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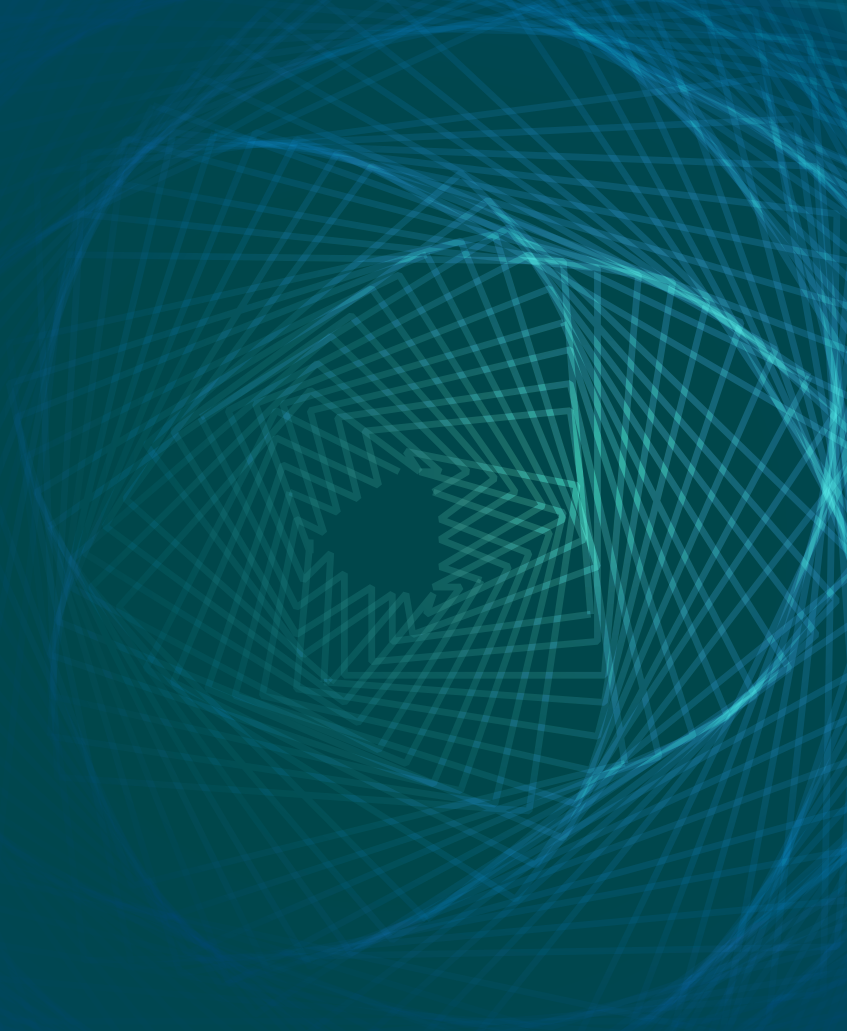

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The Effect of Authentic Task-Oriented Applications on Problem-Solving Skills in Robotic Programming Teaching

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Abstract

This study aims to examine the effect of authentic tasks in group programming education on the problem-solving skills of secondary school 5th-grade students. A weak experimental single-group pretest-posttest model was applied to gather data. The study participants consisted of 56 5th grade students, 25 girls, and 31 boys, studying in a private secondary school in the 2018-2019 academic year. The "problem-solving skill scale" was applied as a pre-test and post-test to define the participants' problem-solving skills. There is no statistically significant difference in students' problem-solving skills ($p = 0.657$) according to related (dependent) samples t-test results. The effect size results ($d = 0.06$) indicate that authentic tasks in group programming education moderately impact participants' problem-solving skills. There is also no statistically significant difference by gender ($p = 0.212$) on students' problem-solving skills. The effect size results ($d = 0.09$) show that authentic tasks in group programming education have a high effect on participants' problem-solving skills by gender.

Keywords: group programming, robotics programming, problem-solving skills, authentic tasks, authentic learning, Lego Mindstorms EV3

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Introduction

In the 21st century, individuals need to access information easily and quickly, adapt to developments and changes in the technological field, and produce logical results by thinking analytically (Duran, Özdemir & Kaplan, 2015). Therefore, today's students are expected to have some skills such as problem-solving, critical thinking, creative thinking, analyzing and synthesizing, working collaboratively, and thinking systematically (Alkan, 2019), reasoning (Göksoy, 2018), and effective and efficient use of information and communication technologies (Sırakaya, 2018). It is thought that these unique skills can be developed by programming education with various methods and techniques (Saygıner & Tüzün, 2017).

