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## **Analysis of Studies on Coding Education: A Meta Synthesis Study**

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**Abstract:** In this research, 39 studies carried out between 2015 and 2021 were examined by metasynthesis method. In this context, current trends in published research on coding education in Turkey have been tried to be determined. Studies on coding education in Turkey were examined according to the years they were published, the subject and application areas of the studies, research methods, study groups, data collection tools, data analysis techniques, results and suggestions. In order to examine the publications included in the research, a data collection form was developed by the researchers and analyzed within the framework of the determined categories. As a result of the findings, it was seen that more studies were carried out on coding education in 2019-2020, studies were carried out to determine opinions on robotics and coding education, studies were carried out in the field of educational science, case study and experimental design were preferred, mostly secondary school students were preferred as the study group, and the data were collected mostly by interview technique. It has been revealed that content analysis is frequently used in analysis. When the studies examined, it was seen that mostly results were obtained to explain the current situation and suggestions for applications were included. In line with the results of the research, longitudinal or experimental studies can be made for coding education.

**Keywords:** Coding education, Robotic coding, Metasynthesis

### **Introduction**

With the 21st century, different skills come to the fore in education programs. Critical thinking, problem solving, communication, collaboration, information and technology literacy, flexibility and adaptability, global competencies and financial literacy are the basic 21st century skills. Another skill that supports these skills is coding. In the 2023 vision document of the Ministry of National Education indicated that in the three-year period at primary, secondary and high school levels, students, teachers, education administrators, public, curriculum, educational content, etc., at school and out of school. The studies to be carried out for this vision are stated and these studies will provide integration of production skills such as coding, 3D design, electronic design into learning processes (MEB, 2022). For this reason, studies on coding education are carried out in Turkey as well as in the world.

Coding education for students plays an important role in developing analytical and critical thinking skills (Higuera-Rodriguez & Medina-Garcia, 2020). At the same time, increasing reasoning skills, developing problem-solving skills and developing design-oriented ideas are at the center of coding-oriented studies in the field of education. Providing the necessary infrastructure for students to achieve these skills will be an important step.

With the development of technology day by day, new educational approaches and models have emerged. One of these models is the robotic coding education model. Robotic coding education is a sub-dimension of STEM

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(Reader, 2019). Developments such as driverless cars and unmanned aerial vehicles have increased people's interest in robotics and have expanded development platforms that even non-engineers can work on it (Ozturk, 2017).

As a word meaning, a robot is a device that can detect movements in its environment, interpret what it perceives and make decisions as a result, transform its decision into action with an output signal, and make autonomous or semi-autonomous decisions thanks to its sensors (Okuyucu, 2019). In addition, robots can be defined as devices consisting of self-controlled electronic and mechanical units by programming (Arora, 2008). The content of robots must have the features of perception, planning and action. These features enable robots to detect objects around them, make a plan that enables them to act appropriately, and take actions other than perception in order to interact with their environment (Okuyucu, 2019). With the development of technology, robots and autonomous vehicles take more place in our daily lives, and the importance of the software that runs them is increasing (Ozturk, 2017).

Coding; In other words, programming is called block-based programming, which literally means combining and bringing together the operations that are planned to be carried out according to certain rules and order (Reader, 2019). Coding is also defined as a special sub-task of programming that allows the writing of instructions to fulfill the purpose according to an algorithmic scheme and the use of the algorithm in specified programming languages (Guleryuz, 2019). Coding is a language used for individuals to communicate with communication technologies. It is telling computers to follow step-by-step instructions and what exactly they need to do (Gultepe, 2018). Considering all these definitions, it can be said that coding is the appropriate set of commands in any coding language, the algorithm created to deliver computer-functional electronic devices to a specific purpose.

Robotic coding, on the other hand, is defined as block-based programming to control and direct the movements of a robot created for various purposes (Reader, 2019). In addition, "the process of writing commands consisting of symbols and special words prepared to provide certain functions to electronic devices is defined as coding or programming" (Ersoy et al., 2011)

Coding education has an important place in the education of individuals who are equipped with 21st century skills, have problem solving and product development skills, and can use technology effectively. Recently, with coding education and robotics, twenty-first century skills such as problem solving, algorithmic thinking, and critical thinking skills have been tried to be taught especially to younger age groups (Barr & Stephenson, 2011; Fessakis, Gouli, & Mavroudi, 2013; Grover & Pea, 2013).

