

STUDENT AND TEACHER VIEWS ON A WEB-BASED AND AUGMENTED REALITY SUPPORTED ACTIVE LEARNING SYSTEM: A CASE STUDY

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Abstract

This study aims to get feedback on a web-based and augmented reality supported active learning system (ARGEİLİM) that aims to improve the scientific process skills of 6th grade students. In this context, the opinions of six students and a teacher who participated in a pilot study were taken. Qualitative data collection tools were used in the research, and the model of the research is case study. Semi-structured interview questions were prepared separately for students and teachers. The data obtained from the interview questions were evaluated under five sub-headings: the effect of the developed system on learning, the evaluation method, the use of the system, the design of the system, the activities and the gamification elements. Both students and teachers stated that ARGEİLİM had a positive effect on learning. They found it sufficient to use it as an assessment tool. In addition to these, they also expressed positive opinions in terms of design, ease of use, effectiveness and gamification. In addition, it was concluded that the students found the lesson taught with ARGEİLİM more fun and effective.

Keywords: web portal, augmented reality, science process skills, interactive learning

1. INTRODUCTION

People have faced various problems throughout their lives, have tried to cope with them and have continued their lives in this direction (Bakioğlu & Çevik 2020). Individuals need to be active in the education process so that they can choose different ways against the problems they face, be open to innovations and gain skills (Kuzey 2013). The basic skills that enable students to be active and responsible for their own learning, to know research methods and tools, and to progress on the scientific path are defined as scientific process skills (Çepni, Ayas, Johnson & Turgut 1997). "Scientific Process Skills" have been added to today's science curriculum to observe, measure, classify, record data, form hypotheses, use data, create models, change variables, control variables, and conduct experiments (MEB 2018). Along with this curriculum, students are expected to record the developments throughout the process, numerical and non-numerical data, and present these data (MEB 2018). It can be said that teaching environments are an important factor in students' learning and use of these skills. Web environments where students can perform various experiments and activities can enable students to use these skills more often and whenever they want. In this case, it can be said that the skills they use frequently can improve.

The pandemic period we have been through has shown us the importance of web-based learning portals because the students had to take an education away from the laboratories at school and tried to perform various experiments with the materials they could find at home. They did not fully realize the achievements of the subjects they learned, experiments and activities related to the subject. We can say that web-based education is an alternative that can be used remotely, especially in cases where formal education cannot be provided face-to-face, such as natural disasters and epidemics. Web-based education (WBE), which is a distance education method, is defined as an education program that is carried out by making use of computer and internet technologies (Erümit 2013). In addition, it can be said that taking an active role in the learning processes of students working with web-based learning systems can contribute positively to the development of scientific process skills.

In order to activate students working on web-based learning systems, to increase their willingness to learn and to ensure their continuity, web content should be presented in an interactive way. Research

has revealed that presenting content to students in an interactive way in a web-based learning system increases meaningful learning (Woo & Reeves 2007; Su et al., 2005; Chang 2001). However, many developed web-based learning environments do not allow students to interact with learning content. Especially the last pandemic has shown us that web-based learning systems were not very useful for students who do not have self-learning skills. During this period, students could not carry out many experimental or practical activities that should be done in school laboratories in their working environments at home. Studies carried out during this period revealed that students interact poorly with learning content during online lessons during the pandemic period, which negatively affects learning (Jena 2020; Mukhtar et al., 2020).

Innovative technologies that can provide computer-human interaction can be used in web-based learning systems for students to take an active role in learning activities. Augmented reality, one of these technologies, has unique features that can provide computer and human interaction (Billingham, Clark & Lee 2015). Augmented reality technology has unique features that allow the student to interact with the learning content. AR is a technology that simultaneously locates digital information on real-world objects (Azuma et al., 2001). AR simulates real learning scenarios, allowing students to perceive learning objects as if they were real. Augmented reality can present virtual content in a real physical environment to obtain information about real objects (Türker 2021). Thanks to this technology, experiments that are difficult, costly or impossible to perform in educational environments can be easily experienced in the classroom environment (Atasoy, Tosik-Günve & Kocaman-Karaoğlu 2017). Many studies suggest that learning environments can be supported by Augmented reality technology to ensure students' permanent learning in education (Türel and Bayer, 2020). The use of this technology, especially as a supporting tool for Web Based Learning Systems, may allow students to do many experimental activities in their own study environment.

In this context, an augmented reality supported and web-based learning system (ARGEİLİM) has been developed with the study. ARGEİLİM active learning system offers different and unique lesson plans in accordance with the 5E Teaching Model, covering the first four unit acquisitions of the secondary school sixth grade science curriculum, aiming to develop students' scientific process skills through interactive ways. These lesson plans, which are supported by various technologies such as augmented reality technology, simulation and animation, and suitable for the 5E teaching model, offer activities and content to improve students' scientific process skills. This model consists of 5 cognitive stages. These; engaging, exploring, explaining, elaborating and evaluating (Duran & Duran 2004). The Engaging phase of the cycle aims to assess students' prior knowledge or identify possible misconceptions. The Explore phase is encouraged to apply process skills such as observing, questioning, researching, testing predictions, forming hypotheses, and communicating with other peers. The Explanation phase allows students to ask questions about the concepts they discovered and these concepts (Duran & Duran 2004). During the Elaboration phase, students are encouraged to design new experiments or models based on new skills or concepts they have acquired. Evaluation is the stage at which both formal and informal evaluation approaches are presented. Various fictional stories given with the first stage of the 5E lesson plan in ARGEİLİM enable students to find themselves among the heroes of the fairy tale they read. In order to solve a scientific problem given with a story, the student establishes a connection with the main character, establishes hypotheses, conducts experiments and tries to learn the subject in depth by searching for solutions (Figure 1).

As ARGEİLİM active learning system presents the flow of 5E lesson plans in a narrative form, it attracts students' attention and enables them to maintain their curiosity until the last stage of 5E learning steps. It can be said that the most important factor supporting this continuity and active participation is augmented reality activities. In this context, while students learn theoretical subjects in a fun way in the web-based learning environment, they can also do experimental activities with Augmented Reality technology as in their own school (Figure 2). While doing this, they can use their tablets or mobile devices.



