bones the same?" were asked. In this process, the students answered the questions showing that they remembered the subject and this stage was continued effectively. It can be said that this stage is also an easily applicable step for the teacher. Because teachers often perform this stage in their classes in order to remind past subjects or establish relationships between subjects.

Supposition. The aim is to help students predict the answer of the inquiry question based on their prior knowledge and ideas. One prediction that can be said here is that "The bones of children are more durable and the bones of the elderly are more deformed and broken or heal more quickly." Predictions were taken from the students at this stage. Some examples of the predictions taken in the application were as follows: "The bones of the elderly are broken more quickly because they are larger.", "The bones of the elderly are broken more quickly because they are used more." Prediction or hypothesis is not established by the teacher, students are expected to establish them. However, if the students do not come up with a prediction for a certain period of time, the teacher can form a common prediction/ hypothesis by guiding the students. It was seen that the students put forward ideas in the implementation but had difficulty in expressing these ideas as hypothesis or prediction sentences. However, with the help of the teacher, prediction sentences were established. Then, the prediction sentences that the whole class will work for a common purpose were expressed by the students. At this stage, one of the points to be considered is to make predictions to be directed to the targeted experiment. When different predictions or

hypotheses come from the students, the teacher is required to effectively guide the students in order to gather the subject. In this context, it is expected that the teacher should have a hypothesis/ prediction sentence in mind.

Implementation. First of all, the bone examination experiment was carried out by the students to understand the parts of the bones. For this purpose, the teacher asked the question "Which parts do you think the bones consist of?" The students formed groups in order to find an answer to this question and the worksheet (Appendix 1) is distributed.

Figure 3. Section from Experiment 1

Students performed the experiment by following the instructions in the worksheet. The worksheet contains the purpose of the experiment, the materials and a small part of the procedure. Students are expected to write the name of the experiment, its procedure, observations, predictions, and results. In this process, the students examine the bones and try to find out what is happening inside and outside the bone. In the experiment it was observed that the students completed the worksheet effectively but they wrote very short sentences. It was found that the students usually expressed the necessary parts with longer sentences verbally, and when it came to write, they formed shorter sentences. During the implementation process, the results of students, which they reached, were discussed in the class. In this way, the class reached a conclusion about what the parts of the bones are.

It was observed that the students successfully performed the experiment in the implementation. However, in this process, it was noticed that there were times when the students did not pay attention to the topic and talked among themselves in group experiments. This situation was solved by the teacher's small interventions. However, an important point to be noticed here is that this situation was observed much less in the classroom of the teacher who used the experiments and activities more in his class. In this context, it can be said that students will get used to this process as experiments and activities are included. In the implementation, no extra difficulties were observed during the experiment process and the teacher completed the experiments appropriately.

The lesson then focused on which parts can be effective for the strength of the bones, and therefore the functions of the parts of the bone. In this section, the students were allowed to draw parts of the bone in parallel with their investigations and write what they know about their tasks. The answers received from the students were reflected on the board. The animation (Figure 4) is then displayed to illustrate the parts of the bones and their functions.

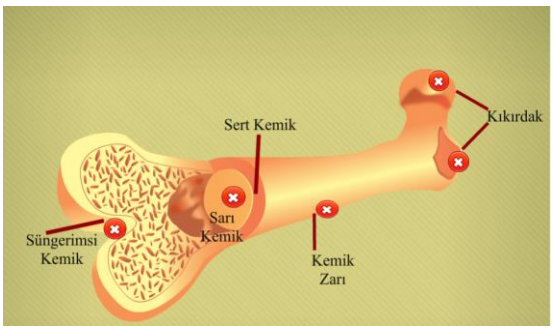

Figure 4. Bone Animation Section 1

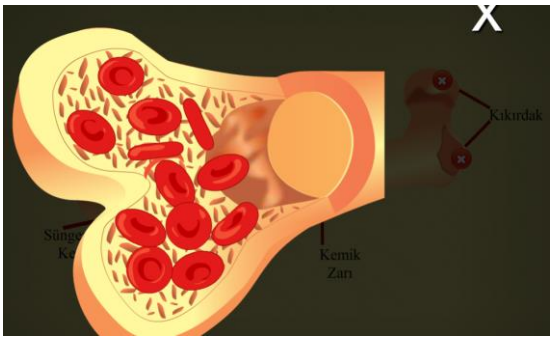

Figure 5. Bone Animation Section 2

While watching the animation, it was stopped where necessary, questions were asked to the students to further discuss the concepts. For example, the question “What do you know about the bone membrane and what is its duty?” was asked. The students expressed their opinions on this subject. Then the teacher

clicked on that part to show the animation about the task of the bone membrane. In this way, all parts were emphasized and the animation related to their tasks (Figure 5) was watched. Cartilage was also included in the discussions in this section.

In this stage, it was understood that the students liked the animations very much and their interest in the course increased during this process. In addition, thanks to the animations, teachers experienced ease in the process. In other units, if teachers want to include animations, they can use ready-made animations in the web environment. However, if they cannot find the animation they want, they can make the animation with the animation programs which have very simple languages. In this context, it can be said that the preparation of this stage is also feasible.