Coding education in Turkey has been included in the Information Technologies and Software course starting from the 5th grades since 2012. In addition, it is seen that there are contents for coding, programming and engineering skills in the programs of courses such as science courses, technology and design courses. When it comes to such small age groups, it is not possible to teach coding with traditional teaching methods. In accordance with the constructivist approach, it is necessary to ensure that the child learns through play, learns by doing and living, and the organized learning environment is student-centered (Uzun & Uz, 2018). It is clear that teachers who will teach these courses and provide students with coding and algorithmic thinking skills should be trained in a similar context instead of the traditional approach in order to organize a suitable learning environment for students (Hubwieser et al., 2015).

Numerous studies have been conducted in the literature to determine the effect of coding on various variables. When the results obtained from the studies are examined, it has been revealed that the variables that examine the effect of the use of robotics in education are effective in gaining students (Barak & Zadok, 2009). In another study, the importance of coding content and the importance of determining students' views on this subject and teachers' content knowledge levels were mentioned (Ozcinar et al., 2016). It has been determined that there is a steady increase in studies on coding education (Talan, 2020). It has been emphasized that the success of integrating coding education into the school curriculum will depend on teachers' perceptions of coding and how much they are prepared for innovative teaching activities (Wong et al., 2015). There are many studies on coding education in Turkey in recent years. However, these studies differ from each other. A metasynthesis study was needed to determine the trends in these studies. In addition, coding education has started to take its place in the lessons since 2012 in Turkey. In addition, since 2019, it has come to the fore to provide information technology teachers with in-service training on coding education (YEGITEK, 2019). The integration of coding skills into learning processes is emphasized in the 2023 vision document of the Ministry of National Education (MEB, 2022). In this study, in terms of showing the current trends in the studies conducted before 2023, it is aimed to determine the trends in the studies conducted between 2015-2021 on coding education in Turkey.

## **Research Questions**

It is aimed to consider the meta-synthesis method according to the regulations made in education in Turkey, publication years, application area, system analysis, concluding methods, data collection tools, data analysis, and recommendations. In addition, in this study, research on tendency towards coding education was interpreted and synthesized. In this study, answers to the following questions were sought.

- 1- In which years did the research on coding education take place?
- 2- What are the subjects and application areas of research on coding education?
- 3- What are the research methods used in research on coding education?
- 4- Which study groups were preferred in the studies on coding education?
- 5- What are the data collection tools used in research on coding education?
- 6- What are the data analysis techniques used in research on coding education?
- 7- What are the results of the researches on coding education?
- 8- What are the suggestions developed in research on coding education?

## **Material and Methods**

### **Research Model**

In this study, meta-synthesis research method, which is a qualitative research design, was used to reveal the trends in the studies on coding education and to synthesize the obtained data. Meta-synthesis is a qualitative methodology that uses both qualitative and quantitative studies as data or analysis units (Bair, 1999; Paterson, et al., 2001; Strobel & van Barneveld; 2009). Meta-synthesis is the grouping of similar studies on a determined subject, theme or field of study under certain criteria and reinterpreting the qualitative findings or interpretations of these studies by combining and comparing them (Campbell et al., 2003; Calik & Sozbilir, 2014; Walsh & Downe, 2005). Data analysis units differ according to different researchers. In this research, both quantitative and qualitative studies were used as data analysis unit.

### **Data Sources and Data Collection Tool**

In this study, the problem was defined according to the meta-synthesis steps developed by Walsh and Downe (2005). In this study, graduate theses and academic articles about robotics and coding education between 2015-2021 were examined. Within the study, 39 articles were examined by reaching the full texts in pdf format made in the field of robotics and coding education. The studies and graduate theses examined within the scope of the study were accessed through the databases of ULAKBIM, Google Akademik, Dergipark, Eric and YOK National Thesis Center using the keywords "coding" and "robotic coding" applications. Certain criteria have been established about whether or not these studies will be included in the research. These criteria are that the studies were conducted within national borders, they were between 2015-2021, the full text of the study was reached, and it included the keywords of coding or robotic coding applications. For this reason, as a result of the eliminations made according to the criteria, 39 articles suitable for the purpose of this study were included in the research (Appendix-1).

A publication evaluation form was developed by the researchers to examine the publications included in the study (Table 1). In this form, there are nine categories: the year the research was published, the subject and application area, research method, study group, data collection tool(s), data analysis technique, results and suggestions. While these data collecting, meta-synthesis steps developed by Walsh and Downe (2005) were applied. These steps are expressed as searching for articles, making decisions about inclusion, evaluation studies, conceptualizing and comparing the steps of analyzing studies involving "translation" of different texts, synthesizing the findings.

### **Data analysis**

In publication evaluation form there are categories for describing the year the research was published, the subject and application area, the research method, the study group of the research, data collection tools, data analysis techniques, results and recommendations. 39 articles included in the research were analyzed within the framework of the determined categories. During the data analysis process, a code from 1 to 39 was given to each

study according to the year it was published (2015-2021) (S1, S2, .... S39). These codes were used during the presentation of the findings.

