SCIENCE TEACHING WITH AUGMENTED REALITY APPLICATIONS: STUDENT VIEWS ABOUT 'SYSTEMS IN OUR BODY' UNIT*

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ABSTRACT

Many mobile applications have emerged thanks to the technological developments that have taken place today. One of these applications is the augmented (virtual) reality application used on smartphones and tablets. Some augmented reality applications are being prepared using 4D-technology and transforming the virtual environment into real life. The present research is to investigate the views of the students about the use of augmented reality applications with 4D-technology related to the 'Systems in Our Body' unit in our 6th-grade science class. This study was conducted using phenomenological method in the scope of qualitative research. In this study, the participants consisted of nine students who volunteered to participate in this research. The data were obtained from semi-structured interviews. The data of the interviews with seven students were recorded on voice recorder and then the data were transferred to the text. The interview data of two students who did not want to record their interviews were written with pen-paper and transcripted. The analysis of the data was carried out by content analysis using the NVivo 9 program. The findings obtained in this research showed that the result of the augmented reality application was that the systems in our body unit is effective in better understanding, increasing the motivation of the students to science lessons and making the lessons fun.

Keywords: *Augmented reality, virtual reality, science teaching*

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INTRODUCTION

It is stated that the more activities that will activate the sensory organs are organized in the learning environment, the more effective, easy and permanent learning is (Çepni, Ayas, Ekiz, & Akyıldız, 2010). The way to benefit more from sense organs is possible by combining education systems and technology (Daşdemir, Cengiz, Uzoğlu, & Bozdoğan, 2012). In this way, it can be easier to learn and understand abstract and difficult subjects and concepts.

Educational applications have been developed for tablets and mobile phones enrich students' imaginations and materialize abstract concepts. These educational practices have begun to be a part of the daily lives and learning environments of not only adults but also children (Timur & Özdemir, 2018). Augmented reality (AR) applications, which are especially used in mobile applications, make a great contribution to today's learning environments (Bacca, Baldiris, Fabregat, & Kinshuk, 2019; Ibáñez, Serio, Villaran, & Kloos, 2016; Özdemir, 2017; Zhang, Sung, Hou, & Chang, 2014). Augmented reality is a live, direct or indirect physical appearance created by enriching sound, images, graphics and location data produced by computers or mobile devices (Arslan & Elibol, 2015; Huang, Chen, & Chou, 2016). The rise of the use of personal mobile devices, especially since recent years, has led to the rapid growth of augmented reality applications in many fields, such as industry, medicine, tourism and education (Garzón & Acevedo, 2019). The positive results of incorporating augmented reality technology into each of these areas are expressed by some studies (see Billinghurst, Clark, &Lee, 2015; Chang & Hwang, 2018; Chao & Chang, 2018; Wu, Hwang, Yang, & Chen, 2018; Yim, Chu, & Sauer, 2017). Thanks to such studies, the deficiencies of augmented reality applications are eliminated and these applications have been further developed (Garzón & Acevedo, 2019).

The educational value of augmented reality applications depends not only on the use of technologies but also on the design of augmented reality applications, ease of application and how they are integrated into learning environments (Durak & Karaoğlan Yilmaz, 2019). It is stated that properly planned augmented reality activities can provide significant advantages in teaching science subjects (Hwang, Wu, & Chen, & Tu, 2016; Sırakaya & Alsancak Sırakaya, 2020). It is very important to use these advantages in educational environments. How and in what way augmented reality technology is applied in educational environments is a matter of curiosity (Garzón, Pavón, & Baldiris, 2019). Today, students' opinions are needed to expand the more efficient use of developing augmented reality technology in educational environments and evaluate its applications. Evaluation of the effects of augmented reality applications from the perspective of students is crucial in determining the ideal use of augmented reality in educational environments. Therefore, students' opinions about the advantages, positive aspects, negative aspects and difficulties of augmented reality applications will provide significant data about the use of augmented reality in schools. In this study, students' opinions were consulted about the use of augmented reality application on the subject of "skeleton and muscular system", "respiratory system" and "circulatory system". In this way, it will be possible to have an idea about the effects of augmented reality applications on the teaching process.

This research aims to investigate the opinions of students about the use of 4D technology applications in the 6th-grade science lesson 'Systems in Our Body' (skeleton and muscular system, circulatory system and respiratory system) unit.