The role of educational institutions is critical in educating individuals under the needs of the century. The importance of coding education has been noticed in today's world, where information and communication technologies are increasing. In this context, the curriculum is revised by both coding education in Turkey and in the world (Akpinar & Altun, 2014). Many countries have

started to prepare the curricula of information technologies according to younger age levels to develop creative thinking of individuals, increase their problem-solving skills, and ensure permanent learning (Grout & Houlden, 2014). With this arrangement, it is aimed that individuals gain algorithm and programming logic, albeit at a basic level (Öndeş, 2016). With the "Information Technologies and Software Course (Secondary School 5th and 6th Grades) Curriculum" published by the Ministry of National Education in Turkey, it is aimed for individuals to acquire computational thinking, collaborative work, and problem-solving skills (TTKB, 2017). Collaborative learning environments are required for individuals to demonstrate these skills (Uğuz, 2019). Cooperative learning positively affects the process of structuring knowledge, such as finding a solution to a determined problem and product development by finding individuals together for a purpose (Carlan et al., 2014). Special and different approaches should be used to gain programming skills for individuals (Gomes & Mendes, 2007). Many programming environments are prepared for individuals to program by thinking algorithmically (Denner, Werner & Ortiz, 2012). The individuals in the teaching programming alongside real-life problems offering active in process them keep to the creative thinking and problem-solving, such as high-level thinking skills, authentic learning activities aimed at that formula be used on flow (Sequin, 2019). In addition, some teaching strategies such as group programming were redesigned according to the needs of individuals to facilitate programming education (Karaoğlu, 2018).

Group programming individuals work together in pairs to develop the code (Berenson, Slate, Williams & Ho, 2004). As a result of the literature review, it has been observed that programming with groups provides a pleasant learning environment by increasing social interaction between individuals (Kelleher & Pausch, 2005), and individuals develop more functional codes (Arisholm, Gallis, Dybå, & Sjøberg, 2007). In addition, however, it was concluded that it increased individuals' motivation towards learning (Hwang et al., 2012). Finally, since programming with the group is beneficial for beginners (Cliburn, 2003), it has been observed that it effectively improves individuals' self-confidence and problem-solving skills (Dongo, Reed & Hara, 2016).

There are many easy-to-learn, block-based, entertaining software used in programming teaching at the primary education level (Yükseltürk & Altıok, 2016). As an example of software; Code can be given to Game Lab, Scratch, Make Blok, MIT App Inventor, and Microsoft Minecraft Education Edition. When the studies in which block-based coding tools are used in programming teaching are examined, the frequently used tools include App Inventor, Scratch, and Alice (Fasy, Hancock, Komlos, Kristiansen, Micka, Theobold, 2020). Block-based coding tools have advantages such as easy creation of codes, easy detection of errors (Basawapatna, 2016), and music, pictures, animation, etc. It enables the concretization of abstract structures by establishing relationships between algorithms with many multiple supports (Koç, 2015).

Another method used in programming teaching is programming with robots. In programming activities with robots, individuals can program in block-based coding environments, observe the results instantly, and realize their learning in a concrete way (Çankaya, Durak & Yünkül, 2017). As a result of the literature reviews, studies (Kurebayashi et al.2019; Liu, Newsom, Schunn & Shoop, 2013) have been reached that show that programming teaching using robots is fun. In addition, robotic programming; studies are showing that it affects affective domain skills (attitude, motivation, etc.) as well as cognitive domain skills (mathematical and computational thinking, etc.) (Şişman & Küçük, 2017).

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There are many educational robots that can be used in programming teaching. Examples of educational robots used in educational environments; Mindstorms Ev3, Spike Prime, Wedo 2.0 developed by Lego company can be given. Lego robotic coding tools contribute positively to individuals' 21st century skills (critical thinking, problem-solving, creative thinking, etc.) (Strawhacker & Bers, 2015). Similarly, Blancas et al. (2020) state that, learning using educational robots offers students the opportunity to solve problems, think creatively, and collaborate.In learning environments where Lego robotic tools are used, using it for solving real-life problems in order to increase the programming skills of individuals, it contributes to the analysis of problems in the cause-effect relationship and then to produce solutions, thus allowing programming to develop not only success but also problem-solving skills. (Kabatova & Pekarova, 2010).

This study investigates the effect of authentic task-oriented applications on the problem-solving skills of middle school 5th-grade students in teaching robotic programming with a group. Answers to the following questions were sought as part of the research:

- Is there a significant difference between the pre-test and post-test mean scores of the study group students regarding the problem-solving skill scale?
- Is there a significant difference between the study group students' pre-test and post-test mean scores on the problem-solving skill scale regarding gender?

Theoretical Framework

Programming and Teaching Programming

Programming: is the process that occurs as a result of compiling codes by creating an algorithm according to the rules of this programming language to solve a mathematical or logical problem (Demir, 2015; Lye & Koh, 2014). When the studies conducted in recent years are examined, teaching programming is essential in gaining 21st-century skills. Shin and Park (2014) emphasize that students should be taught programming skills at an early age. Teaching programming has been revealed that skills such as creative thinking, problem-solving, and critical thinking within 21st-century skills are developed. However, Wong and Cheug (2020) suggest that more studies should be done on how many 21st century skills are taught to students. Although learning programming contributes to the development of higher-order thinking skills of individuals, more efforts are needed for skill development related to solving problems (Noh & Lee, 2020). For this, individuals should be able to solve problems, computational thinking, etc., at an early age. To gain many new 21st century skills, solutions based on real-life problems should be presented (Barradas, Lencastre, Soares & Valente, 2020).

Group Programming

One of the commonly used methods in teaching programming is group programming. Group programming includes two people. The group is the structure that consists of the fewest people in which individuals interact in a way that will be affected or affected by each other (Demir, 2019). Thus, interaction is the main issue in group programming. If anyone cuts off or leaves the group, the group becomes completely ineffective. Group programming method should be applied according to specific rules (Nicolescu & Plummer, 2003). The first of these rules is that the group members must work together to complete the tasks successfully on the same computer. Second,

both members of the group have a role. While the driver is working on the coding, the navigator should observe the driver, check the codes, and make suggestions to eliminate errors when necessary. Third, all designs and codes within the application should be decided by the driver and navigator together. Fourth, group members must communicate continuously to complete the task. Finally, fifth, the roles among the group members should be changed from time to time so that the members gain experience in both roles.

Authentic Learning

According to the constructivist learning approach, students learn best by analyzing and then interpreting the newly learned information with past knowledge and experiences (Scheurman & Newman, 1998). Active learning is provided when students associate their past knowledge with new knowledge (Brown, Collins, & Duguid, 1989). When learning is related to real life, students become more motivated towards the events they encounter in the classroom (Hamurcu, 2016). To bring about critical changes in education, a new dimension has been brought to the instructional design with authentic learning by developing activities within the framework of the authentic context (Young, 1993).

Authentic learning includes teaching techniques that relate the problems in daily life with the information taught in educational institutions. Authentic learning enables individuals to work collaboratively (Borthwick, Bennett, Lefoe & Huber, 2007). The primary purpose of authentic learning is to teach students to find solutions to these problems by presenting real-life problems and transferring the solutions they find to situations that they may encounter later, instead of making them memorize a subject to teach a subject (Aydin, 2016).

Problem Solving Skill

Problem-solving begins with experiencing difficulty in achieving a goal (Dewey, 1997). When the individual encounters any difficulty, he starts to produce solutions for that situation. Problem-solving skill is what decisions should be made regarding the problems encountered and the actions that need to be taken to reach a solution after these decisions (Aynas, 2018). In other words, problem-solving skills; can be defined as the mental search carried out to reach the correct result in situations where a problem is not clear (Martinez, 1998), or as the level of learning all the rules necessary to reach a solution and using them together to solve the problem (Bilen, 1993; Karaca & Karaca, 2021). Problem-solving skill consists of six stages (Bilen, 1993): understanding the problem, defining and limiting the problem, collecting information to solve the problem, forming a hypothesis, testing the hypothesis, and reaching a solution.

This study aims to see how authentic task-based practices in group programming education affect students' problem-solving abilities in secondary school. A single-group experimental pretest-posttest methodology was used to collect data. The study participants consisted of 56 5th grade students, 25 girls and 31 boys, studying in a private secondary school in the 2018-2019 academic year. To collect data, the "problem-solving skill scale" was applied as a pre-test and post-test to determine the participants' problem-solving skills. The t-test results for related (dependent) samples demonstrate no statistically significant differences in students' problem-solving abilities ($p = 0.657$). Authentic task-based practices in group programming education have a moderate impact on the problem-solving skills of participants, according to the effect size data ($d = 0.06$).

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Students' problem-solving skills do not reveal a statistically significant difference by gender, according to unrelated (independent) samples t-test results ($p = 0.212$). Authentic task-based practices in group programming education had a large effect on the 5th-grade students' problem solving skills by gender, according to the effect size data ($d = 0.09$).

Methods

Research Model

According to McMillan and Schumacher (2014), in order for the studies to be valid and reliable, it is necessary to select the appropriate research method for the relevant research. This study investigates the effect of authentic task-oriented applications on problem-solving skills in robotic programming teaching; a quantitative research method has been used. In addition, a weak experimental single group pre-test-post-test design was chosen among the experimental research methods included in the experimental research methods.