Fig. 1. An image of a fictional story given with the first phase of the 5E lesson plan in ARGEBİLİM.

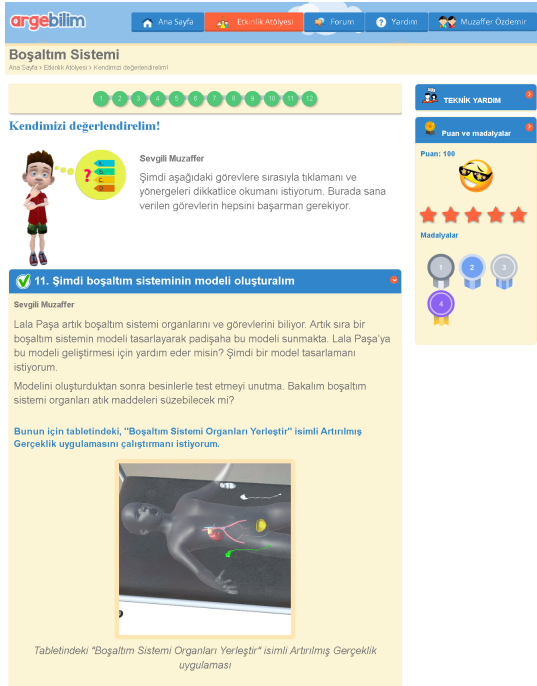


Fig. 2. A simulation that allows students to observe the Circulatory System with AR at ARGEBİLİM. In the figure on the left, the theoretical content presented to the student in the web-based learning system, and on the screen on the right, the AR simulation (drag and drop interactive) that the student should apply about this content is given.

Learning content should support students' self-directed learning skills and be delivered to them in an interactive way (Brookfield, 2009). In addition, there is a need for new learning environments in order for the experimental or applied activities carried out at school to be carried out in out-of-school studying environments. When the literature was examined, there was no active learning system supported by web-based and augmented reality to help students improve their scientific process skills. In this context, in this study, a web-based learning approach supported by Augmented Reality technology was presented in order to improve students' scientific process skills, and it was presented to the opinions of teachers and students within the scope of a pilot study. The aims of this web-based learning system are to enable the student to interact with the learning content, to support the development of self-directed learning skills, to enable both theoretical and experimental activities to be carried out in out-of-school learning environments, to record learning data and to facilitate the evaluation of these data in the learning process.

2. MATERIALS AND METHODS

2.1. Materials

ARGEİLİM is a learning system that allows students to interact with the learning content with the help of AR supported simulations and presents the theoretical content in a web-based interactive environment. There are 14 activities in ARGEİLİM that meet the secondary school 6th grade science curriculum. There are 120 AR-based simulations prepared for these activities. Php/Mysql and javascript programs were used in the development of the web-based components of this system. Mobile-based AR applications were developed in Unity program with the help of Vuforia asset. In addition, these AR applications have been transformed into interactive simulations with the help of C# programming language. The learning portal of ARGEİLİM can be accessed at <http://argebilim.com/webportal>. Students and teachers can log in to ARGEİLİM with their user information (Figure 3). In this way, the interaction of the students with the interactive content and the learning process can be recorded. Teachers, on the other hand, can monitor all learning activities of students and give them feedback.

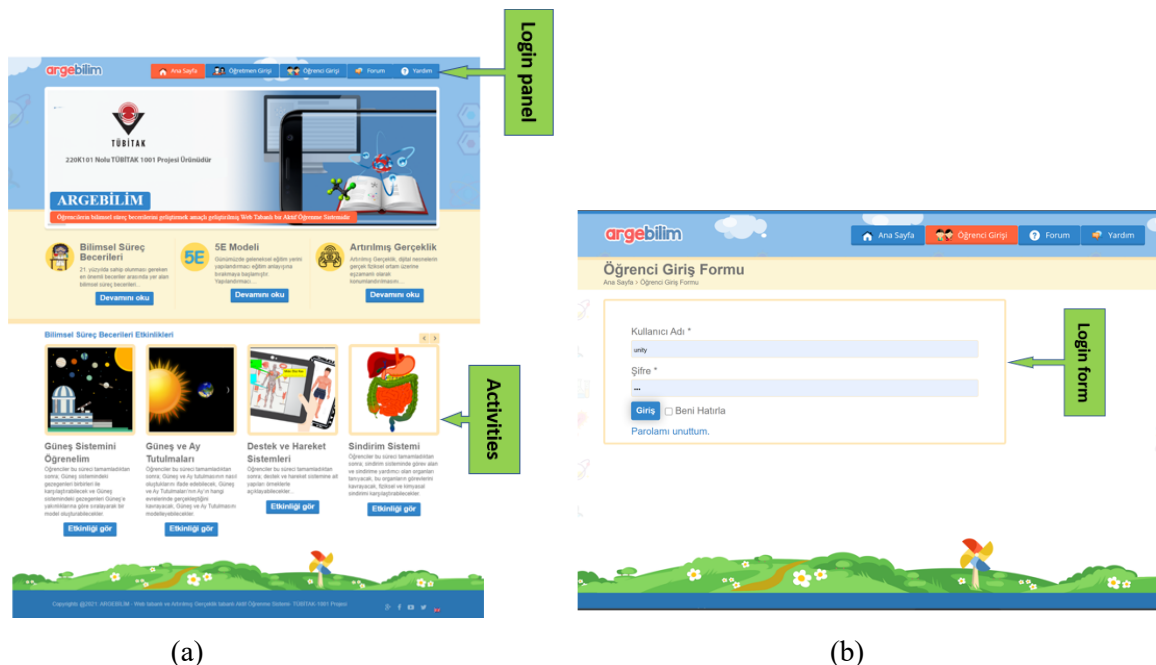


Fig. 3. (a) Welcome screen for students and teachers and (b) Login screen of ARGEİLİM.

After logging into ARGEİLİM, students are directed to a page where they can see the activities they need to do (Figure 4). On the activities page, the achievements of the activity and the percentage of completion of the tasks in this activity are shown to the student. In addition, students can see and choose other activities they need to do on the same page.