RESEARCH METHOD

Research Model

In this study, phenomenological design, one of the qualitative research methods, was used. In the phenomenology design, individuals' perceptions of a phenomenon and the meanings they attribute to these phenomena are tried to be determined, and the source of this study is individuals who experienced and reflected the phenomenon under investigation (Cresswell, 2013). The design of this study was determined as phenomenology since secondary school 6th-grade students were seen as individuals who live and reflect the phenomenon of skeleton and muscular system, respiratory system and circulatory system in their classes.

Participants

The participants of this study consisted of nine 6th-grade students who volunteered to participate in the present study in a secondary school in the district of Göynücek in Amasya in the 2017-2018 academic year.

Data Collection Tool

In this study, an interview form consisting of semi-structured questions was prepared as a data collection tool by the researchers. The interview form consisted of three parts: "Skeleton and Muscular System Interview Questions", "Respiratory System Interview Questions" and "Circulatory System Interview Questions". In the preparation of the interview form, the opinions of two faculty members and three science teachers who were experts in science education were consulted. In line with these views, the interview form was finalized. Data collection tool has been included in the appendix.

Data Collection

First, the subjects of the respiratory system, circulatory system and skeleton and muscular system, which were included in the second unit of the 6th-grade s in the science course, were carried out with the students. Relevant topics were covered from textbooks. The subject of the respiratory system was carried out in three lesson hours, one-hour of which was augmented reality technology applications. Also, The subject of the circulatory system was carried out in five lesson hours, one-hour of which was augmented reality technology applications. The subject of the skeleton and muscular system was carried out in three lesson hours, one-hour of which was augmented reality technology applications. For the augmented reality applications, the 4D Anatomy program, which was compatible with the operating system of the teacher tablet, was downloaded and installed. Images of the respiratory system, circulatory system and skeleton and muscular system working synchronously with the 4D Anatomy program were provided. During the implementation process, question and answer activities were held about the structure and organs. Detailed information about the structure and organs was provided with augmented reality technology. During the lesson, abstract topics and concepts were embodied with augmented reality applications. Semi-structured interviews were conducted with the students after all subjects were finished. Verbal statements from students were transcribed during the interview.