Then, to show the effect of calcium, one of the substances that give hardness to the bones, a bone holding test was performed in the vinegar (Figure 6) which is the continuation of the same experiment (Appendix 1). Here, the students discussed the rigid and elastic structures in the bone.

Figure 6. Section from Experiment 2

At this stage, the reason for the stretching of the bones was emphasized. Observations and comments of the students were taken related to the case. In this way, it was discussed which parts are effective in the breaking or healing process of bones and where cartilage tissue is located. Then the teacher asked the question whether all bones are the same or not. Another question that could be asked is if all our bones are broken or healed in the same way. In this way, the transition to the bone types in our body was made. What the students know about long-short and flat bone was learned. The process was continued interactively through the animation of the bone types (Figure 7). There are different bones in the animation, students were asked to classify them as flat-short-long bone. In this animation, the students performed the activity themselves on the interactive whiteboard. It was observed that even the students who did not regularly participate in the lessons too much tried to be active in this lesson. At this point, it can be said that interactive animations increase students' interest and participation.

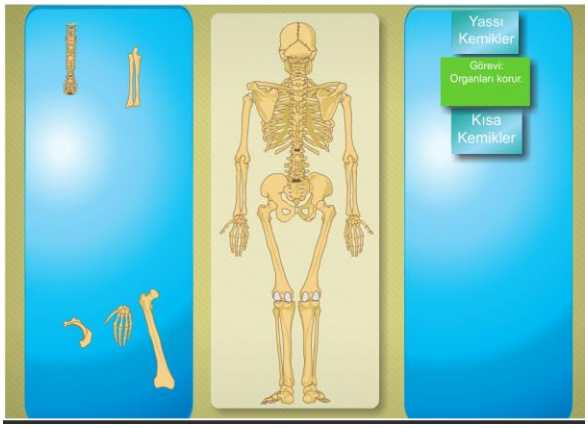

Figure 7. Bone Types Animation

Summation. This part was carried out at the end of both experiments. The students were asked to make a general comment in parallel with the inquiry question. In the current implementation, it was observed that the students' verbal expressions were good and they could make comments. However, if students find it difficult to comment in an implementation of this activity, the teacher can support the students' interpretation process with example expressions.

Exhibition. The students presented their data and results by identifying a spokesperson from each group. The opinions of each group were taken and then the teacher and the students reached a conclusion. At this stage, it is important to pay attention to the fact that the spokesperson is not always the same person. It can be stated that in the current implementation, the presentation skills of the students were good. It was observed that the students were excited during the process, but considering that this situation would disappear in time, it can be said that it is important for in terms of the communication skills of the students. After the students' presentations, the evaluation activity was started. The diagnostic branching tree

assessment activity (Figure 8) was used for bone parts and varieties. This activity was appreciated by the students. As a result of the applications, it was observed that the students more liked the animations in which they were active. It is thought that this situation should be taken into consideration in the applications to be made in future. In addition, it can be said that it would be appropriate to use alternative measurement and evaluation tools in this process.

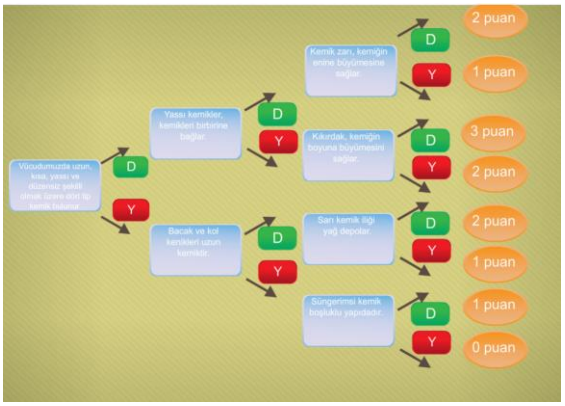

Figure 8. Evaluation Activity

Finally, the inquiry question was asked again and the answers were received after all experiments/processes. In this case, they understood the structures that give the bone stiffness and which (child/ elderly) bone will break and heal more quickly. They also noticed that there were three types of bones in our bodies and that each one had a different structure. This part should be considered in the materials to be designed in future. It was appreciated by the teachers and students that the inquiry question was re-visited again with the answers to the question. It is thought that this stage can be added to all similar materials. Figure 9 includes the following answers: 1. The bones of the elderly are more easily broken and healed more difficult. 2. This is parallel to the changes in the structure of the bones and the structures that give the bone stiffness. 3. There are three types of bones in our body and there are differences in their structures.