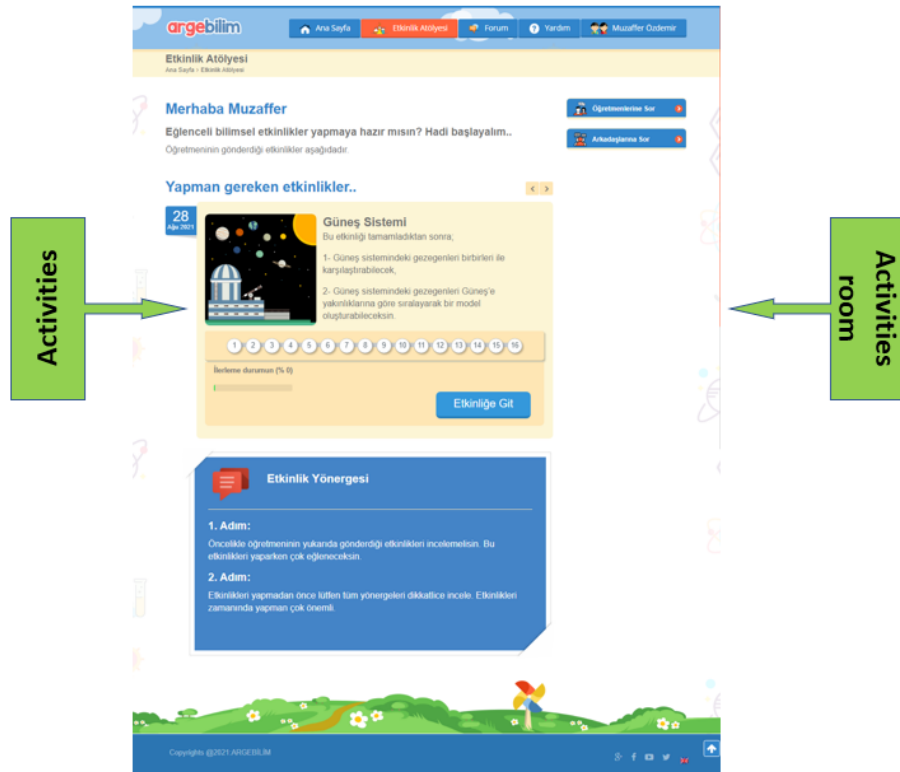


Fig. 4. Learning outcomes related to the topics to be explained on the welcome screen of ARGEBİLİM, buttons leading to the tasks in the activity, and the percentage of completion of the activity.

After the student chooses an activity, they are directed to the first stage of the 5E Teaching Model. tasks in these stages are initially closed (Figure 5). Students cannot move on to the next task after completing the previous task. In other words, when the previous task is completed, the next task is unlocked. Tasks completed by the student are marked as completed.

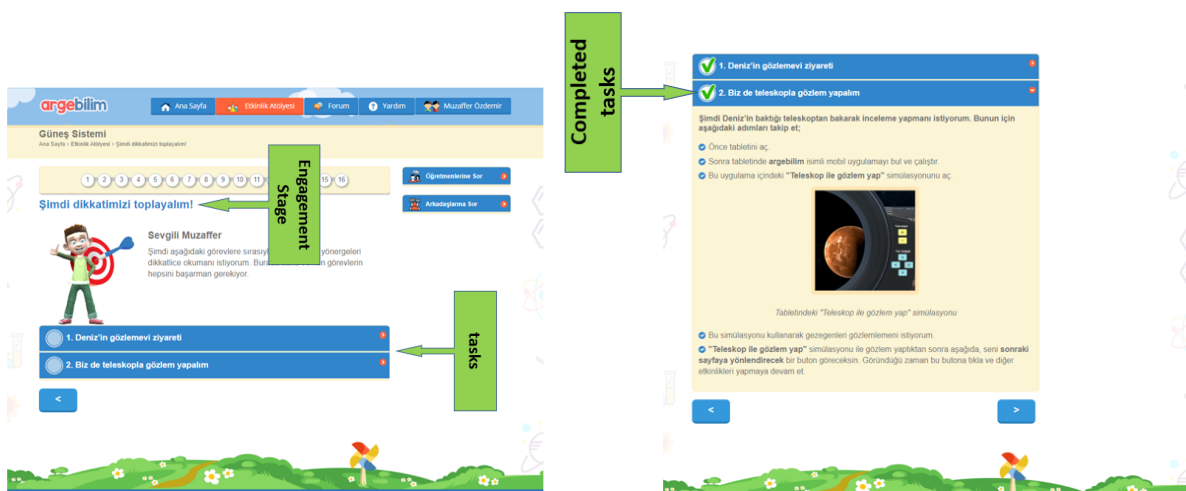


Fig. 5. The content presented to the student in ARGEBİLİM with the first stage (Engagement) of the 5E Teaching Model.

Students who learn theoretical knowledge through ARGEBİLİM's web portal can perform experiments in activities with AR technology with the help of their tablets or mobile devices. Students who learn theoretical knowledge through ARGEBİLİM's web portal can perform experiments in activities with AR technology with the help of their tablets or mobile devices.

ARGEBİLİM can record AR activities carried out with the help of mobile devices such as tablets and report them for teachers' evaluation (Figure 6). Whether the students perform the tasks assigned to them or not can be followed both by themselves and by the teachers. If AR activities/experiments are not performed in ARGEBİLİM, the task associated with this activity is marked as incomplete. In this case, the next task will not be shown to the student.