Table 1. Publication evaluation form

Code	Year of publication	Subject Area of the Study	Field of Application of the Study	Method of the Study	Group of the Study	Data Collection Tools	Data Analysis Techniques	Results	Recommendations
S-1									
S-2									
.									
.									
S-39									

### Validity and reliability

In this study, validity and reliability were tried to be ensured within the framework of these principles. Verifiability is ensured by a comprehensive collection of findings from a large number of studies involving various methodological approaches (Bair, 1999). To ensure verifiability in this meta-synthesis study, all studies that met the inclusion criteria were read and recorded by creating a summary form. In order to ensure the reliability or credibility of the findings, the selected articles were reviewed by another expert. Lincoln and Guba (1985) suggested making a detailed description, including direct quotations in the report, and using a language that is understandable for the reader to ensure the transferability of the research. In order to ensure the transferability in this study, the year of publication of the research, the subject and application area, the method of the research, the study groups of the research, the data collection tools, the data analysis techniques, the results and suggestions were created in tables to describe the results and suggestions, and presented to the reader in detail in the findings section.

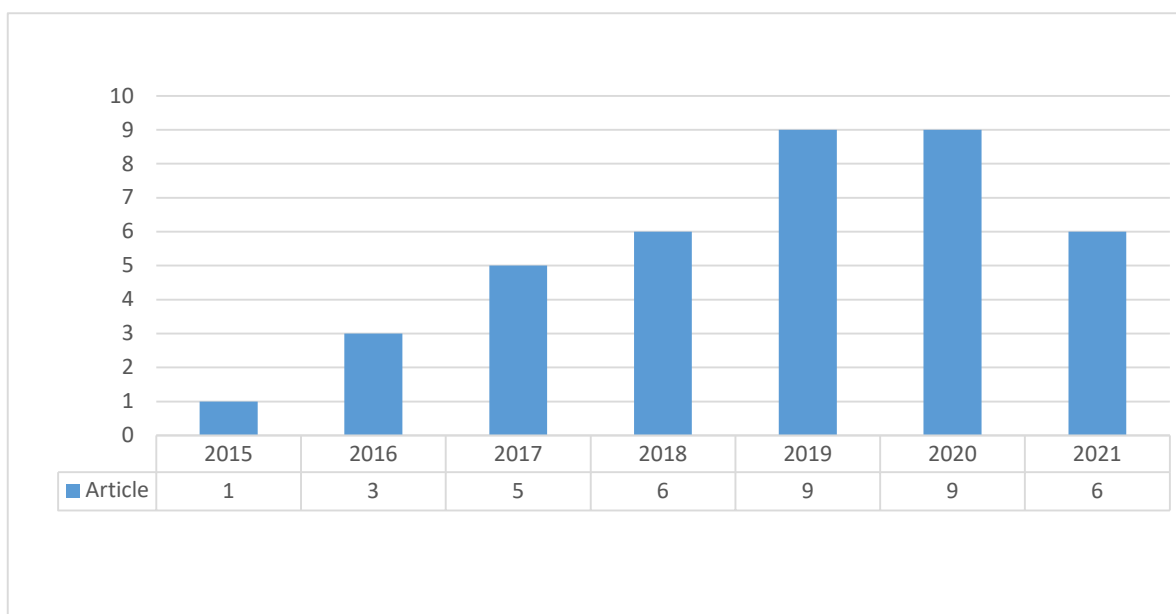


Figure 1. Distribution of the studies according to years

## Results and Discussion

Studies on coding education in Turkey were examined by meta-synthesis method with sub-objectives (year of publication, subject and application areas, research methods, study groups, data collection tools, data analysis techniques, results and suggestions). The findings obtained in this study are presented above. When the distribution of studies on coding education in Turkey according to the years of publication is examined, it has been determined that it belongs to the year 2019 and 2020 with the most 9 articles. It was determined that the least number of articles belonged to 2015 with 1 articles (Figure 1).

When the studies on coding education in Turkey are examined in terms of subject areas, it is seen that most of the studies are on coding education applications, followed by opinions on coding education and studies on product or program development in coding education (Table 2).

Table 2. Examination of the studies conducted in coding education according to the subject areas

Subject area	Studies	f
Opinions on coding education	S1, S2, S3, S4, S5, S6, S11, S12, S13, S14, S15, S16, S18, S23, S24, S25, S26, S27, S28, S30, S32, S34, S37, S39	24
Coding education apps	S7, S17, S21, S29, S31, S33, S35, S36, S38	9
Product or program development in coding education	S8, S9, S10, S19, S20, S22	6

When the studies are examined according to the fields of application, it is seen that the studies are mostly carried out in the field of education science and computer and engineering education followed it. However, there are few studies in the field of special education and music education for coding education (Table 3).