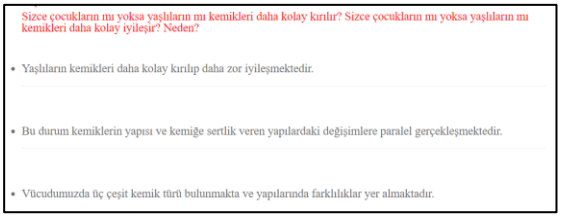

Figure 9. Inquiry Question Answers

FINDINGS

As a result of the study, web-assisted science material suitable for guided inquiry approach was applied effectively. It can be said that one of the most difficult parts during the application period is to create a discussion environment. In both the inquiry question and the questions asked in the animations, it can be stated that the teacher tried to direct the correct answer or give clues about the answer. The other difficult part is the establishment of hypothesis. Considering that conjecturing a hypothesis is a high-level scientific process skill, it is natural that students have difficulty in this part. In general, it is understood that all processes were effective in the application of the material.

In the study, the students expressed a positive opinion about the web-assisted science material in accordance with the guided inquiry approach. The students stated that the animated concept cartoons were interesting, that they put themselves in character and that they were very happy when their views came true. In addition, the students stated that the interactive whiteboard, animation, and inquiry questions were good and they liked them very much. In addition, the students stated that inquiry questions, videos and experiments helped them to understand better. A student's opinion on this subject is as follows: “It helped me learn, I learned better. I understood better by seeing its pictures and watching its video.” In addition, the students stated that the material contributed to the love of science lesson. A student expressed his/her opinion “I love the science lessons now, and I look forward to having science lessons.”

The analysis of the data obtained from the teachers revealed that the teachers found the prepared material useful. Teacher A stated that the prepared material in the systems unit of the science course is very useful: “It was very useful...Ease of use is very comfortable. You know, there's instructions and everything. And there is no problem.” In addition, the teachers stated that the material improves the students' conceptual understanding, group work, entrepreneurship skills, interest in the lesson, and the skills to relate the lesson to daily life. An example of this situation is: “It certainly has a positive effect. It is very useful for learning. Besides, they have carried the information they have learned to daily life.” Teacher A also

added an extra comment regarding the inquiry question and said: "The questions in the introductory part were very well thought out questions. What I liked the most is the introductory questions." As a result, it can be said that the teachers used the materials effectively, they liked them and the materials had positive effects on students.

The teachers and students generally expressed positive opinions about the material and made some suggestions about the process. Some of the students requested that the animations in the educational sites, especially three-dimensional animations, take part in the application process. In the feedback from the teachers, it was stated that sound should be added to the animation and there should be a test besides the evaluation made at the end of the subject. Additionally, a teacher stated that the web site could be developed into a forum-style site that would increase the interaction of teachers and students. The developed material (on the web site) includes the purpose and the materials needed for the experiments, and the subsequent web page contains images or information about the result. However, there is no information about the construction process of the experiment. Although worksheets were used for this purpose, it was understood during the implementation period that there were deficiencies on the web site.

DISCUSSION, CONCLUSIONS and SUGGESTIONS

As a result of the study, it was understood that the web-assisted science material which is suitable for guided inquiry approach was used in the teaching process effectively. Especially interactive whiteboard, animations, and inquiry questions were appreciated by the participants. In this context, it can be said that web-assisted inquiry approach can be used in science education and similar materials related to other units can be prepared.

In the study, it was concluded that the students expressed positive opinions about the web-assisted science material in accordance with the guided inquiry approach. The students stated that they liked the features such as interactive whiteboard, animations, inquiry questions, interactive objects, and web site. In science education, it is stated in the literature that web/ technology assisted inquiry-based learning is effective (Sing & Chew, 2009; Türkmen, 2009). In addition, in the study conducted by Zhang (2005), most of the participants in the interactive e-learning groups expressed that they liked the interaction and flexibility features provided by the system. It can be said that interactive whiteboards increase students' interest in the lesson. It is stated in the literature that the lessons become more fun/ enjoyable thanks to interactive whiteboard applications (Hall & Higgins, 2005). In the current study, the students stated that they understood the subject better, could relate it to daily life and learned deeply due to the material. In this context, it can be said that the applied material was effective and had positive effects on the students.

The findings showed that the material was liked and found useful by the teachers. The main reason for this situation was expressed as the material is a regular, systematic, and gradual system aligned with the science standards. Although there are many materials, animations, videos, etc. related to science subjects in the literature, these are generally accessed by pressing different buttons within the same web site. In this study, it was understood that the material was liked by the teachers in parallel with the fact that it was a step by step structure and on a single page. In this context, it can be suggested that it would be advantageous for teachers to make similar materials.

In the developed material (the web site), the stages of the experiment are not included in the web page in the section for the experiments. However, it is not possible for students to know this process when some experiments cannot be performed due to lack of material or time. In order to eliminate this situation, it may be suggested that the experiment videos are added to the web site.

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Appendix 1
Experiment Worksheet

Experimenters:

Experiment No: 1

Name of the Experiment: (What do you think the name should be?)

Purpose of the Experiment: To examine the external and internal structure of the long bone

Materials to be Used: 2 uncooked chicken bones separated from meat, scalpel, magnifying glass, vinegar, 2 jars.





Predictions:

Experimental Procedure:

Examine the upper surface of the bone

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Observations:

Results: