

The Opinions of Middle School Students, High School Students, Pre-Service Science Teachers and Science Teachers about Robotic-Assisted Practices in Teaching Renewable Energy Sources

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Abstract: In this research, it is aimed to determine views related about training renewable energy source assisted by robotic education to middle school students, high school students, candidate science teachers and science teachers. In the study, this subject has been tried to teach by using the Lego® Mindstorms EV3 Training Kit and the Lego® Renewable Energy Kit. In the study one group pretest-posttest experimental design was used. The study group of study consists of a total of eighty people including twenty middle school students, twenty high school students, twenty preservice science teachers and twenty science teachers. The training has been proceeded on four stages through eighty hours. Middle school students were trained about robotics in the first stage, high school students were trained in the second stage, preservice science teachers were trained in the third stage and science teachers were trained in the last stage, respectively. In the research, semi-structured interview form has been used for defining opinions and suggestions of middle school students, high school students, candidate science teachers and science teachers about lego assisted training. The data obtained from the research has been analyzed by SPSS packet program. In the light of this study, it is defined how middle school students, high school students, candidate science teachers and science teachers perceived this education with legos as a technique.

Keywords: Robotics, Renewable energy resources, Lego® mindstorms EV3 educatin kit, Lego® renewable energy kit, Middle school students, High school students, Teacher candidates, Science teachers

Introduction

It has become mandatory to use new methods and teaching materials in order to increase the quality of science education, make students interested in the lesson and to relate science subjects in daily life. As long as students become passive and keep taking notes, they cannot use in their lives, the information they learn. For this reason, science lessons become more and more difficult and boring. This situation indicates that our students do not receive a qualified science education and new methods, techniques and approaches should be used in science and technology lessons (Mercan Hbek, 2014). Cameron (2005), when Science and Technology education in the world is examined, a new practicable technology area emerges. This technological innovation, called "Robotic", which was integrated with various disciplines, has become an essential part of Science and Technology education process and especially science and engineering education (Koç Şenol and Byk, 2015). The most common area of robotics in education is in the support of STEM (Science, Technology, Engineering and Math) education. Most of the studies in this field have resulted in the positive effect of robotics in STEM education (gl, 2013). Alimisis, Kynigos (2009), in addition to the usage of technology in educational environments, the interest on the usage of robotics associated with education program has risen worldwide especially in science and technology education from pre-school to higher education institutions in various education programs (zdođru, 2013). Tools such as robotics that can be programmed to give programming education with a physical robotic, smart objects and do it yourself kits and sets, virtual robotic programming environments and robotic programming languages have become widespread (Numanođlu and Keser, 2017). In countries where robotic education is consciously and systematically performed, robotic education is conducted with Lego (Fidan and Yalın, 2012). Products that are produced by Lego company, has many models, appeal to various age groups and consist of programmable Lego, has positive effects on the problem solving and high-

level thinking skills of students (Özdoğan, 2013). Lego is a strong material which is used for making students eager to lesson, to entertain them while learning and to draw their attention to the subject. Increase in the success of the students will provide the motivation for the teacher towards the lesson (Marulcu and Sungur, 2013) Lego practices are commonly used in learning and teaching processes. In this process, it is important that teachers and learners should be interested and eager to robotics practices when reaching the objective. Especially, it is crucial for teachers who have an important role in the process of planning, designing and practicing for robotic practices used in lessons, to be eager/intent, to provide the efficiency of the practices to be conducted and to prepare Lego robotic education practices (Çukurbaşı et al., 2018).