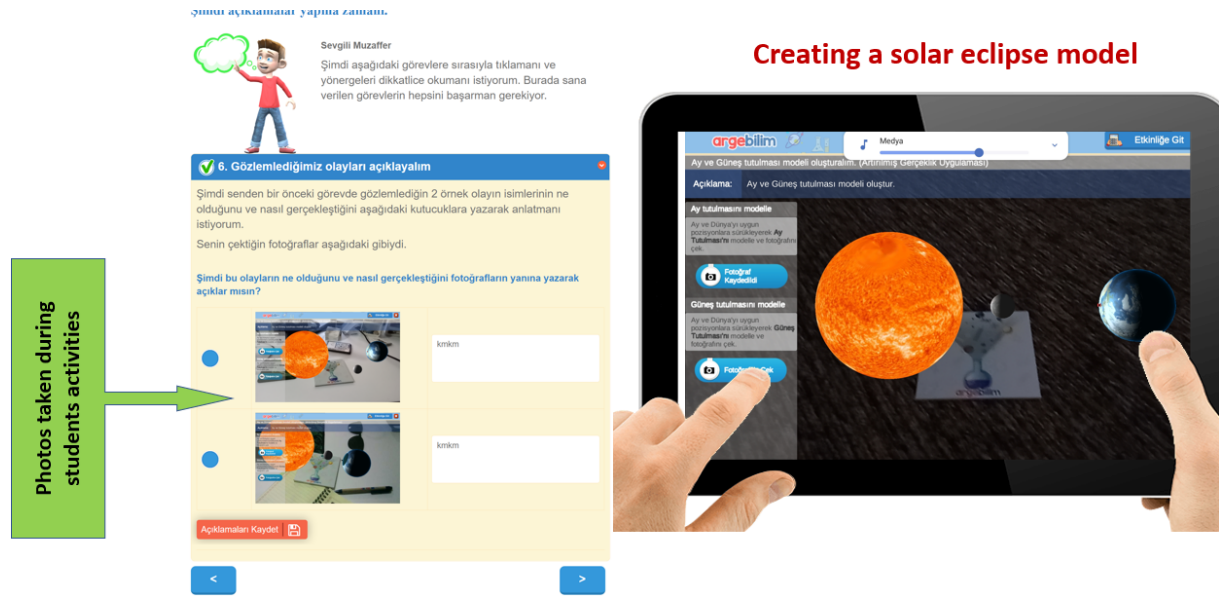


Fig. 6. Photos taken by students in an activity they did with AR at ARGEBİLİM. To complete this task, students are required to make scientific explanations about the photographs.

2.2. Method

In the research, case study, one of the qualitative research methods, was preferred in order to examine the experiences of teachers and students on ARGEBİLİM (Niglas 2010; Creswell and Clark 2017). A pilot study was conducted by applying ARGEBİLİM for 14 weeks to 6th grade students in a secondary school in Turkey in the fall semester of the 2022-2023 academic year. The teacher assigned an activity to the students every week through the web portal of ARGEBİLİM. After the application, the opinions of 6 students and a teacher were taken with the help of a semi-structured interview form developed and validated by the researchers.

2.3. Participants

The study group of the research consists of a total of six students and a teacher. Within the scope of the ethics of the research on volunteerism, the teachers and students participating in the research were given the necessary information about the purpose of the research and the voluntary consent text was prepared and included in the study. Interviewed students, according to the rate of completing the activities; The students who completed the activities were classified as "High", the students who completed half of the activities were classified as "Medium" and the students who completed very little of the activities were classified as "Low". In order to protect personal data and ensure impartiality in the analysis process of the research, 2 students from each of the 3 groups participating in the research were selected and students defined as "High" were given HS code, students defined as "Medium" were given MS code, students

defined as "Low" were given LS code, and their answers were given according to the findings of the study given in the section respectively. The answers of the teacher participating in the research were given with the letter code T.

2.4. Data Collection Tool

A semi-structured interview form consisting of 7 questions for 6th grade students and 8 questions for the teacher was prepared, and necessary improvements were made on these questions by consulting expert opinions. Care has been taken to ensure that the interview form questions prepared in this direction do not contain more than one judgment, and that they are clear and understandable. The final form was given to the participants about the importance, content and scope of the interview form and how it should be filled, and it was applied to the sample group of the research. The interview form application process was prepared to take an average of 30 minutes.

2.5. Data Analysis

The data obtained from the semi-structured interview form consisting of 7 questions for 6th grade students and 8 questions for the teacher were explained with descriptive content analysis. Data obtained from interview questions; The effect of the developed system on learning was evaluated under 5 sub-headings: evaluation system, system usage, system design, activities and gamification.

3. RESULTS

All of the students who participated in the research stated that the ARGEBİLİM system affected their learning positively, the course taught with this system provided more effective learning than other courses, and they found the ARGEBİLİM learning portal remarkable because it provided a different learning environment from the others. Similarly, the teacher stated that they observed that the interest, success, motivation and positive attitudes of the students who used the ARGEBİLİM system towards the science course increased. The students who participated in the research stated that the ARGEBİLİM system made it easier for them to learn the subjects they had difficulty in learning, the lessons taught with this system had a great effect on their learning, and the system shortened the learning time. They expressed a positive opinion about the evaluation system of learning. All participants agree that the developed web-based active learning system is effective in reinforcing learning.

3.1. Findings Obtained From Students

The question "Do you think the ARGEBİLİM learning system supports your learning? How do you think you support/disagree?" Some of the answers of the participating students to the question are as follows.

(HS1): *"Yes, it supports. My exams are very good, it contributes to my exams and makes me more successful. I'm bored while solving from the test book, I can't solve it much, but here I like it more because it's like a game and I want to do more activities, it supports this way."*

(MS2): *"Yes, I think because like my friend, I was bored while taking tests, but I am not bored with it anymore because it makes it so much more fun with 3D views."*

(LS1): *"Yes, because when I solve it in the book, I get bored after an hour and a half, otherwise I learn a little better because it has 3D, I can do it for two or three more hours without getting bored. It supports it in a good way, for example, we try to solve it by just reading from the book, but there is 3D, it becomes fun and can tell the truth when you get it wrong."*

"Could you have achieved the same success without this system? Can you explain your thinking?" Some of the students' answers to the question are as follows.

(HS1): *"So, I think I couldn't, because as I said, I was getting bored more while solving from test books and I was not solving it, and then my success level was decreasing. But as I said now, because it is fun, it affects me more and makes me study more."*

(MS2): *"I probably couldn't because sometimes I get bored while taking tests. This is causing my grades to drop."*

(LS1): *"I do not think so. Because I both explain a subject that I do not understand there and I see it in 3D there and I can solve more questions there."*

"You used the ARGEBİLİM learning system in science class. Can you share your experience with this system with us?" Some of the answers of the participating students to the question are as follows.

(HS2): *"At first, I did the activities, then there is a card reading thing, we did them, then there is something like a form, we filled it out, then we moved on to other activities and there is a boy named Deniz, we read his information that way."*

(MS2): *"My experiences I looked at 3D models, I made explanations, I did sorting, etc. These really affected my learning."*

(LS1): *"When I started the new application, I couldn't do it at first, then I got used to it. At home, I tried to solve it in my spare time."*

"Can you share with me your experience about the ease of use of the system?" Some of the answers of the participating students to the question are as follows.

(HS2): *"It was easy, but we couldn't move on to other activities like this for a while, that thing happened, but other than that, there was no problem. In general, I think it was appropriate for our level."*

(MS1): *"It was easy, some of my friends had problems while I was going to such sections, but I didn't."*

(LS1): *"It was easy because I like to study from my own tablet too, it's easy because I like it."*

"How did this system affect your learning of science subjects?" Some of the answers of the participating students to the question are as follows.

(HS1): *"I couldn't do the small and big blood circulation, I couldn't understand it very much, but we could see it in three dimensions with simulations and AR card. This made it very easy for me to learn the subject."*

(MS1): *"For example, I did not understand the respiratory system, I had such moments when I made the respiratory system from ARGEBİLİM. I made respiratory system questions in an easier way in Quiz about the excretory system."*

(LS1): *"It worked well because you can enter the subject that I could not do, for example, the subject that we did not go through, or you can enter there and get preliminary information. 3D has had a huge impact on the systems in our bodies. I did a lot of things there, I checked them again and I did it again, because there are games like puzzles."*

"What are the positive and negative aspects of the course taught with this system when compared to other courses?" Some of the answers of the participating students to the question are as follows.

(HS2): *"The positive aspects are more fun and more like this, for example, I have a lot of fun in this lesson while I get bored in other lessons. Thanks to this ARGEBİLİM, I do more by doing games and activities. Even though the negative aspects are ARGEBİLİM, I still have a little difficulty."*

(MS1): *"It doesn't have that many negative aspects, I don't get bored because the positive aspects are fun. Also, I like to study with tablets like this, I mean, I also study with my tablet at home, so I don't get bored like that. I don't want to work when I'm bored."*

(LS1): *"Positive, we can learn more without getting bored and with 3D. On the negative side, the application sometimes lags a lot and for example, when it says 1, 2, 3 there, when I click on one, it loads but does not open."*

“Was there any subject that you could not understand without this system? What topics were they? Why wouldn't you understand? How did this system make you understand?” Some of the answers of the participating students to the question are as follows.

(HS2): *“As I said, I had never understood the big and small blood circulation, it was a convenience. I was messing around with its locations, and there it was something more because it was detailed three-dimensional.”*

(MS2): *“I probably wouldn't have understood the respiratory system. Because the respiratory system seemed so different and confused to me.”*

(LS1): *“I would not understand the circulatory system, teacher. Because it's so complicated.”*

“How did this system make you understand?” Some of the answers of the participating students to the question are as follows.

(HS1): *“It was easier for me because it was shown in a more understandable way.”*

(MS2): *“With 3D models, I easily saw what was where and learned where it was, so it made it easier for me to learn.”*

(LS1): *“Because it has 3D. I'm roaming next to you, I throw something I step on something like an object something slides.”*

“What is the difference between the courses taught with the ARGEBİLİM learning system and the other courses?” Some of the answers of the participating students to the question are as follows.

(HS2): *“We do it with more fun and more creativity, for example, with ARGEBİLİM, and we want to do it more, we wish it were endless and we could do it. Mathematics is a very difficult subject and confusing operations, but for example, we do operations in ARGEBİLİM, but it still seems easier and more fun to me. If we used such a system in other lessons, I would not get bored and I would be more successful.”*

(MS1): *“Sometimes I get bored when I solve a math test, but I don't get bored like that when I'm doing it at ARGEBİLİM, so how can I say it, I don't get bored because there are fun things here. There are 3D view models, I don't get bored of it.”*

(LS2): *“In ARGEBİLİM, we can make preliminary information about a subject that I do not know, and the advanced degree in ARGEBİLİM increases because it is difficult and easy. This makes it easier for us to learn. I wish we had seen all classes in a similar system.”*

“How did you find the tablet applications (augmented reality, simulation, games, etc.) that you use with the ARGEBİLİM learning system?” Some of the answers of the participating students to the question are as follows.

(HS1): *“I like it a lot. I never thought I could learn with such fun.”*

(MS2): *“3D designs sometimes twitched when opening them on the tablet, I couldn't look straight like that, the games were good, they were fun.”*

(LS2): *“The games were very good, I already love the 3D.”*

“How did these practices affect your learning of science subjects?” Some of the answers of the participating students to the question are as follows.

(HS2): *“For example, let's say we have moved on to a topic now, the respiratory system, we can see it in a three-dimensional way and it can be more effective that way, well.”*

(MS1): *“It affected, I said in the respiratory system. In the respiratory system, I learned by looking at those models.”*

(LS1): *“It's good because there are mind games, there is an AR card, for example, we are trying to match it here. impacted in a good way.”*

“How were the designs of these applications?” Some of the answers of the participating students to the question are as follows.

(HS2): *“I think it was very beautiful and very successful, I liked it very much, it was very beautiful, it was prepared in a very nice way, I liked it very much.”*

(MS2): *“It was nice, so it was nice.”*

(LS2): *“it was nice.”*

“Have you had any problem(s) while using these applications? What are you alive?” Some of the answers of the participating students to the question are as follows.

(HS1): *“For example, I'm going to open a simulation and it keeps me waiting for two or three hours. He does things slowly, so there is no problem other than that, other than that, it goes very smoothly. There was no problem with the card one, it was in the simulation, it was not in the games.”*

(MS2): *“No, I didn't have a problem.”*

(LS2): *“Yes. When I open 3D, it's very bad, weirdly, he writes intent and digestive system while doing things, it says 1, 2, 3, when I click on it, the balloon comes out, it says something like Deniz or something, I press it again but I can't open it.”*

“What are the features you liked most in the ARGEBİLİM learning system?” Some of the answers of the participating students to the question are as follows.

(HS1): *“There are 3D activities and there is a boy named Deniz in the activities, I liked the experiments he did there, there is also the interpretation part in the same activity, I liked it too, I couldn't do it much, but I still liked them very much.”*

(MS1): *“Augmented reality was really cool.”*

(LS2): *“Games is well”*

“In terms of ease of use, what were your favorite features of the ARGEBİLİM learning system?” Some of the answers of the participating students to the question are as follows.

(HS2): *“The card was the more thing that was kept, I think I liked the way it was used. I just do one card towards the tablet, and when it turns into something three-dimensional, I really like it, it's a nice thing.”*

(MS1): *“The games, the scrolling ranked games, they were the best.”*

(LS1): *“3D applications and simulations”*

“In terms of learning, what were the features you liked most in the ARGEBİLİM learning system?” Some of the answers of the participating students to the question are as follows.

(HS1): *“Quizzes, evaluations, matches they're so good.”*

(MS2): *“Augmented reality can be”*

(LS1): *“3D applications”*

“In terms of evaluating the learnings, what were the features you liked most in the ARGEBİLİM learning system?” Some of the answers of the participating students to the question are as follows.

(HS2): *“For example, let's say he gave a visual, we were giving the answer to what this pump was compared to, I liked them very much. I liked the three-dimensional one, which evaluated it in so many ways, that part was evaluating it a lot.”*

(MS1): *“Probably games in the evaluation.”*

(LS1): *“The beauty of both activities and reflective diary questions, the application phase is very nice.”*

“In terms of carrying out the activities, what were the features you liked most in the ARGEBİLİM learning system?” Some of the answers of the participating students to the question are as follows.

(HS1): *“I liked that it was fun, it was easy to use and easier, it also allowed us to learn the subjects better.”*

(MS1): *“AR is probably my favorite while doing the activities because it was much easier to learn there.”*

(LS1): *“At first, I did it directly, I did not expect it at all, but as time passed, it started to hang.”*

“Are there any features that you would like to change in the ARGEBİLİM learning system? If so, can you share them with us?” Some of the answers of the participating students to the question are as follows.

(HS2): *“There is no feature I want changed.”*

(MS1): *“I don't want to change it, this is so beautiful.”*

(LS2): *“Actually, the system is pretty good overall. However, I had a problem with the ask a friend part. I would like it to change.”*

“Are there any features that you would like to change in the design of the ARGEBİLİM learning system?” Some of the answers of the participating students to the question are as follows.

(HS2): *“I really liked the design, I enjoyed it. There's nothing I want to change.”*

(MS1): *“I don't know, I'm not a design person, but overall I like the design.”*

(LS1): *“I like it very much in general, there is no feature that I want to change.”*

“Are there any features that you want to be added to the ARGEBİLİM learning system?” Some of the answers of the participating students to the question are as follows.

(HS1): *“There is no feature I want added.”*

(MS1): *“More games can be added. Games can be added more often. It would be nice to have games in it while performing AR.”*

(LS2): *“No there's not. I am very satisfied with the system.”*

“Do you have any suggestions about gamification elements of ARGEBİLİM learning system?” Some of the answers of the participating students to the question are as follows.

(HS2): *“No, I think it's a nice application as needed, I think there is no need.”*

(MS1): *“No. I don't think it should be added, I used it like this and it was nice, I used it with fun, so I don't have that problem.”*

(LS1): *“I am very happy with the system and I loved the games. There is nothing I want added.”*

“Are there any other experiences/recommendations you would like to add besides these?” Some of the answers of the participating students to the question are as follows.

(HS2): *“I have nothing to add.”*

(MS1): *“No there's not.”*

(LS2): *“I was able to study more, I learned more about the subject. Normally, science was a class that I didn't like very much in the 5th grade or something. But when I got tablets, I did more and I started to like it more. I started to love the science lesson because I learned better because I could do the subjects more and better.”*

3.2. Findings Obtained From Teacher

You guided the use of ARGEBİLİM learning system in your science lesson. Could you share your experience with this system with us?” The answer given by the participant teacher to the question is as follows.

(T): *"First of all, I can say that it is a good application. The children enjoyed doing the practices and the effects of the practices, I was able to observe very clearly myself in the lesson. There were some subjects that were difficult to learn before. Here, I think it is more beneficial for children in the form of learning by living together with the activities."*

"Do you think this portal is effective in students' learning/reinforcing science subjects? Explain your reason." The answer given by the participant teacher to the question is as follows.

(T): *"Of course it is effective, especially in the reinforcement phase, very, very effective. The augmented reality and simulations that you apply in the events that they cannot see or have trouble seeing because of the nature of the subjects, they experienced them all, they entered the system as if they were in their hands, as if they were in front of them, it was very very nice for them. That's why I think it was effective in their learning by seeing, seeing in three dimensions, and feeling as if they were in front of them one-on-one."*

"Have you had any technical problems with this portal? If so, can you share it with us?" The answer given by the participant teacher to the question is as follows.

(T): *"Yes, it happened, the school is a big school, it is a crowded school, we have a large number of students, there were some problems due to our internet problem. But when we evaluated it as doing the applications at home as a solution, we somehow overcame this and got it in return."*

"Do you think students can use this system effectively in science lesson? From where?" The answer given by the participant teacher to the question is as follows.

(T): *"Yes, I don't just think about it, I see it because they express their satisfaction every time. While doing the applications, they convey how they felt or how they could look at the subject. Thanks to these transfers, I am aware that they do it with pleasure, so I think it is used effectively."*

"Are there any difficulties in the effective use of this system in science lessons? Can you explain? If so, how were/can be overcome these difficulties?" The answer given by the participant teacher to the question is as follows.

(T): *"Sometimes they had technical difficulties, but they overcame it in a short time thanks to your help and support. Other than that, there was no problem. No other problems were encountered."*

"Were there any features you liked in the ARGEBİLİM learning system? If so, can you share them with us?" The answer given by the participant teacher to the question is as follows.

(T): *"I wonder which one should I share, each of which is beautiful... First of all, the activities were prepared by working on them and focusing on achievements. Prepared in a way that considers the student. Very usable and applicable level, beautiful."*

"Were there any features you wanted to change in the ARGEBİLİM learning system? If so, can you share them with us?" The answer given by the participant teacher to the question is as follows.