Sample

The study participants consisted of 56 5th grade students, 25 girls and 31 boys, studying in a private secondary school in the 2018-2019 academic year. In the sampling determination process, one of the non-random sampling methods included in the sampling methods, the appropriate sampling method, was used. This sampling method; enables the groups or individuals suitable for the purpose of the research to be reached more efficiently in terms of time, labor, and money (Büyüköztürk et al., 2016).

Application Process

The implementation phase consists of 13 weeks in total. First, for six weeks, students were given a basic beginner-level Lego Mindstorms Ev3 training. Then, activities were carried out within the basic initial training "5. Robotics Adventures with Class Ev3". In the remaining seven weeks of the application process, seven authentic missions were included in the Lego Mindstorms Ev3 space mission set to improve students' problem-solving skills.

Data Collection and Analysis

In order to gather data, the problem-solving skill scale was used. This scale was developed by Ge (2001) in his doctoral study in the field of teaching systems, and the problem-solving skill scale translated into Turkish by Coşkun (2004) was applied as a pre-test and a post-test to determine the problem-solving skills of 5th-grade students. The scale includes a total of 20 items related to 4 problem levels. The reliability coefficient of the Problem Solving Skill scale was found to be 0.84.

The Kolmogorov-Smirnov test was applied to determine whether the data collected in two stages, pre-test and post-test, have a normal distribution. According to the test result, the data were distributed normally in the sample group. It was examined whether there is a statistically significant difference between the students' problem-solving skills scores with the correlated (dependent) samples t-test. The unrelated (Independent) samples t-test was used to examine whether there is a statistically significant difference between students' problem-solving skills scores according to gender.

Findings

First research question of the study was, " Is there a significant difference between the pre-test and post-test average scores of the study group students regarding the problem-solving skill scale? Kolmogorov-Smirnov test was conducted to determine whether the data showed a normal distribution. The data for this test are shown in Table 1.

Table 1. Normality Test

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistics	***N***	***p***	***Statistics***	***N***	***p***
Pre Test	0,089	56	0,200	0,971	56	0,197
Post Test	0,087	56	0,200	0,968	56	0,148

The p values found as a result of the process are equal to each other and p = 0,200. Since the significance test result of the Kolmogorov-Smirnov test used for normality test is higher than p> 0.05, the data are distributed normally. In order to determine whether there is a significant difference between the students' scores before and after the application, the dependent samples t-test was conducted. Test results are included in Table 2.

Table 2. Dependent Samples T-Test Statistics of Pre-Test and Post-Rest Scores of Problem-Solving Skills

Measurement	N	$\bar{X}$	S	sd	t	p
Pre Test	56	3,637	0,600	55	-0,445	0,657
Post Test	56	3,686	0, 675			

When Table 2 is examined students' final test average scores of problem-solving skills (x post test = 3.686), a pre-test of the average score (x pre- test = 3.637) seems to be great (x post test > X pre- test). Considering the results of the related samples t-test, there is no significant difference in the problem-solving skills of the students [t (55) = -0.445, p = 0.657]. Based on this result, authentic task-oriented applications in robotic programming teaching with groups do not have an effect on the problem-solving skills of 5th-grade students.

The second research question of the study was, "Is there a significant difference between the pre-test and post-test average scores of the study group students on the problem-solving skill scale in terms of gender variable?" In order to find an answer, unrelated (independent) samples t-test was used. First of all, Kolmogorov-Smirnov test was conducted in order to test whether the data obtained from the participants showed normal distribution or not. The data showed normal distribution feature since the p values before and after the application are higher than 0.05 (Table 3).

Table 3. Gender-Related Normality Test Results Before and After the Application

		Kolmogorov-Smirnov			Shapiro-Wilk		
	Gender	Statistics	N	p	Statistics	N	p
Pre Test	Male	0,131	31	0,189	0,962	31	0,320
	Girl	0,118	25	0,200	0,969	25	0,627
Post Test	Male	0,100	31	0,200	0,966	31	0,411
	Girl	0,112	25	0,200	0,949	25	0,237

* (p <0.05)

According to Table 3, it is calculated that the average of the pre-test scores of male students in the problem-solving skill test is $\bar{X}m = 3.82$, and the average of the pre-test scores of female students is $\bar{X}f = 3.40$. As seen in Table 4, according to the results of the unrelated (independent) sample t-

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test, there is a statistically significant difference in favor of males between the pre-test scores [t (54) = 2,706, p = 0,009] of the study group students' problem-solving skill scale. (p <0.05), posttest [t (54) = -1.262, p = 0.212] there is no significant difference in terms of gender variable (p <0.05).