Table 3. Examination of the studies conducted in coding education according to the application areas

Application area	Studies	f
Educational science	S1, S2, S3, S4, S5, S6, S7, S8, S11, S21, S22, S23, S25, S26, S28, S29, S30, S31, S32, S35, S37, S39,	22
Computer education	S10, S13, S14, S15, S17, S18, S24, S27, S38	9
Engineering education	S9, S19, S20, S34	4
Special education	S16, S33, S36	3
Music education	S12	1

In the article studies on coding education in Turkey, it has been determined that the case study design, which is one of the qualitative research methods, is mostly preferred. The case study pattern was followed by document analysis, phenomenology and action research. Experimental design was mostly preferred among the quantitative research methods. The experimental pattern was followed by design research, survey method and cause and effect design. The findings regarding the research method in coding education studies in Turkey are presented in Table 4.

Table 4. Findings regarding the preferred research method in coding education

	Research method	Studies	f
Qualitative	Case study	S5, S11, S14, S15, S18, S23, S32, S37	8
	Document analysis	S4, S1, S6	3
	Phenomenology	S25, S39	2
	Action reasearch	S22	1
Quantitative	Experimental design	S3,S17,S29,S31,S33,S35,S36,S38	8
	Design research	S8,S9,S10,S19,S20	5
	Survey method	S2, S16, S13, S30	4
	Cause and effect design	S21	1
Mixed		S7,S12,S24,S26,S27,S34	6

When the findings related to the study group preferred in coding education were examined, it was determined that the most studies on coding education were preferred by secondary school students. The study group of teachers followed the secondary school students. The study group with the least number of studies was the study in which one parents were involved (Table 5).

Table 5. Findings regarding the preferred study group in coding education

Study group	Studies	f
Secondary school students	S2, S3, S5, S7, S13, S14, S17, S21, S27, S29,S30,S32,S35,S37	14
Teachers	S12, S13, S14, S15, S18, S23,S24,S28,S34	9
Primary school students	S3, S16, S22, S31,S33,S37	6
Product development equipment (mbot, Arduino, software etc.)	S8,S9,S19,S20	4
High school students	S3,S5,S37,S38	4
Document (article,thesis etc.)	S1, S4, S6, S26	4
Undergraduate students	S10, S16,S25	3
Associated degree students	S11,S36	2
Preschool students	S37,S39	2
Parents	S13	1

Interview form was mostly preferred in data collection tools for studies on coding education. Interview forms are followed by scales and questionnaires. In the examined studies, it is seen that document review, achievement test, observation form, visual material, and performance evaluation rubric are used less as data collection tools. The data collection tools preferred for coding training are presented in Table 6.

Table 6. Findings on preferred data collection tools in coding education

Data collection tools	Studies	f
Interview form	S5, S7, S10, S11, S14, S15, S18, S22, S23, S24, S25, S27, S28, S32, S33, S34, S36, S39	18
Scale	S2, S16, S17,S21, S24, S29, S30, S33, S35, S38	10
Questionnaire	S3, S8, S12,S13,S23, S30, S34	7
Document review form	S1, S4, S6, S26	4
Achievement test	S7, S27, S31	3
Observation form	S22, S37	2
Visual material	S22, S39	2
Performance evaluation rubric	S7	1

In quantitative studies on coding education, mostly descriptive statistics were used. It is seen that this is followed by the analyzes to test whether the work created for product observation and testing in the design research is working, and the tests that reveal the differences between the groups. It has been determined that content analysis is mostly preferred in qualitative studies on coding education. It is seen that content analysis is followed by descriptive analysis. Also there are studies using thematic analysis and thinking aloud protocol analysis. The data analysis techniques preferred in coding education are presented in Table 7.

Table 7. Findings on data analysis techniques preferred in coding education

Method	Data analysis techniques	Studies	f
Quantitative	Descriptive statistics	S2,S16,S21,S24,S30,S34,S35,S36,S38	9
	Tests revealing differences between groups	S3, S17,S24,S29, S31, S33	6
	Product observation and testing in design research (testing whether the resulting product works)	S8,S9,S19,S20,S37	5
Qualitative	Content analysis	S6,S11,S12,S13,S15,S18,S22,S23,S24, S25,S26,S28,S32,	13
	Descriptive analysis	S1, S4,S5,S10,S12,S14,S15,S27,S39	9
	Thematic analysis	S7	1
	Think aloud protocol analysis	S16	1

When the studies are examined in terms of their results, it is seen that there are mostly results for explaining the current situation, followed by the results for intervention, product or program development. The results which preferred in coding training are presented in Table 8.

**Table 8. Findings regarding preferred outcomes in coding education**

Results	Studies	f
Conclusions to explain the current situation	S1, S2, S4, S5, S6, S11, S12, S13, S14, S15, S16, S18, S21, S23, S24, S25, S26, S27, S28, S30, S32, S34, S37, S39	24
Consequences for intervention	S3, S7, S17, S29, S31, S33, S35, S36, S38	9
Results for product or program development	S8, S9, S10, S19, S20, S22	6

In the studies on coding education, it is seen that the suggestions are mostly made for applications. This is followed by recommendations for future research and program development. Preferred recommendations in coding education are presented in Table 9.

**Table 9. Findings regarding preferred suggestions in coding education**

Recommendations	Studies	f
Suggestions for application	S2, S3, S5, S8, S11, S13, S14, S15, S16, S18, S21, S22, S23, S24, S25, S27, S28, S29, S32, S36, S38, S39	22
Recommendations for program development	S1, S4, S10, S14, S24, S28, S33, S34, S37, S38, S39,	11
Suggestions for future researchs	S6, S7, S9, S12, S19, S20, S26, S30, S31, S35	10
Those don't offer suggestions	S17	2

## **Conclusion**

In the research, it is considered important in terms of revealing the trend in the studies on coding and robotics between 2015-2021. In this study, the results obtained from the researches on coding education in Turkey were discussed. In this context, when the distribution of studies on coding education in Turkey according to the years of publication is examined, most of studies were found in 2019 and 2020, while the least number of studies were found in 2015. Considering the publication years of the studies, it is seen that the studies continue to increase. This finding coincides with the findings of the other studies in the literature (Aksu & Durak, 2019; Schad & Jones, 2020; Talan, 2020; Yolcu & Demirer, 2017).

When the studies on coding education in Turkey are examined in terms of subject areas, it is seen that most of the studies are on coding education applications, followed by opinions on coding education and studies on product or program development in coding education. Studies on the use of robotics in education are seen to be conducted on applications (Costa & Fernandes, 2008; Lindh & Holgersson, 2007; Shimada et al., 2012; Sullivan & Bers, 2017; Sanal & Erdem, 2017; Varnado, 2005; Williams et al., 2007). As a result of applied studies on robot design, robot competitions and robot projects, students can develop many skills such as problem solving, finding practical solutions to problems, critical thinking, realizing their own abilities, gaining first-hand experiences by doing and living, increasing the level of using technology and more willingness to use technology. It has been seen that they won (Costa & Fernandes, 2008). In a study by Sanal and Erdem, (2017), the effects of coding and robotics studies on problem solving skills were investigated. The problem solving processes of the students who did coding and robotics studies in the research and the problem solving processes of the students who did not do coding and robotics studies; It has been concluded that if the problem is technical, it varies. However, some studies suggested that students working with Lego and robots do not contribute significantly to their problem solving skills and student success (Lindh & Holgersson, 2007; Varnado, 2005), they do not provide a rich content to students in mathematics, science and engineering and do not provide very specific information. In studies on robots, it has been seen that the using of robots in education has positive effects on students' cognitive, language, social and moral development. In a study conducted by Cankaya et al., (2017), it was concluded that students' opinions about their education with robotic programming were generally positive, and that the education provided was motivating, entertaining and contributed to programming learning.

When the studies are examined according to the fields of application, it is seen that the studies are mostly done in the field of education, followed by computer and engineering education. However, there are few studies in the

field of special education and music education for coding education. In the study conducted by Yolcu and Demirer (2017), it was found that these disciplines, in which the use of robotics in education is mostly in STEM studies, are composed of science and technology, robot applications, computer science, camp programs, foreign language, mechatronics, physics, chemistry, biology and electronics courses, respectively. This finding supports the finding of the study. In the study conducted by Talan (2020), it was understood that the studies on educational robotics applications were mostly structured in the field of Information Technologies. Coding is not only limited to computer science, but also very important in terms of interdisciplinary interaction (STEM) (Guleryuz, et al, 2020).

In the article studies on coding education in Turkey, it has been determined that the case study design, which is one of the qualitative research methods and experimental design, which is one of the quantitative research methods, is mostly preferred. The case study pattern and experimental design were followed by, design research and mixed design from quantitative research methods. It has been determined that the least used research methods related to coding education are action research from qualitative research methods, causal comparison designs from quantitative research methods. In the study conducted by Yolcu and Demirer (2017), it was seen that qualitative, quantitative and mixed methods were preferred, respectively, and the fact that qualitative case studies and quantitative experimental research designs were predominantly used in these studies is similar to this finding. In a study conducted by Donmez (2017), in which the opinions of students and team coaches on robotic tournaments were examined within the framework of STEM education and a case study pattern was used, it was determined that robot kits were fun and functional, attracted students' attention, increased their motivation, and increased their interest in research and scientific studies. In the study conducted by Talan (2020), in which studies on educational robotics applications are examined, it is striking that quantitative and mixed methods are based on as a research method, but the qualitative method is relatively not preferred.

When the findings related to the study group preferred in coding education were examined, it was determined that secondary school students were preferred the most in the studies on coding education. The study group following the secondary school students was the teachers. The study group with the least number of studies was the study in which one parent was involved. This finding can be considered as an indication that science, technology and engineering education is given from an early age to meet the qualified workforce needs of countries (Sullivan & Bers, 2017). In secondary school, however, students encounter different disciplines. These disciplines include disciplines in STEM education such as science, mathematics, technology and design. This situation can be considered among the reasons for the high number of studies at the secondary school level. Talan (2020) concluded in his study that most of the studies on coding are done at the secondary school level. In addition, in the study conducted by Yolcu and Demirer (2017), it was concluded that the studies on the use of robotics in education were mostly carried out in the secondary school, primary school and pre-school period, respectively. These results are consistent with the results of this study. As a result of the research conducted by Talan (2020), it was understood that the studies were generally carried out at the secondary school level. As robots become more common in our daily lives, the use of educational robot kits is becoming a popular tool to provide children with opportunities to learn how to make their own robots (Resnick, 1998). According to Bers (2007), while most of the studies are done in middle and high schools (Rogers & Portsmore, 2004), recent studies have started to look at the use of robotics in early childhood, preschool classrooms (Bers et al., 2002; Cejka et al. , 2006). Unlike the generations who memorize, do not question, and cannot criticize, these skills are tried to be instilled with coding education at an early age in order to raise new individuals equipped with 21st century skills. While the basic information of coding education was learned in engineering faculties, today these trainings are given at secondary school levels. This situation provides benefits for students to learn software education in the process and in a more solid way.

In the studies on coding education, the data collection tools were mostly preferred by the interview form. This is followed by scales and surveys. In the studies examined, it is seen that achievement test, observation form, visual material, document review and performance evaluation rubric are used less as data collection tools. Among the data collection tools used in the study conducted by Yolcu and Demirer (2017), it is seen that observation and interview forms are used the most. While the interview part of this finding is in parallel with this result, the observation form explains the opposite situation. In this study, it can be said that the preference of interview, one of the data collection tools, is related to qualitative studies and mixed studies. In the study conducted by Talan (2020), it was concluded that the most used data collection tools were learning level/achievement, interview, observation, attitude and questionnaire.

It has been determined that content analysis is mostly preferred in qualitative studies on coding education. It is seen that this is followed by descriptive analysis. It is seen that descriptive statistics are mostly used in quantitative studies on coding education, followed by analyzes to test whether the product created for product



observation and testing in design research works, and tests that reveal the differences between groups. In a study conducted by Talan (2020), it was determined that the most used data analysis technique in the studies examined was frequency/percentage, mean/standard deviation, t-test and ANOVA. It is important to choose the right method in studies and to apply the chosen method appropriately (Frankel & Devers, 2000).

When the studies are examined in terms of the results, it is seen that mostly results are found to explain the current situation, followed by the results for intervention and product or program development. In the examination of the results of the studies on coding education in Turkey, the most coding education; It has been stated that it significantly affects attitudes, thoughts, verbal creativity, attitudes towards technology, motivation, self-efficacy and perceptions. It can be said that coding and robotics education improves students' self-confidence by increasing their attitudes and motivation towards the lesson (Akman-Selcuk, 2019; Kilinc, 2014; Talan, 2020; Yolcu, 2018). Another is that there are results that have a positive effect on thinking styles (problem solving, critical thinking, reasoning, creative thinking, mental image, etc.). Similar studies have shown that coding and robotic education increase problem solving skills (Canbeldek, 2020; Sanli & Erdem, 2017). In fewer studies, it has been determined that students perform active learning with the help of robotic codes, some limitations of educational robotic applications are determined, there is no learning loss according to the forgetfulness levels of coding and robotic subjects, the in-service training period in coding education is insufficient and limited, and the software functionally meets certain expectations. performance, usability, safety, reliability and maintainability have been determined as the results that add added value to the hardware on which it works.

It is seen that descriptive statistics are mostly used in quantitative studies on coding education, followed by analyzes to test whether the product created for product observation and testing in design research works, and tests that reveal the differences between groups. It has been determined that content analysis is mostly preferred in qualitative studies on coding education. It is seen that this is followed by descriptive analysis. In a study conducted by Talan (2020), it was determined that the most used data analysis technique in the studies examined was frequency/percentage, mean/standard deviation, t-test and ANOVA. It is important to choose the right method in studies and to apply the chosen method appropriately (Frankel & Devers, 2000).

When the studies are examined in terms of the results, it is seen that mostly results are found to explain the current situation, followed by the results for intervention and product or program development. In the examination of the results of the studies on coding education in Turkey, the most coding education; It has been stated that it significantly affects attitudes, thoughts, verbal creativity, attitudes towards technology, motivation, self-efficacy and perceptions. It can be said that coding and robotics education improves students' self-confidence by increasing their attitudes and motivation towards the lesson (Akman-Selcuk, 2019; Kilinc, 2014; Talan, 2020; Yolcu, 2018). Another is that there are results that have a positive effect on thinking styles (problem solving, critical thinking, reasoning, creative thinking, mental image, etc.). Similar studies have shown that coding and robotic education increase problem solving skills (Canbeldek, 2020; Sanli & Erdem, 2017). In fewer studies, it has been determined that students perform active learning with the help of robotic codes, some limitations of educational robotic applications are determined, there is no learning loss according to the forgetfulness levels of coding and robotic subjects, the in-service training period in coding education is insufficient and limited, and the software functionally meets certain expectations. performance, usability, safety, reliability and maintainability have been determined as the results that add added value to the hardware on which it works.

It is seen that the suggestions made in the studies on coding education are mostly made for applications. It is seen that this is followed by suggestions for future research and program development. Similarly, a study emphasized that the success of integrating coding education into the school curriculum will depend on teachers' perceptions of coding and how much they are prepared for innovative teaching activities (Wong et al., 2015). With the development of the Internet and technology, software and coding are also developing. For this reason, the prominence of suggestions for providing in-service training on robotic coding to the stakeholders of the education and for the inclusion of robotics and coding courses in the curriculum and their association with the achievements explains this situation. In the study conducted by Wong et al., (2015) to determine the difficulties of integrating coding education into the school curriculum, it was revealed that teachers need training and have deficiencies related to the curriculum. In the study conducted by Yukselturk and Altiok (2015), it was concluded that teacher candidates want to be informed about developing technologies and they need this type of training to improve themselves. Sonmez and Sahinkayasi (2021), in the study of teachers' views on the maker movement and robotic coding activities, stated that most of the participants, administrators, teachers and parents did not have the knowledge and skills about MH and RC, they had difficulty in finding support for their studies on the subject. He also stated that it prevented the spread of related activities. In another study conducted by Oz Yildiz

et al., (2020), it was concluded that teachers expect in-service training on the subject to be given by the National Education Directorates. YEGITEK (2019), on the other hand, suggested in his report that regular in-service training should be provided for information technology teachers and that coding education should be included in training-support courses. Wong et al., (2015) emphasized that the success of integrating coding education into the school curriculum will depend on teachers' perceptions of coding and how well they are prepared for innovative teaching activities. In many countries, various training activities are organized for teachers in order to disseminate educational robotic activities in educational institutions (Kim et al., 2015).

Countries, educators and scientists, who are aware of the importance of providing science, technology and engineering education to students in the first years of their education, are trying to conduct various researches to examine the effects of computer and robotic use in education in order to gain these skills (Bers, 2007). For this reason, it is evident that there is an increased interest in studies on the use of robotics in education and studies examining the effects of many different variables (Yolcu & Demirer, 2017). As a result of this study, in 2020, more studies were carried out on coding education, studies were carried out to determine opinions on robotics and coding education, case study was preferred more than qualitative research, mostly secondary school students were preferred as the study group, data were collected mostly by interview technique, and the analyzes were analyzed. It has been revealed that content analysis is frequently used. In the studies, it was seen that mostly results were obtained to explain the current situation and suggestions for applications were included.

## **Recommendations**

In this research, it is aimed to examine the studies on coding and robotics education in different dimensions and to share the results with researchers. The following recommendations can be made as a result of this research. While it is known that the examined studies contribute to the field of coding education from different dimensions, it is thought that examining the relevant literature as a whole on the basis of these dimensions will contribute to the perspectives on coding education. It is thought that this study will guide future research. As a result of this study, it is seen that there are many studies conducted with secondary school students. However, there are also studies for high school and pre-school. In other studies to be done, longitudinal studies related to robotic coding can be planned. In addition, studies based on different years, using different methods and different data collection tools can be examined. When the studies are examined in terms of the results, it is seen that there are mostly results to explain the current situation, however, the suggestions made in the studies on coding education are mostly for applications. This situation raises the need for more experimental studies on robotic coding. Here, the proficiency level of knowledge and skills of teachers, who have an important role in practice, comes to mind. In a study conducted by Wong et al., (2015) to determine the difficulties of integrating coding education into school programs, it was revealed that teachers needed training and had deficiencies related to the curriculum. In addition, in many countries, various training activities are organized for teachers in order to disseminate educational robotic activities in educational institutions (Kim et al., 2015). In Turkey, in-service trainings can be organized for practitioners to associate coding education with the program and to implement it.