There are many studies in the literature which examine the motivations, attitudes and opinions of students about educational robotic activities and towards robotic practices which are getting wider and wider in education. (Hussain, Lindh and Shukur, (2006); Lindh and Holgersson (2007), Atmatzidou, Markelis and Demetriadi (2008); Liu, (2010); Sullivan (2008); Smith, (2013); Kasalak, (2017). There are studies in the literature which state that using robotics in education plays a positive role in learning, develops critical thinking and problem solving skills, is effective in increasing students eagerness to learn (Ersoy, Madran and Gülbahar, 2016; Chen, Quadir and Teng, 2011; Highfield, 2010; Shimada, Kanda and Koizumi, 2012). In his study, Özdoğan (2013) has determined that learning environments enriched with Lego robotic kits increase the motivations of students towards Science and Technology lesson. In Lindh and Holgersson's (2007) study in which the effects of robotic toys (Lego) was examined, it was observed that success of students has increased in students who like problem-solving activities and students who have taken Lego-robot training have become more successful in the next year. In their study, Atmatzidou, Markelis and Demetriadi (2008) have determined that robotic practices increase the problem-solving skills and programming abilities of students in primary and middle school. Çayır (2010) stated that learning environment supported by Lego-robot has positive effects on scientific process ability and sense of self which is extremely important for the development of 8th-grade students. Sullivan (2008) stated that robotic activities positively affect students' scientific process skills. In their study, which was conducted with 6th and 7th-grade students by using Lego Mindstorms robotic kit, Çavaş et al. (2012) have determined that scientific creativity and scientific process skills of students have increased. In their study Fidan and Yalcin (2012) stated that robotic designing and programming with Lego robotic education set is not supposedly difficult, on the contrary, it is fun as well as educative and a person who is not expert on programming language can easily program the robotic made with Lego set. In this context, it is aimed in this study to determine the opinions of middle and high school students, science teacher candidates and science teachers about robotic-aided practices in the teaching of renewable energy resources subject.

Method

This study aims to determine the opinions of middle and high school students, science teacher candidates and science teachers about robotic-aided practices in the teaching of renewable energy resources subject. In the study, one sample pre-test post-test model from pre-experimental designs was used. Study group of the research consists of a total of 80 people, 20 middle school students, 20 high school students, 20 science teacher candidate and 20 science teachers. The education given to each participant group in the research lasted 20 hours. This education lasted a total of 80 hours with 4 phases. Educations about renewable energy subject were given to middle school students in the first phase, to high school students in the second phase, to teacher candidates in third grade and to science teachers at the last phase. In the research, Lego® Mindstorms EV3 Education Set and Lego® Renewable Energy Sets were used in the activities. Lego® Mindstorms EV3 Education Set and Lego® Renewable Energy Set were introduced to participants in the first stage of the practice, then groups of four were made to perform 5 activities in the sets about sun and the wind energy subjects by turns.

Data Collection Tools

Semi-structured interview form is used in order to determine the opinions and suggestions of middle and high school students, science teacher candidates and science teachers about robotic-aided practices in the teaching of renewable energy resources subject.

Findings

A total of 80 people participated in the research with a total of 20 7th grade students, 10 female and 10 male, 20 male high school students studying in 9th grade, 20 teacher candidates, 12 female, 8 male and 20 science teachers, 14 female and 6 male. In order to disguise the names of the participants in the study group, nicknames were given in accordance with ethical rules, (M.S.S.1, M.S.S.2, M.S.S.3,...) to middle school students, (H.S.S.1, H.S.S.2, H.S.S.3,...) to high school students, (T.C.1, T.C.2, T.C.3,...) to teacher candidates and (T.1, T.2, T.3,...) to teachers.

100% of the participants have answered that yes, it helped to the question which was directed to middle school students, high school students and teacher candidates "Have Lego® Renewable Energy Sources been beneficial while learning renewable energy sources subjects?". Some of the answers given by participants are as follows:

M.S.S.1: "Yes it has. And I had a lot of fun."

M.S.S.2: "Yes it has and I had a blast."

M.S.S.3: "I made a solar car and it moved after I put it under the sun, I had a lot of fun. I want to be an engineer in a car company."

M.S.S.4: "I was always curious about how the solar panel on our building works, now I learned and my curiosity is satisfied, thank you very much."

H.S.S.1: "It helped a lot, we were handling the subject only theoretically."

H.S.S.2: "Learning by performing and experiencing is always better, we do not forget what we've learned."

H.S.S.3: "When we practice, not only the lesson becomes more enjoyable but also we learn completely."

H.S.S.3: "Yes, it helped, we produced electricity from wind and sun."

T.C.1: "I think it helped a lot. We made it by ourselves and produced by ourselves. It was a student-centered study."

T.C.2: "Yes it helped, making our own wind turbine was so much fun."

T.C.3: "It helped. It provided a much more fun learning."

T.C.4: "I did not know about Lego that can be used in lessons but now I learned. It helped a lot. It requires attention. It made me very happy to produce electricity."

T.C.5: "Yes, it helped a lot. We made a wind-driven car and solar car with my friends. It was fun to build and this is the first time I've produced electricity."

T.C.6: "Yes, it helped a lot. We made our own solar car and produced our own electricity."