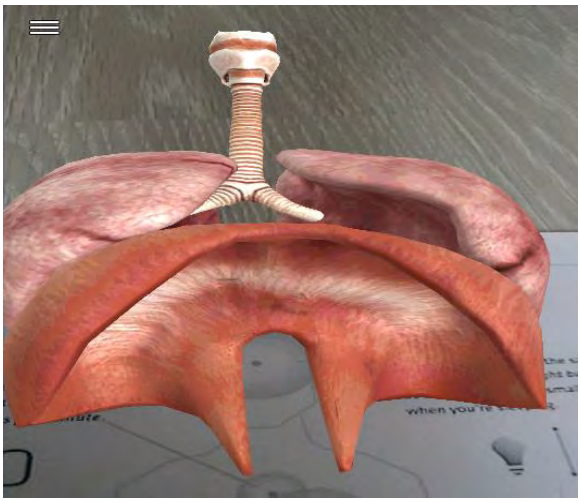

Figure 1. *Example of Augmented Reality Visual for the Respiratory System*

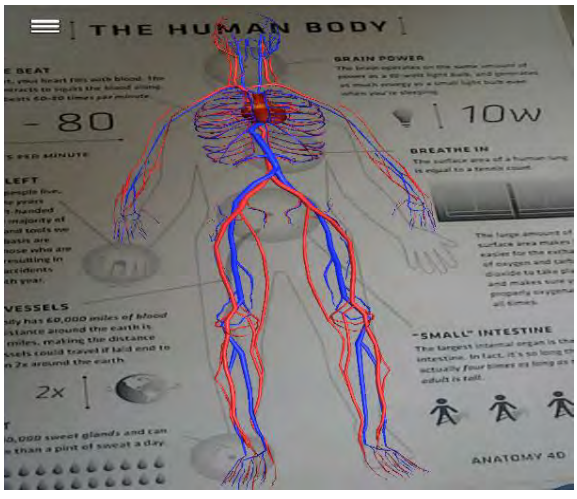

Figure 2. *Example of Augmented Reality Visual for the Circulatory System*

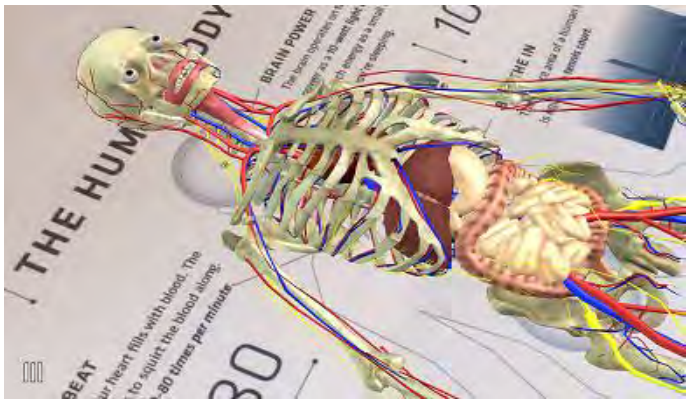

Figure 3. *Example of Augmented Reality Visual for Skeletal and Muscular System*

Data Analysis

Descriptive analysis method was used using the NVivo 9.0 program in the data analysis. In the descriptive analysis method, the existing situations are summarized, and quotations are also included (Aydın Günbatar, 2019). According to this analysis, the data were collected under six salient categories as follows:

- Learned with the respiratory system
- Reasons for preference of the respiratory system
- Learned with the circulatory system
- The reasons why the circulatory system is preferred
- Learned with the skeletal and muscular system
- Reasons for choosing the skeletal and muscular system

The data were presented using modeling for better understanding by readers.

FINDINGS

In this section, the codes of the categories obtained as a result of the analysis of the data were presented with modeling. The opinions of the students about what they learned about the "respiratory system" through the augmented reality application are presented in Figure 4.

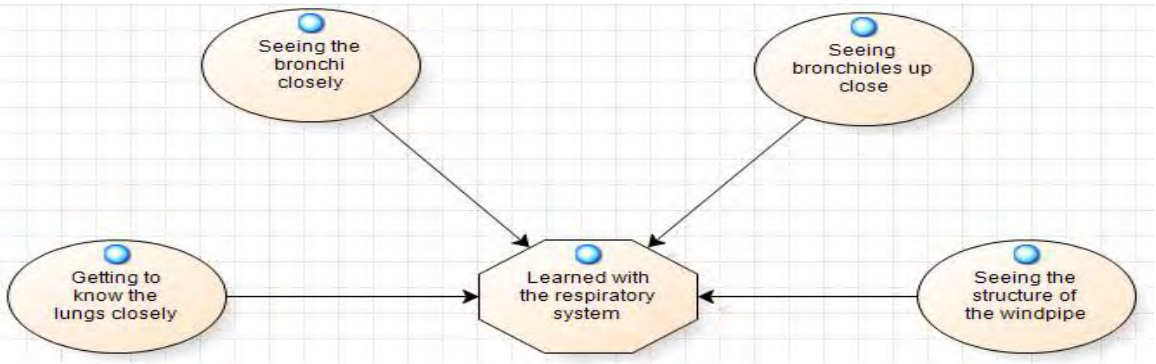

Figure 4. *Learned Information about Respiratory System*

Accordingly, the students stated their views on the subject of the respiratory system with the application of augmented reality: "getting to know the lungs closely", "seeing the bronchi closely", "seeing the bronchi closely" and "seeing the structure of the trachea."

The opinions of the students regarding the reasons for preferring to process the "respiratory system" subject through the augmented reality application in the course are given in Figure 5.

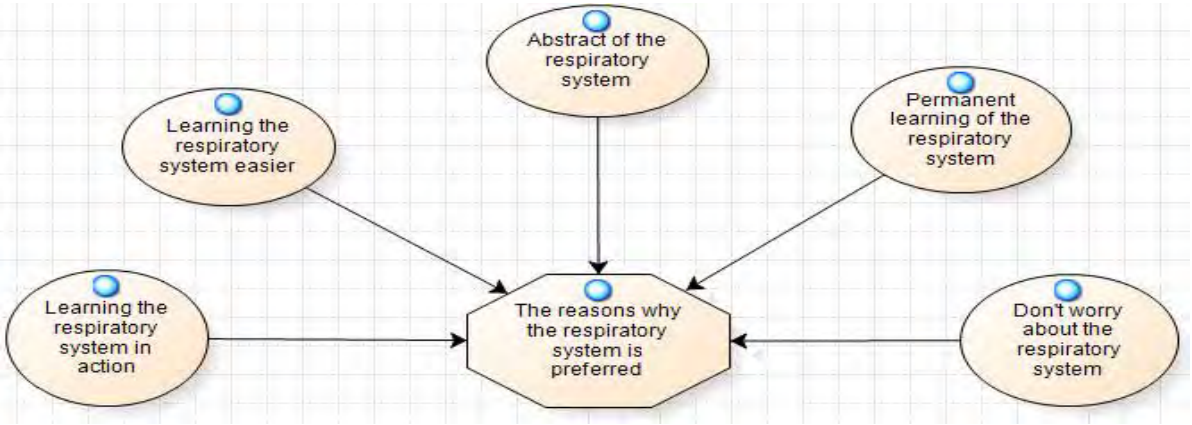

Figure 5. *The Reasons for Preferring the Presentation of the Respiratory System with Augmented Reality*

Then, the students stated the views of "learning the respiratory system by moving", "learning the respiratory system more easily", "being abstract of the respiratory system", "learning the respiratory system permanently" and "wondering about the respiratory system."

The opinions of the students about what they learned about the "circulatory system" through the augmented reality application are given in Figure 6.

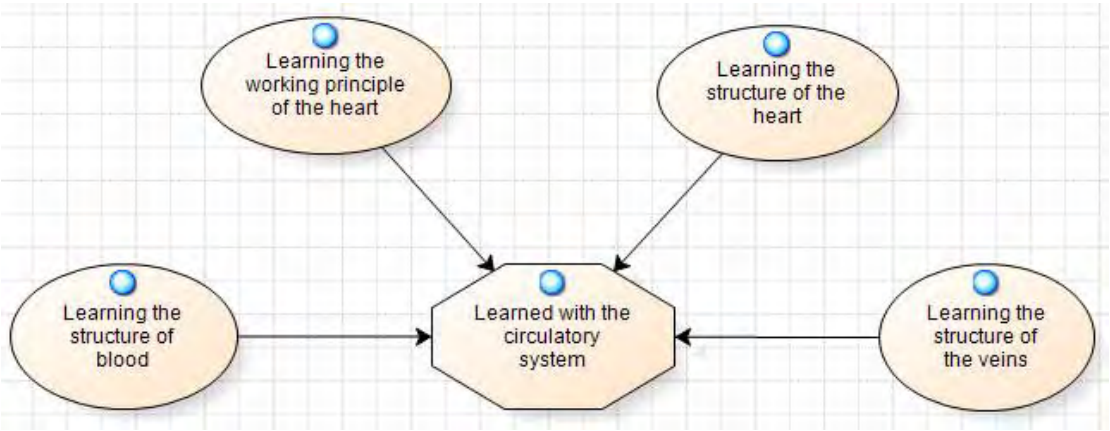

Figure 6. *Learned Information about the Circulatory System*

Afterwads, the students expressed their views of "learning the structure of the blood", "learning the working principle of the heart", "learning the structure of the heart" and "learning the structure of the vessels."

The opinions of the students about the reasons for preferring to process the "circulatory system" issue in the course through the augmented reality application are presented in Figure 7.

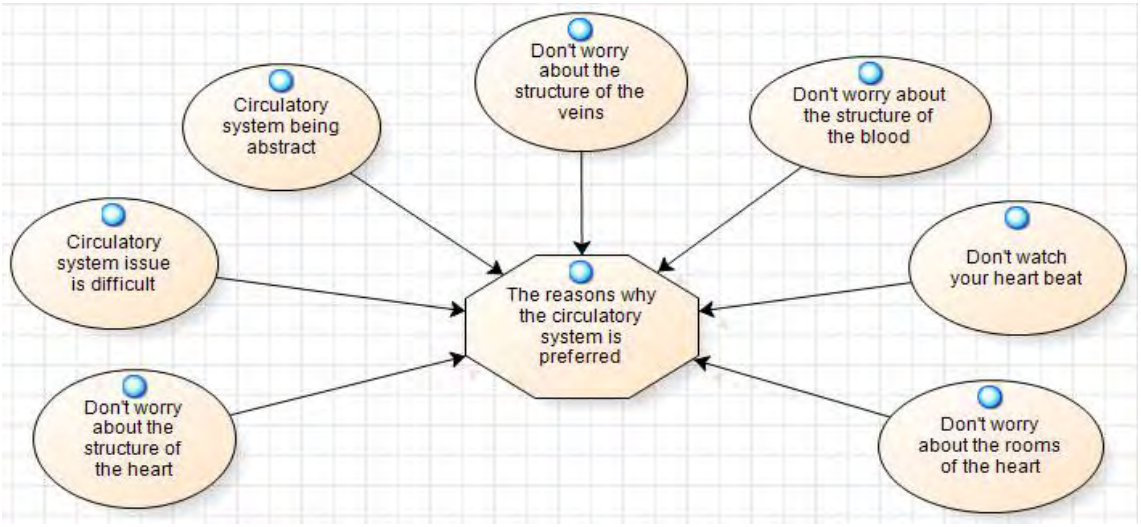

Figure 7. *The Reasons for Preferring the Presentation of the Circulatory System with Augmented Reality*

According to this, students learned "do not worry about the structure of the heart", "the circulatory system is difficult", "the circulatory system is abstract", "the structure of the blood vessels", "the structure of the blood", "watching the heart beat" and "wondering the chambers of the heart. They stated their views.

The opinions of the students about what they learned through the augmented reality application on the subject of “skeleton and muscular system" are given in Figure 8.

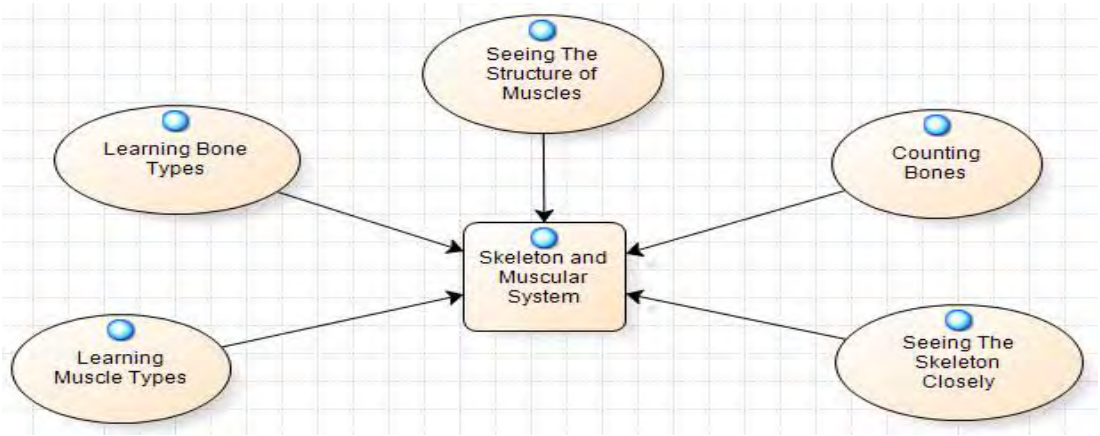

Figure 8. *Learned Information about the Skeleton and Muscular System*

Later, the students expressed their views of "learning muscle types", "learning bone types", "seeing the structure of muscles", "counting bones" and "seeing the skeleton closely."

The opinions of the students about the reasons for preferring to process the topic of "skeleton and muscular system" through the augmented reality application in the course are shown in Figure 9.

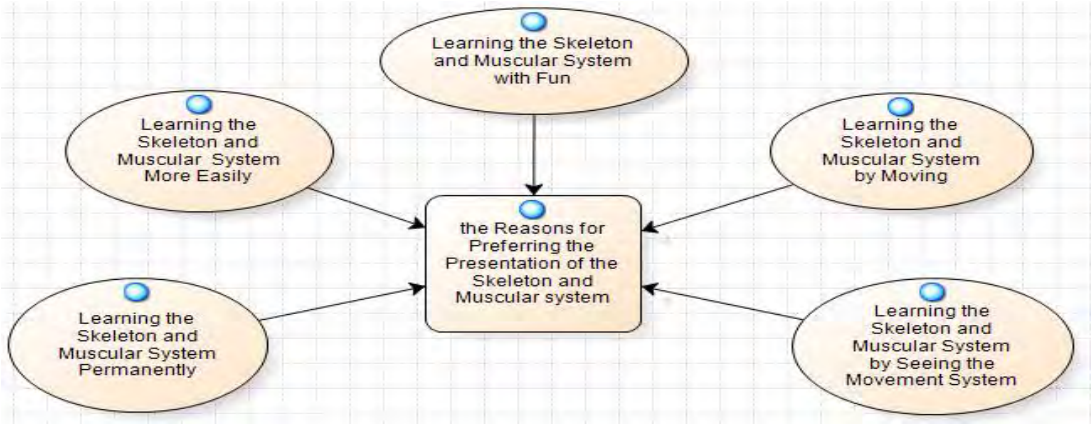

Figure 9. *The Reasons for Preferring the Presentation of the Skeleton and Muscular System with Augmented Reality*

Accordingly, students had some views of "learning the skeleton and muscular system permanently", "learning the skeleton and muscular system more easily", "learning the skeleton and muscular system with fun", "learning the skeleton and muscular system by moving" and "learning the skeleton and muscular system by seeing the movement system."