Table 4. Independent Samples T-Test Results of the Pre-Test and Post-Test Mean Scores of the Study Group Students on the Problem-Solving Skill Scale

	Gender	N	X̄	S	sd	T	p
Pre Test	Male	31	3,8224	0,58720	54	2,706	0, 009
	Girl	25	3,4087	0,54457			
Post Test	Male	31	3,7885	0,61459	54	1,262	0, 212
	Female	25	3,5604	0,73763			

Conclusions and Discussion

When the results regarding the first question of the study were examined, it was determined that there was no statistically significant difference. These results were similar to the study results of Bala (2019), Vatansever and Baltacı Göktalay (2018), Kalelioğlu and Gülbahar (2014), Genç and Tınmaz (2010) and Dalton (1986) in the literature. In addition, Çınar (2019) stated that there was no significant difference in problem-solving skills in the object-oriented robot programming study, which was carried out with the participation of high school students. From this point of view, it can be said that problem-solving skills do not differ according to grade level. Kalelioğlu and Gülbahar (2014) also concluded that there is no significant difference in the problem-solving skills of elementary school students in their programming activities with Scratch. Considering the Information Technologies and Software course curriculum published by the Ministry of Education and Discipline in 2018, the total duration of the Programming and Original Product Development, Problem Solving field in the annual plans corresponds to 11 weeks, 22 lesson hours. The lack of difference in this study can be shown as seven weeks, 14 lesson hours, and insufficient sample size. In a study conducted with Lego Wedo 2.0, which was developed by the Lego company and is more suitable for primary school level, Uğuz (2019) concluded that students' problem-solving skills were positively affected. As a matter of fact, Lego robotic tools are remarkable (Tse, 2019), encourage problem-solving (Mojica, 2010), enable learners to experiment (Şişman & Küçük, 2017) and teach by living by taking an active role in the process (Alimisis & Kynigos, 2009) emphasizes that it encourages students to solve problems with its features. In addition, Nam, Kim, and Lee (2010) and Calder (2010) concluded that programming education has an important effect on increasing students' problem-solving skills. In many studies, it has been concluded that vocational school students' problem-solving and analytical thinking skills are effective on programming success (Grant, 2003; Pillay & Jugoo, 2005). From this point of view, another reason why the results we obtained within the scope of the study were different from other studies can be shown by the selection of the appropriate sampling method.

When the results regarding the second question of the study were examined, it was determined that there was no statistically significant difference. These results are similar to studies of Tatlısu (2020), Vatansever and Baltacı Göktalay (2018), Açık (2013), Kasımoğlu (2013), Üstündağ and Beşoluk (2012) and finally Karaca and Yılmaz(2009). In addition to similar studies, Ülger (2012) found a significant positive difference in favor of female students according to the gender variable in her research in which she tried to determine the relationship between creative thinking skills and problem-solving skills 5th-grade students (n = 108).

The following recommendations may be given regarding the results of the research:

- Different results can be found by expanding the sample size or adding a control group.
- The problem-solving skills of different grade students' can be examined.
- The effect of different authentic tasks in robotics and coding courses on different thinking skills (such as creative thinking, critical thinking, algorithmic thinking) within 21st-century skills can be investigated.
- Studies can be carried out using different training sets (Lego Spike Prime, Lego Wedo 2.0) belonging to Lego company.
- By creating an experimental and control group; If there is a difference in terms of hardware and programming, problem-solving skills between the two trainings can be tested by using Lego Mindstorms Ev3 in the experimental group and Lego Spike Prime in the control group.
- The scope of authentic task-oriented applications can be expanded, and applications can be carried out in a longer period.
- By giving information about authentic learning and authentic tasks to the instructors who carry out the courses related to programming teaching, it can be supported to produce projects related to real-life problems.
- Apart from the Robotics and Coding course, research can be carried out by including authentic task-oriented applications in STEM studies that deal with problems in life.

References

Açık, S. (2013). *Lise öğrencilerinin öğrenme stilleri ve problem çözme becerileri arasındaki ilişkinin incelenmesi.* (Yüksek lisans tezi). Yükseköğretim Kurulu Ulusal Tez Merkezi'nden edinilmiştir. (Tez No. 336332)

Alimisis, A. D., & Kynigos, C. (2009). *Constructionism and robotics in education, Teacher education on robotics-enhanced constructivist pedagogical method,* 11-26. http://dide.ilei.sch.gr/keplinet/education/docs/book_TeacherEducationOnRobotics-ASPETE.pdf adresinden erişilmiştir.

Alkan, A. (2019). Özel yetenekli öğrencilerin programlama dili öğretiminde kodu game lab yazılımının problem çözme becerileri düzeyine etkisi. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi,* 50(1), 480-493. doi:10.21764/maeuefd.486061

Arisholm, E., Gallis, H., Dybå, T., & Sjøberg, D. I. K. (2007). Evaluating pair programming with respect to system complexity and programmer expertise. *IEEE Transactions on Software Engineering*, 33(2), 65–86. doi:10.1109/TSE.2007.17

Aydın Aşk, Z., (2016). *Matematik dersinde otantik görev odaklı öğrenme süreçlerinin incelenmesi: Bir eylem araştırması. Gaziantep Üniversitesi, Eğitim Bilimleri Enstitüsü:* Yayınlanmamış doktora tezi.