Some of the answers to the question which was directed to middle school students, high school students and teacher candidates "What could be the advantages of learning with Lego?" are as follows:

M.S.S.1: "I think it would be more fun and more memorable since it is practical."

M.S.S.2: "We would learn while having more fun."

M.S.S.3: "It would stick to people's mind faster and clearer."

M.S.S.4: "I believe that it would increase our interest in the lesson and make it easy to learn."

M.S.S.5: "It would provide practice-oriented, student-centered lesson."

M.S.S.6: "It would be more memorable when we learn while practicing."

M.S.S.7: "Lessons would be more enjoyable and educational."

H.S.S.1: "we would visualize the subject which we learn visually."

H.S.S.2: "lessons would be more entertaining and logical."

H.S.S.3: "everyone would be eager to listen."

H.S.S.4: "we would have more fun in lessons and understand better."

H.S.S.5: "it would develop the ability of creative thinking."

H.S.S.6: "it would be perfect for students like us who are studying in vocational schools. We learn better when we make and learn by ourselves."

T.C.1: "It would provide the lesson to be more fun and practical." I think every teacher should use in appropriate lessons."

T.C.2: "I believe that Lego would develop the psychomotor abilities of students as well as provide them to learn more memorable."

T.C.3: "Children would learn by practicing-experiencing, thus it would provide them to learn faster and more efficiently."

T.C.4: "My students would learn while having fun."

T.C.5: *"Teachers would learn while having fun and develop their hand skills."*

Some of the answers the participants gave to the question "What could be the disadvantages of teaching with Lego?" which was asked to the participating middle-school students and high-school students and teacher candidates are as follows:

T.1: *"I don't think it would work very well, but maybe some of our friends might take it out of education and turn it into a game."*

T.2: *"Time might become an issue during lessons."*

T.3: *"It was fun learning with the Renewable Energy Set but when I asked my teacher its price, I found it expensive. I think all children would be able to learn with these tools if they were cheaper."*

H.S.S.1: *"Some students might turn the lesson into play."*

H.S.S.2: *"Lesson hours would become longer."*

H.S.S.3: *"Problems would arise if there were not enough sets."*

H.S.S.4: *"It's a waste of time for students who are not very interested."*

T.C.1: *"I don't think there would be any disadvantage if the implementation was done in a planned and organized way."*

T.C.2: *"I don't think there would be a disadvantage, however, I think the fact that not every school has these sets is already a disadvantage for some."*

Some of the answers given to the question "What would you think about the idea of appropriate lessons being taught with Lego? Would you want this? Why?" which was asked to the participating middle-school and high-school students are as follows:

M.S.S.1: *"I think it would be a more fun, more catchy, and more efficient learning experience because it would be applied training."*

M.S.S.2: *"I think that being pulled out of the parrot fashion of our education system and learning by trying and applying would be more fun, more memorable, and more efficient for us students."*

M.S.S.3: *"It would allow us children to understand the lesson better and not get bored during classes."*

M.S.S.4: *"We get bored and worn out a lot in classes and don't understand the lesson. But with this system, classes would become fun, we would not get bored and understand the lessons well."*

H.S.S.1: *"Yes, I would want that, I think Lego being used in classes would be nice and fun."*

H.S.S.2: *"I think it would be very fun. I would want that because we would understand the lesson easily."*

H.S.S.3: *"No, class hours would get longer."*

H.S.S.4: *"I would want that, I think classes would be more productive."*

H.S.S.5: *"I would want it but only if we get to perform applications with the materials as well."*

H.S.S.6: *"I think I would struggle with it, that's why I wouldn't want that."*

All participants replied to the question "Would you consider using the Lego® Renewable Energy Set while teaching the renewable energy sources subject in your current or future teaching profession? Why?" which was asked to teacher candidates and teachers in the study as "yes, I would" and some of the answers are as follows:

T.C.1: *"Yes I would. It is very practical, fun, and a do-it-yourself, find-it-yourself type of activity. It is a very nice practice aimed to teach the subject to students as well as possible. There would be no problem at all as long as you allocate enough time."*

T.C.2: *"I would. Because learning while having a fun time would be easier."*

T.C.4: *"I certainly would, I think it would enable students to learn easier. It would make the learning process more active."*

T.C.5: *"I would very much like to use it, but I think its cost is too much, not every school might be able to get it."*

T.C.6: *"I would. Children would obtain knowledge that is more permanent as they do the applications themselves. However, we might struggle in terms of cost."*