DISCUSSION AND CONCLUSION

When the opinions of the students about the use of augmented reality applications with 4D technology related to the 6th-grade science lesson 'Systems in Our Body' (respiratory system, circulatory system and skeleton and muscular system) unit, the data were collected under six categories. In this section, the findings obtained about the specified categories are discussed in light of the literature.

The students participating in the present study stated that thanks to the augmented reality application about the respiratory system, they closely observed and recognized the structure of the lung, bronchus, bronchi and trachea. Regarding the circulatory system, the students stated that they closely examined the structure and working principles of the heart, blood and vessels. Regarding the skeleton and muscular system, the students reported that they understood the structure, types and working principles of muscles and bones. Based on these findings obtained in the present study, it is thought that students have learned the abstract and incomprehensible subjects and concepts of the respiratory system, circulatory system and skeleton and muscular system concretely with the application of augmented reality. Some of the studies that support this idea are as follows. Some topics that are difficult to learn can be easily learned with the augmented reality application (Chang & Hwang, 2018; Farias, Dantas, & Burlamaqui, 2011; Medina, García, & Olguín, 2018; Ozdemir, Sahin, Arcagok, & Demir, 2018; Singhal, Bagga, Goyal, & Saxena, 2012; Wojciechowski & Cellary 2013). Using augmented reality technology in education ensures that the subjects that need to be learned are appealed to more sense organs. Thus, abstract subjects are embodied (Karagozlu, 2017). According to the study conducted by Bicen and Bal (2016), students can better grasp the contents of the lessons with augmented reality applications. Pérez-López and Contero (2013) stated in their study with students between the ages of 9-11 that augmented reality applications increased the academic achievement of students regarding systems in our bodies. Yip, Wong, Yick, Chan and Wong (2018) stated that in courses conducted with augmented reality technology, students learned the subjects better and the courses were more efficient.

The common views of the students participating in this research among the reasons for choosing respiratory system, circulatory system and skeleton and muscular system in the course are that the

augmented reality application makes the learning more permanent, it is more fun, it quenches students' curiosity, the organs it shows are more realistic. It appeals more than one sense organ. Based on these findings, students' desire to use augmented reality application; it can be thought that the subject of systems in our body is abstract for students; the traditional teaching does not attract the students' attention, whereas this method makes lessons more enjoyable. Some of the studies that support this idea are as follows. Sırakaya and Sırakaya (2018) stated in their study that they wanted to use the augmented reality application in the lessons and it positively affected students' motivation. Some augmented reality applications are of interest to students and provide them with a fun educational environment (Durak & Karaoğlan Yilmaz, 2019). Using augmented reality in education, students' interest and attitudes towards courses increase positively (Subhashini, Siddiqua, Keerthana, & Pavani, 2020). Therefore, it is stated that performing activities in classes related to augmented reality applications increases students' academic success (Chao & Chang, 2018; Khan, Johnston, & Ophoff, 2019). In a study conducted by Toledo-Morales and Sanchez-Garcia (2018), the findings showed that the use of augmented reality applications in the teaching process positively affected the learning process, and students preferred augmented reality applications more than traditional teaching.

As a result, in the 6th-grade science lesson 'Systems in Our Body' unit, the students learned that they understood the structures and organs better related to the respiratory, circulatory, skeleton and muscular systems in the use of augmented reality applications with 4D technology. Moreover, they claimed that the lesson was more enjoyable and attracted their interest and attitude. They stated that their motivation increased and they learned the subjects concretely. In this context, the results of this research are briefly presented in Figure 10.