(T): *"As I just said, it's beautiful as it is, maybe more different things can be added and enriched over time, I like it this way too, it's pretty good, I think it's enough. It can be enriched over time and the number of events can be increased. Here, it can only put the student in trouble in terms of time, but apart from that, there is no deficiency for me, as far as I have observed, it is beautiful."*

"Are you able to control the learning activities of the students with the ARGEBİLİM learning portal? What activities were you able to supervise?" The answer given by the participant teacher to the question is as follows.

(T): *"We actually checked with you. In fact, at what level it was done or not, or where they encountered problems and difficulties, here are some things as a solution to them."*

“Did there be anything you couldn't control? If so, what are they?” The answer given by the participant teacher to the question is as follows.

(T): “No, I haven't been able to control.”

How was the learning and success levels of students affected by the ARGEBİLİM learning system? Can you explain?” The answer given by the participant teacher to the question is as follows.

(T): “It was positively affected. I proudly say this. According to the curriculum, our lesson hours are certain, and the subjects are also intense, so there were times when we had to go through some subjects without dwelling on them for too long, or there were times when we assigned students homework as individual work, but there is a huge difference between homework assignments and current tablet assignments. They do this more happily, more willingly, because it is technology-intensive, of course, because it is something related to their interests. Therefore, when it comes to desire and instinct, learning naturally returns to you as success.”

“Do you think that the ARGEBİLİM learning system contributes to the learning of each student? From where?” The answer given by the participant teacher to the question is as follows.

(T): “I think in general. I think the student who wants to add something to it. When he does it consciously, I think it adds a lot to the application when it runs as it should or should work. Because the events have already been prepared in this direction. Since it is design-oriented, it is a direct point shot, but it happens in every classroom, if there are people who do it for the sake of doing it in every school, of course they are, of course, I still think it will benefit them, even if it is visually, yes.”

“Do you have any other experiences/suggestions that you would like to add?” The answer given by the participant teacher to the question is as follows.

(T): “I sincerely want it to spread widely. We are currently working with two classes, and when we see such positive results, I wish we could apply it in every class. I hope that there will be such an opportunity in time, I will be very happy for the children. I hope that it will be very beneficial for the development of children to be in an environment where children can reach whenever they want in a place like EBA, and to be in such an area. Our parents also informed me that the children carried out the activities without getting bored and that they wanted the tablet applications to continue in the second semester, and the positive changes in the exam results attracted the attention of the parents. Positive feedback has arrived. This application can also be developed for courses other than science.”

4. DISCUSSION AND CONCLUSION

The study group of the research, which was carried out to examine the student and teacher experiences related to the ARGEBİLİM web-based learning system, consists of 6 students and 1 teacher. To be implemented in this context, a semi-structured interview form consisting of 7 questions for the 6th grade students and 8 questions for the teacher was prepared. The effectiveness of the developed system for learning was evaluated under five sub-headings as "evaluation of academic success", "system use", "system design", "activities" and "gamification".

When the answers given by the participant students to the question about whether ARGEBİLİM supports learning or not; It was determined that the students generally developed a positive attitude towards the ARGEBİLİM learning system. It has been determined that the students stated that their current study routines have changed thanks to these applications and that these routines are more fun and permanent. They stated that the visuals in the activities in the ARGEBİLİM had a positive effect on their learning of the science course subjects. Students stated that thanks to the ARGEBİLİM, an easier, more understandable and enjoyable learning is created, thus increasing their willingness to study and study time. Students stated that their success in school exams increased thanks to all these positive effects of the ARGEBİLİM. In addition, the students who were classified according to the degree of

completion of the activities in the ARGEBİLİM stated that they thought that they would not have achieved the same success without this system.

When the answers given by the participant students in all groups to the question of the research about the experiences of the students who use the ARGEBİLİM within the scope of science lesson; It has been determined that students have a positive effect on their learning. Except for one of the students who were grouped as high level, it was learned that the participant students did not have any problems while applying the activities and the student who had problems while applying the activities solved the problem in a short time. In general, the students stated that they saw the ARGEBİLİM system in terms of ease of use as appropriate for their level. It was determined that the students stated that the ARGEBİLİM system was effective and efficient in learning science subjects. It was determined that there were common answers from the students in all groups about the benefits of the system for learning science subjects; they stated that the system affects their motivation especially when they learn the subjects that they have difficulty in understanding and that the learning processes are more effective and permanent thanks to visually supported activities such as AR simulation. The students stated that the science lesson held with the ARGEBİLİM was more fun than the other lessons. The students repeated that using the ARGEBİLİM in science lessons motivated them more and this had a positive effect on their learning processes. The students stated that they would not be able to understand some units or subjects in the science lesson so easily without the ARGEBİLİM, and the learning processes would become more difficult. Students, who stated that their learning processes were affected positively by the ARGEBİLİM, stated that the reason for this situation was the visually supported activities in the ARGEBİLİM.

Students stated that they found the science lesson conducted with the ARGEBİLİM more creative, fun, and permanent and productive in terms of learning processes than other lessons. Students mostly stated that they were bored in other lessons and that they had difficulties especially in mathematical operations. Participating students, who stated that they were satisfied with the system in general, stated that the ARGEBİLİM motivated them at a high level and had fun in their learning processes. Due to this and similar reasons, they stated that they thought that using systems similar to the ARGEBİLİM in other courses would increase their success.

It was determined that the students in all groups expressed positive opinions about the tablet applications they used with the ARGEBİLİM. Students stated that they enjoyed using tablet applications, and that visually supported activities increased their motivation and interest in the lesson. The students stated that the ARGEBİLİM contributed positively to their learning process of science subjects, and that they could learn the subject much more comfortably and permanently with visual interactive activities, especially in some difficult subjects. In addition, it was determined that the students expressed that they liked the designs of the tablet applications. Students stated that the system slows down while using tablet applications, especially in activities involving simulation and using AR cards. Students, who stated that they had internet-based problems in addition to these problems in tablet applications, stated that they did not have any problems with other tablet applications.