T.C.7: *"I certainly would. It improves dexterity, allows for group work, and provides learning by experience."*

T.C.8: *"Yes I would. Because it is very fun and educating. Children having fun while learning allows the knowledge they obtain to be more permanent."*

T.C.9: *"I would. Children are the future. Our future depends on their upbringing. The earth being more livable is related to the further use of renewable energy sources."*

- T.2:** "Yes, the usage of practice instead of verbal lessons provides a more permanent learning experience."
T.4: "I would, of course, if I had the material."
T.5: "Yes, I would, because I think Lego would arouse curiosity and lead to a more permanent learning experience."
T.6: "I'm thinking of using Lego to carry out learning by observing and experiencing."
T.8: "I would, I think that students' motivation and interest in the lesson would increase."
T.9: "Yes I would, students learn faster when they produce and the information becomes permanent."
T.10: "I would certainly use it if I had access to it."
T.12: "I certainly would, it would be a very lasting learning experience for the child to see that energy is generated from the wind by using the wind rose model that he/she made."

95% of the teacher candidates and all of the teachers gave the answer "Yes, I would" to the question "Would you have liked to have a robotics-based class during your undergraduate education? Why?" which was asked to the participating teacher candidates and teachers. Some of the answers the teacher candidates and teachers gave are as follows:

- T.C.1:** *"Yes. I would like to improve myself on different aspects and learn the different materials and teaching techniques in my future teaching career. I would like to be an unorthodox teacher. Robotics-based education would contribute to my academic success positively."*
T.C.2: *"I would. I would be knowledgeable in this sense too and become a more beneficial teacher to students."*
T.C.3: *"I would. I am sure that the education I would receive from robotics-based classes would be more permanent."*
T.C.4: *"I certainly would. I would like to digress from the monotonous lecturing and learn by practicing."*
T.C.5: *"I would like it a lot. Because I had fun while learning and produced an output in the application we did and this made me very happy."*
T.C-6/7: *"I would. We learned by having fun. I both had fun and learned."*
T.C.8: *"Yes, I would. Both to improve myself and to give my students this kind of education."*

- T.1:** "Yes, I would, I have to learn to teach."
T.2: "I would like it a lot, I think it would be very beneficial."
T.3: "I certainly would, it is time to abandon classic methods in order for us to switch to a technological education system."
T.4: "Yes, because if we had a robotics-based class during my undergraduate education, my students would be able to experience a more active education with me."
T.5: "Yes, because I feel like a stranger to these activities at the moment."
T.6: "I certainly would but our different responsibilities at school limit our time allocation in this period of time. Also, everything would be better when it is learned in its place and time."
T.7: "Yes I would, I wouldn't want to learn about robotics this late. We can get to children easier if we understand them. Dealing with Lego is something they like to do and I could have been using it to make them gain acquisitions for a long time."

Discussion and Conclusions

In the study, the opinions of the participants consisting of middle-school students, high school students, science teacher candidates and science teachers on robotics-based applications and the teaching of the renewable energy sources subject were examined. The participants in the study stated that the Lego Renewable Energy Set was very beneficial in the education of the renewable energy sources subject. Thus, it is seen that the use of technology in education produces positive outcomes.

The participants in the study stated that the usage of Lego in teaching had advantages in terms of learning more memorable, learning while having fun, participating in group work, learning by experience, and students being more enthusiastic about lessons. The teacher candidates and teachers stated that they would consider using the Lego Renewable Energy Set while teaching the renewable energy sources subject. Also, the majority of the teacher candidates and teachers stated that they would like to have a robotics-based class during their undergraduate education. On the other hand, participants expressed the disadvantages of teaching with Lego as it takes too much time, there aren't enough sets, it is difficult to practice in crowded classrooms, sets being expensive and they cannot keep up with the curriculum since they have a curriculum to execute. In the study conducted by Cüre and Özdener (2008), teachers believe that developing technology makes learning easier, increases the success of student and teacher, draws the attention of students and technological practices are

necessary for a more effective education, however, it is revealed that teachers also think it is difficult to benefit from technology in crowded classrooms and using it will increase their responsibilities. Kuşkaya Mumcu, Koçak Usluel (2004) have determined that according to teachers, insufficient budget possibilities, which is the leading factor that prevents technology to be used in education plays an important role in both providing access to technology and the sustainability of technology.

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