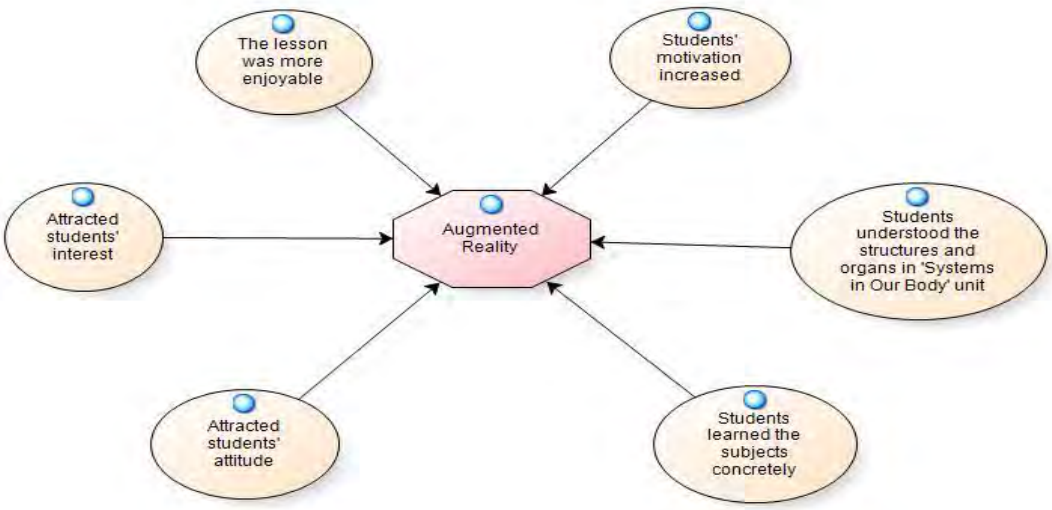

Figure 10. *The Findings Obtained in the Present Research*

Suggestions

In future studies, the effects of augmented reality application in teaching the subject of systems in our body can be determined by experimental studies. It may be stuck to integrate refined reality applications into the teaching process. Students' motivation for the lesson can be increased by preparing different augmented reality applications, especially abstract subjects.

REFERENCES

Arslan, A., & Elibol, M. (2015). Analysis of educational augmented reality applications: The case of Android operating system. *International Journal of Human Sciences*, *12*(2), 1792-1817.

Aydın Günbatar, S. (2019). Fenomenolojik araştırma (Olgu Bilim) yöntemi. H. Özmen ve O. Karamustafaoğlu (Ed.), *Eğitimde araştırma yöntemleri* içinde (s. 293-316). Pegem Akademi.

Bacca, J., Baldiris, S., Fabregat, R., & Kinshuk (2019). Framework for designing motivational augmented reality applications in vocational education and training. *Australasian Journal of Educational Technology*, *35*(3), 102-117.

Chang, S. C., & Hwang, G. J. (2018). Impacts of an augmented reality-based flipped learning guiding approach on students' scientific project performance and perceptions. *Computers & Education, 125*, 226–239.

Chao, W. H., & Chang, R. C. (2018). Using augmented reality to enhance teaching and learning. *Advances in Social Sciences Research Journal*, *5*(12), 455–464.

Çepni, S., Ayas, A., Ekiz, D., & Akyıldız, S. (2010). *Öğretim ilke ve yöntemleri*. Celepler Matbaacılık.

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches (Third edition)*. Sage.

Daşdemir, İ., Cengiz, E., Uzoğlu, M., & Bozdoğan, A. E. (2012). Examination of science teachers' opinions related to tablet pcs using in science and technology courses. *Mustafa Kemal University Journal of Social Sciences Institute*, *9*(20), 495-511.

Durak, A., & Karaoğlan Yilmaz, F. G. (2019). Opinions of secondary school students on educational practices of augmented reality. *Bolu Abant İzzet Baysal University Journal of Education Faculty*, *19*(2), 468-481.

Farias, L., Dantas, R., & Burlamaqui, A. (2011, September). Educ-AR: A tool for assist the creation of augmented reality content for education. In Virtual environments human-computer interfaces and measurement systems (VECIMS). *IEEE International Conference*, pp. 1-5.

Garzón, J., & Acevedo, J. (2019). A Meta-analysis of the impact of Augmented Reality on students' learning effectiveness. *Educational Research Review*, *27*, 244-260.

Garzón, J., Pavón, J., & Baldiris, S. (2019). Systematic review and meta-analysis of augmented reality in educational settings. *Virtual Reality*, *23*, 1–13.

Huang, T. C., Chen, C. C., & Chou, Y. W. (2016). Animating eco-education: To see, feel, and discover in an augmented reality-based experiential learning environment. *Computers & Education*, 96, 72-82.