Barradas, R., Lencastre, J. A., Soares, S., & Valente, A. (2020). Developing computational thinking in early ages: A review of the Code.org platform. In Proceedings of the 12th International Conference on Computer Supported Education (CSEDU 2020, pp.157-168; May 2-4, 2020). ISBN: 978-989-758-417-6

Basawapatna, A. (2016). Alexander meets michotte: A simulation tool based on pattern programming and phenomenology. *Journal of Educational Technology & Society*, 19(1), 277-291.

Berenson, S. B., Slaten, K. M., Williams, L., & Ho, C. W. (2004). Voices of women in a software engineering course: reflections on collaboration. *Journal on Educational Resources in Computing (JERIC)*, 4(1), 3. doi:10.1145/1060071.1060074

Bilen, M. (1993). *Plandan uygulamaya öğretim: strateji, yöntem, teknik, taktik, plan, plan örnekleri, ders araç gereçleri.* Ankara: TAKAV.

Blancas, M., Valero, C., Mura, A., Vouloutsi, V., & Verschure, P. F. M. J. (2020). "CREA": An inquiry-based methodology to teach robotics to children. *In Advances in Intelligent Systems and Computing.* doi:10.1007/978-3-030-26945-6_4

Borthwick, F, Bennett, S, Lefoe, G. and Huber, E. (2007). Applying authentic learning to social science: A learning design for an inter-disciplinary sociology subject, *The Journal of Learning Design*, 2 (1), 14-24.

https://digitalcommons.usf.edu/m3publishing/vol3/iss2021/13
DOI: https://www.doi.org/10.5038/9781955833042

Brown, J. S., Collins, A. and Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18 (1), 32-42.

Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, Ö., Karadeniz, Ş., & Demirel, F. (2016). Bilimsel Araştırma Yöntemleri (21. baskı). Ankara: Pegem Akademi.

Calder, N. (2010). Using Scratch: An Integrated Problem-Solving Approach to Mathematical Thinking. *Australian Primary Mathematics Classroom*, 15(4), 9-14.

Cliburn, D. C. (2003). Experiences with pair programming at a small college. *Journal of Computing Sciences in Colleges*, 19(1), 20-29. Retrieved from http://dl.acm.org/citation.cfm?id=948741&CFID=380881129&CFTOKEN=42051081

Coşkun, M. (2004). Coğrafya öğretiminde proje tabanlı öğrenme yaklaşımı. (Yayınlanmamış Doktora Tezi). *Gazi Üniversitesi Eğitim Bilimleri Enstitüsü*, Ankara.

Dalton, D. W. (1986). *A Comparison of the Effects of LOGO Use and Teacher-Directed Problem-Solving Instruction on the Problem-Solving Skills, Achievement, and Attitudes of Low, Average, and High Achieving Junior High School Learners.* Paper presented at the Annual Convention of the Association for Educational Communications and Technology, Las Vegas, NV, USA.

Demir, F. (2015). *Programlama öğretiminde eğitsel programlama dilinin farklı kullanımlarının programlama başarısı ve kaygısına etkisi.* (Doktora tezi). Yükseköğretim Kurulu Ulusal Tez Merkezi'nden edinilmiştir. (Tez No. 429631)

Denner, J., Werner, L., & Ortiz, E. (2012). Computer games created by middle school girls: Can they be used to measure understanding of computer science concepts?. *Computers & Education*, 58(1), 240-249. DOI:10.1016/j.compedu.2011.08.006

Dewey, J. (1997). *How we think?* New York: Prometheus Books.

Dongo, T., Reed, A. H., & O'Hara, M. (2016). Exploring pair programming benefits for MIS majors. *Journal of Information Technology Education: Innovations in Practice*, 15, 223–239. DOI:10.28945/3625

Duran, M., Özdemir, F., & Kaplan, A. (2015). A research on the use of problem based learning approach: teaching of probability sample. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, 6(2), 250-284.

Fasy, Brittany Terese, Hancock, Stacey A., Komlos, Barbara Z., Kristiansen, Brendan, Micka, Samuel, & Theobold, Allison S. (2020). *Bring the Page to Life: Engaging Rural Students in Computer Science Using Alice.* iTiCSE 2020. Retrieved from https://par.nsf.gov/biblio/10176345. https://doi.org/10.1145/3341525.3387367

Ge, X. (2001). *Scaffolding students' Problem-solving processes on an Ill-structured task using question prompts and peer interactions.* (Doctoral dissertation), The Pennsylvania State University, Pennsylvania.