They stated that the students' favorite features of the ARGEBİLİM are the visual aided activities of the system such as AR, simulation and gamification. In terms of ease of use, the students stated that the most favorite features of the ARGEBİLİM are the visually supported activities and applications. The students stated that the most favorite features of the ARGEBİLİM in terms of learning are the AR applications, 3D and simulation activities included in the system. In terms of evaluating their learning, the students stated the gamification elements, visually supported activities and reflective daily questions in the ARGEBİLİM as their favorite features. Students stated that visually supported activities make the ARGEBİLİM very interesting in terms of performing the activities, but they have problems due to internet or design-based problems in some applications.

When the general answers given by the students to the question about the features they want to change in the ARGEBİLİM and system design are examined; It was determined that the majority were satisfied with the system. Only one of the students grouped as low level stated that he had a problem in the "Ask a Friend" part of the system and stated that he wanted it to change in the system. When the answers given by the students to the question about the features they want to be added to the ARGEBİLİM are

examined; It was concluded that the general population was satisfied with the system and did not have the feature that they wanted to be added. In addition, it was determined that two of the participant students demanded an increase in gamification elements. When the answers given by the students to the question about the gamification elements of the ARGEBİLİM are examined; It was determined that the majority of the participating students liked the system very much and used it with pleasure. Apart from all these questions, when the answers given by the students to the topics they want to add to their suggestions or experiences are examined; It was determined that all participant students were satisfied with the overall system and stated that their success, interest, attitude and motivation towards the science lesson increased.

When the general questions about the use of the system by the teachers participating in the research are examined; It was determined that the participant teacher stated a high level of satisfaction. According to the answers given by the teacher who guided the ARGEBİLİM within the scope of the science lesson; stated that their experience with the system in general included results in favor of the students. In particular, he stated that he observed that the visually supported activities in the system increased the interest and motivation of the students and subsequently their academic success increased. Participating teacher, emphasizing that students' learning by doing and experiencing provides permanent knowledge; As a result of this, he stated that the students' learning about the science lesson units and subjects was efficient, especially thanks to the visual elements and reinforcement tools included in the activities in the system. He stated that the ARGEBİLİM supports his students and is very effective in learning some of the subjects in the science lesson. In general, the participant teacher, who stated a high level of system satisfaction, stated that there were internet-based problems related to the system, but they overcame these problems in various ways.

The teacher who participated in the research stated that the ARGEBİLİM was used effectively in the science lesson and that the students were satisfied with the system and could even easily observe this situation. The participant teacher stated that in addition to the increase in their interest and motivation while applying the system activities, the participant teacher stated that their students did not experience insurmountable difficulties in the ARGEBİLİM and that they found a solution in a short time by getting support for some technical problems.

The teacher who participated in the research stated that the most favorite features, activities and practices in the ARGEBİLİM were carefully prepared for the 6th grade science units and achievements, and the system's applicability. The teacher stated that there is no feature that he does not like or wants to change in the ARGEBİLİM system. In addition, he stated that he thought that this system could be improved over time and that more positive results could be obtained, and that he could easily supervise his students during the application.

The teacher who participated in the research emphasized that the ARGEBİLİM had a positive effect on the learning and achievement levels of the students. He stated that the ARGEBİLİM system is effective on increasing the academic success of the students in the 6th grade units, which include incomplete or insufficiently emphasized subjects in terms of current course acquisitions and durations, and especially in the 6th grade units containing intense and difficult subjects. The teacher participating in the research associated the positive effects of the ARGEBİLİM on the learning and academic success of the students because the system was interesting and motivating.

The teacher who participated in the research stated that she thought that using the ARGEBİLİM was generally effective for each of her students. He stated that due to many factors such as the usefulness of the system, its suitability for the achievement and level, and the interesting designs, it has made a great contribution to the learning of its students thanks to the ARGEBİLİM. The participant teacher, who also stated that the design-oriented ARGEBİLİM system affects the success of the students according to their initiative and wishes; stated that the individual wishes of their students affect the use of the system, and thus their contribution to their academic success has changed to this extent.

The teacher participating in the research, in addition to the ARGEBİLİM; stated that he supports and wants to increase this and similar systems or applications. The participant teacher, who stated that he

received positive feedback from the parents; He stated that he is willing to design similar applications in the future, integrate them into other courses and support them.

In general, when the answers given by the students and teachers to the interview form, which is evaluated under 5 sub-headings: the effect of the system on learning, the evaluation system, the use of the system, the system design, the activities and the gamification; It has been determined that positive feedback has been received for the system. It has been determined that there are no problems with the system apart from the technical problems arising from the internet infrastructure. Participating teachers and students stated that they liked the ARGEBİLİM for many positive reasons such as interesting and motivating. It was determined that similar positive responses were given about system usage and design.

ARGEBİLİM has been developed in a structure that supports active learning with its web-based and Augmented reality supported structure. Thanks to ARGEBİLİM, students continue the learning process in a motivated way and willingly perform the scientific tasks presented to them. This can be an opportunity for them to develop their self-directed learning skills.

Huang et al. (2021) stated that the way to develop students' self-directed learning skills in a web-based learning environment is to support this environment with motivating elements.

In their studies, Hsu et al. (2014) stated that student-centered learning approaches should be adopted in order to improve students' self-regulation skills and necessary arrangements should be made in learning environments for students to actively participate in the learning process. Student-centered approaches allow students to self-assess, play an active role in the learning process, develop self-directed learning skills and achieve learning goals. As it can be understood from the student and teacher opinions obtained within the scope of the research, it can be said that the ARGEBİLİM learning system has been developed in a structure that can meet these features.

Web-based learning environments supported by innovative technologies such as Augmented Reality or Virtual reality can allow students to experience a more effective and efficient learning process in the learning process. This will positively affect their academic success. A few suggestions for future work inspired by this study might be:

-Innovative technologies suitable for students' learning styles can be included in future web-based learning environments.

-Web-based learning environments can be supported with innovative technologies such as AR and VR as well as artificial intelligence components such as ChatGPT to improve students' self-supervised learning skills. In this case, students can receive artificial intelligence-supported feedback or suggestions on subjects they do not understand or in experimental applications without the need for a teacher.

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