Hwang, G.-J., Wu, P.-H., Chen, C.-C., & Tu, N.-T. (2016). Effects of an augmented reality-based educational game on students' learning achievements and attitudes in real-world observations. *Interactive Learning Environments, 24*(8), 1895–1906.

Ibáñez, M. B., Di Serio, A., Villaran, D., & Kloos, C. D. (2016). Support for Augmented Reality Simulation Systems: The Effects of Scaffolding on Learning Outcomes and Behavior Patterns. *IEEE Transactions on Learning Technologies*, *9*(1), 46–56.

Karagozlu, D. (2017). Determination of the impact of augmented reality application on the success and problem-solving skills of students. *Quality and Quantity*, *52*(5), 2393–2402.

Khan, T., Johnston, K., & Ophoff, J. (2019). The impact of an augmented reality application on learning motivation of students. *Advances in Human-Computer Interaction*, *2*, 1–14.

Medina, M., García, C., & Olguín, M. (2018). Planning and allocation of digital learning objects with augmented reality to higher education students according to the VARK model. *International Journal of Interactive Multimedia and Artificial Intelligence*, *5*(2), 53–57.

Ozdemir, M., Sahin, C., Arcagok, S., & Demir, M. K. (2018). The effect of augmented reality applications in the learning process: A Meta-analysis study. *European Journal of Educational Research*, *74*, 165-186.

Özdemir, M. (2017). Educational augmented reality (AR) applications and development process. *Mobile Technologies and Augmented Reality in Open Education* (p. 26-53). IGI Global.

Pérez-López, D., & Contero, M. (2013). Delivering educational multimedia contents through an augmented reality application: A case study on its impact on knowledge acquisition and retention. *Turkish Online Journal of Educational Technology*, *12*(4), 19-28.

Singhal, S., Bagga, S., Goyal, P., & Saxena, V. (2012). Augmented chemistry: Interactive education system. *International Journal of Computer Applications, 49*(15), 1–5.

Sırakaya, M., & Sırakaya, D. A. (2018). The effect of augmented reality use in science education on attitude and motivation. *Kastamonu Education Journal*, *26*(3), 887-905.

Sırakaya, M., & Alsancak Sırakaya, D. (2020). Augmented reality in STEM education: a systematic review. *Interactive Learning Environments*, DOI: 10.1080/10494820.2020.1722713.

Subhashini, P., Siddiqua, R., Keerthana, A., & Pavani, P. (2020). Augmented reality in education. *Journal of Information Technology and Digital World*, *2*(4), 221-227.

Timur, B., & Özdemir, M. (2018). Teachers' views on the use of augmented reality environments in science education. *Journal of Turkish Education Sciences*, *6*(10), 62-75.

Toledo-Morales, P., & Sanchez-Garcia, J. M. (2018). Use of augmented reality in social sciences as educational research. *Turkish Online Journal of Distance Education, 19*(3), 38-52.

Wojciechowski, R., & Cellary, W. (2013). Evaluation of learners' attitude toward learning in ARIES augmented reality environments. *Computers & Education*, *68*, 570-585.

Wu, P. H., Hwang, G. J., Yang, M. L., & Chen, C. H. (2018). Impacts of integrating the repertory grid into an augmented reality-based learning design on students' learning achievements, cognitive load and degree of satisfaction. *Interactive Learning Environments*, *26*(2), 221–234.

Yip, J., Wong, S. H., Yick, K. L., Chan, K., & Wong, K. H. (2018). Improving quality of teaching and learning in classes by using augmented reality video. *Computers & Education*, *128*, 88-101.

Zhang, J., Sung, Y. T., Hou, H. T., & Chang, K. E. (2014). The development and evaluation of an augmented reality-based armillary sphere for astronomical observation instruction. *Computers & Education*,

73, 178-188.

Appendix-1 Interview Questions

Respiratory System Interview Questions

1. Would you prefer to study the respiratory system subject in the lesson using the augmented reality application? If so, why?

2. What did you learn from the augmented reality application about the respiratory system? Can you explain?

Circulatory System Interview Questions

1. Would you prefer to deal with the subject of the circulation system in the lesson over the augmented reality application? If so, why?

2. What did you learn from the augmented reality application about the circulation system? Can you explain?

Skeleton and Muscular System Interview Questions

1. Would you prefer to deal with the subject of skeleton and muscular system in the lesson using the augmented reality application? If so, why?

2. What did you learn from the augmented reality application about the skeleton and muscular system? Can you explain?