Gomes, A. & Mendes, A. J. (2007, September). *Learning to program – Difficultiesand Solutions.* Paper presented at International conference on Engineering Education, Coimbra/ Portugal. Retrieved from http://icee2007.dei.uc.pt/proceedings/papers/411.pdf, (Retrieved November 12, 2018).

Gomes, A., & Mendes, A. J. (2007). Learning to Program-difficulties and solutions. C. S. Furtado & M. d. G. Rasteiro (Ed.), *Proceedings of the International Conference on Engineering Education* (pp. 411). Maryland: International Network on Engineering Education and Research.

Göksoy, S. & Yılmaz, İ. (2018). Bilişim teknolojileri öğretmenleri ve öğrencilerinin robotik ve kodlama dersine ilişkin görüşleri. *Düzce Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 8(1), 178-196.

Grant, N. S. (2003). *A study on critical thinking, cognitive learning style, and gender in various information science programming classes*. The 4th Conference On Information Technology'nda sunulmuş bildiri, Indiana, USA.

Grout, Vic and Houlden, Nigel (2014) Taking computer science and programming into schools: The Glyndŵr/BCS Turing project. Procedia - Social and Behavioural Sciences, 141. pp. 680-685. ISSN 1877-0428

Hamurcu, G. C. (2016). *İlköğretim 7. sınıf Türkçe dersinde otantik öğrenmenin öğrencilerin problem çözme ve okuduğunu anlama becerileri ile derse ilişkin tutumlarına etkisi.* İnönü Üniversitesi, Eğitim Bilimleri Enstitüsü: Yayınlanmamış doktora tezi.

Hwang, W. Y., Shadiev, R., Wang, C. Y., & Huang, Z. H. (2012). A pilot study of cooperative programming learning behavior and its relationship with students' learning performance. Computers & Education, 58(4), 1267–1281. doi:10.1016/j.compedu.2011.12.009

Kabatova, M., Pekarova, J. (2010, Agust). *Lessons learnt with LEGO Mindstorms: From beginner to teaching robotics.* Paper presented at the 1st Slovak-Austrian International Conference on Robotics in Education, Bratislava.

Kalelioğlu, F., & Gülbahar, Y. (2014). The effects of teaching programming via scratch on problem solving skills: A discussion from learners' perspective. *Informatics in Education*, 13(1), 33-50.

Karaca, İ, Karaca, N. (2021). *Okul Yöneticilerinin Problem Çözme Beceri Algılarının İncelenmesi.* Uluslararası Sosyal Bilimler ve Eğitim Dergisi , 3 (4) , 181-200 . Retrieved from https://dergipark.org.tr/tr/pub/usbed/issue/61198/910190

Karaoğlu, H. (2018). *The influence of pair-programming technique on secondary school students' confidence and achievement in computer programming* (Yüksek lisans tezi). Yükseköğretim Kurulu Ulusal Tez Merkezi'nden edinilmiştir. (Tez No. 503649)

Kasımoğlu, T. (2013). *Öğretmen adaylarında eleştirel düşünme, mantıksal düşünme ve problem çözme becerilerinin çeşitli değişkenler açısından değerlendirilmesi.* (Yüksek lisans tezi). Yükseköğretim Kurulu Ulusal Tez Merkezi'nden edinilmiştir. (Tez No. 333418)

Kelleher, C., & Pausch, R. (2005). Lowering the barriers to programming. ACM Computing Surveys, 37(2), 83–137. doi:10.1145/1089733.1089734

Koç, B. (2015). *İşbirlikli öğrenme yönteminin matematik dersindeki erişiye, kalıcılığa ve sosyal beceriye etkisi.* (Yüksek Lisans tezi). Yükseköğretim Kurulu Ulusal Tez Merkezi'nden edinilmiştir. (Tez No.384728)

Kurebayashi, S., Kamada, T. & Kanemune, S. (2009). Learning computer programming with autonomous robots. International Conference on Informatics in Secondary Schools - Evolution and Perspectives (ss. 138–149).

Liu, A., Newsom, J., Schunn, C. & Shoop, R. (2013). Students learn programming faster through robotic simulation. *Tech Directions*, 72(8), 16-19.

Lye, S. Y., & Koh, J. H. L. (2014). Review on teaching and learning of computational thinking through programming: What is next for K-12? *Computers in Human Behavior*, 41, 51-61.

Martinez, M. E. (1998). What is problem solving?. *The Phi Delta Kappan*, 79(8), 605- 609.

McMillan, J. H., & Schumacher, S. (2014). Research in education: Evidence-based inquiry. Pearson Higher Ed.

Mojica, K. D. (2010). *Ordered effects of technology education units on higher-order critical thinking skills of middle school students*. New Jersey: Eisenhower.

Nam, D., Kim, Y., & Lee, T. (2010). The effects of scaffolding-based courseware for the Scratch programming learning on student problem solving skill. *ICCE2010*, 723-727.

Nicolescu, R., & Plummer, R. (2003). A pair programming experiment in a large computing course. Romanian *Journal of Information Science and Technology*, 6(1-2), 199-216. Retrieved from https://www.researchgate.net/publication/228824452_A_Pair_Programming_Experiment_in_a_Large_Computing_Course

Noh, J., & Lee, J. (2020). Effects of robotics programming on the computational thinking and creativity of elementary school students. *Educational Technology Research and Development*, 68, 463–484. doi: 10.1007/s11423-019-09708-w

Öndeş, Ö., (2016, 29 Şubat). *İngiltere ve ABD'de Kodlama Eğitimi*. Hürriyet. Web: http://www.hurriyet.com.tr/egitim/ingiltere-ve-abdde-kodlama-egitimi-40061604.

Pillay, N., & Jugoo, V. R. (2005). An investigation into student characteristics affecting novice programming performance. *ACM SIGCSE*, 37(4), 107 - 110.

Scheurman, G. and Newman, F. M. (1998). Authentic Intellectual Work in Social Studies: Putting Performance before Pedagogy. *Social Education*, 62 (1), 23-25.

Shin, S., & Park, P. (2014). A Study on the Effect affecting Problem Solving Ability of Primary Students through the Scratch Programming. 11.12.2017 tarihinde http://onlinepresent.org/proceedings/vol59_2014/27.pdf adresinden erişilmiştir.

Sırakaya, M. (2018). Kodlama Eğitimine Yönelik Öğrenci Görüşleri*. On dokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi,* 37(2), 79-90.

Strawhacker, A. & Bers, M. (2015). "I want my robot to look for food": Comparing kindergartner's programming comprehension using tangible, graphic, and hybrid user interfaces. *International Journal of Technology and Design Education*, 25, 293-319.

Şişman, B., & Küçük, S. (2018). Öğretmen adaylarınıin robotik programlamada akış, kaygı ve bilişsel yük seviyeleri. *Eğitim Teknolojisi Kuram ve Uygulama*, 8(2), 108-124.

Tatlısu, M. (2020). *Eğitsel robotik uygulamalarda probleme dayalı öğrenmenin ilkokul öğrencilerinin problem çözme becerilerine etkisi*. (Yüksek Lisans Tezi). Yükseköğretim Kurulu Ulusal Tez Merkezi'nden edinilmiştir. (Tez No. 610702)

Tse, S.B. (2009). *MINDSTORMS controls toolkit: Hands-on, project- based learning of controls.* (Master dissertation) Tufys University. Retrieved June 28, 2020 from https://www.learntechlib.com/p/129615

https://digitalcommons.usf.edu/m3publishing/vol3/iss2021/13
DOI: https://www.doi.org/10.5038/9781955833042

TTKB (2017). Bilgisayar bilimi dersi öğretim programı. http://ttkb.meb.gov.tr/program2.aspx/program2.aspx?islem=1&kno=196 adresinden alınmıştır.

Uğuz, H. (2019). *Lego robotikle programlamanın ortaokul öğrencilerinin problem çözme becerilerine ve başarılarına etkisi.* (Yüksek Lisans tezi). Yükseköğretim Kurulu Ulusal Tez Merkezi'nden edinilmiştir. (Tez No. 584836)

Üstündağ, S., & Beşoluk, S. (2012). Fen bilgisi öğretmen adaylarının problem çözme becerilerinin çeşitli değişkenler açısından incelenmesi. *10. Ulusal Fen Bilimleri Kongresi*, (s. 1-8). Niğde.

Vatansever, Ö., & Baltacı Göktalay, Ş. (2018). How Does Teaching Programming through Scratch Affect Problem-solving Skills of 5th and 6th Grade Middle School Students?, *International Journal of Eurasia Social Sciences*, 9(33), 1778-1801.

Wong, G. K. W., & Cheung, H. Y. (2020). Exploring children's perceptions of developing twenty-first century skills through computational thinking and programming. *Interactive Learning Environments*, 28(4), 438-450. doi: 10.1080/10494820.2018.1534245

Young, M. F. (1993). Instructional Design for Situated Learning. *ETR&D*, 41(1), 43-58.

Yükseltürk, E., & Altıok, S. (2016). *Bilişim teknolojileri öğretmen adaylarının programlama öğretiminde Scratch aracının kullanımına ilişkin algıları.* Mersin Üniversitesi Eğitim Fakültesi Dergisi, 12 (1), 39-52.