## **Conflict of interest statement**

The authors declare that there is no conflict of interest.

## **Scientific Ethics Declaration**

The authors declare that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the authors.

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**Appendix-1. Information on studies examined in coding education**

Code of the Study	The Identity of the Study	The aim of the study
S1	(Catlak, Tekdal & Baz, 2015)	The aim of this study is to examine the scientific studies made with the Scratch programming language and to share the results with the relevant segments.
S2	(Kececi, Alan & Zengin, 2016)	In this study, it is aimed to develop a measurement tool that can be used to determine secondary school students' attitudes towards coding learning supported by educational computer games.
S3	(Zengin, 2016)	The purpose of this research; The aim of this study is to examine the changes in students' views on the use of robotic systems in interdisciplinary education, from primary school to the end of high school, according to the variables.
S4	(Demirer & Sak, 2016)	The purpose of this study is to introduce innovative approaches and practices that emerged in the programming field, by shedding light on the current state of the programming education around the world and specifically in Turkey.
S5	(Donmez, 2017)	To determine the opinions of middle school, high school students and team coaches who participated in the "First Lego League/Science Heroes Meet" tournament within the framework of STEM education on the tournament process, robot design, programming and cooperation
S6	(Yolcu & Demirer, 2017)	Examining the studies on the use of robotics in education with a systematic view
S7	(Cankaya, Durak & Yunkul, 2017)	To examine the performances and opinions of students who receive programmatic education with robots.
S8	(Numanoglu & Keser, 2017)	To determine the usability of the mBot- STEM Educational Robot Kit platform, produced and developed by Makeblock, in teaching programming
S9	(Suzen, Ceylan, Cetin & Ulusoy, 2017)	Modeling a robot that draws on the X-Y plane using an Arduino development board
S10	(Uzun & Uz, 2018)	Developing the curriculum of the course by conducting a needs assessment for the elective course 'Embedded Systems and Robotic Applications' taken by the pre-service teachers studying at the Department of Instructional Technologies
S11	(Yilmaz-Ince, 2018)	To reveal the necessity of diversifying and strengthening education in the field of software with the rapidly developing technology.
S12	(Karademir, Cesur, Buyukergen, Kaba & Keseci, 2018)	Examining teacher opinions on whether robots can be used in music education
S13	(Turker & Pala, 2018)	To determine the opinions of 5th and 6th grade students, information technologies and software course teachers and parents of students about coding
S14	(Goksoy & Yilmaz, 2018)	To determine the opinions of the students who take robotics and coding courses and the information technology teachers who teach the course about robotics and coding course.
S15	(Gultepe, 2018)	To examine the reflection of the project on the students through the eyes of the teachers teaching coding (programming) within the scope of the project.
S16	(Alkan, 2019)	To determine the attitudes of gifted students who are educated in a programming environment where students can prepare three-dimensional games with the logic of programming and algorithms towards computer games-assisted coding learning.
S17	(Esgil & Gunduz, 2019)	To determine the effect of using coding activities in computer lessons on students' attitudes towards computers and their affective participation in information technologies lesson.
S18	(Aksu & Durak, 2019)	Examining robotics coding and robotics tournaments from the perspective of Information Technology (IT) teachers
S19	(Topuz, Coban,	Developing the university's own robotics training set that can be used in

	Aslan & Tufancli, 2019)	electronic and robotic coding education, is simple to program, short-circuit protected, can be coded by typing or block-based, module connections are easily visible, has no licensing and copyright issues, is low-cost, and can reduce the export of public resources.
S20	(Sumbul & Colak, 2019)	To design and create a programmable, domestic and national Robotic Coding Training Set that will help children understand the logic of algorithms.
S21	(Korucu & Tasdonduren, 2019)	To examine secondary school students' self-efficacy perceptions towards block-based programming and their attitudes towards robotics according to some variables.
S22	(Akcaay, Karahan & Turk, 2019)	By developing a coding-oriented teaching process in line with the levels of primary school students, the learning experiences of the students in this process are to be examined in depth.
S23	(Unsal & Arikan, 2019)	To examine the opinions of secondary and high school school administrators on coding education.
S24	(Korkmaz, Sahin, Cakir & Erdogmus, 2019)	To reveal the attitudes and coding self-efficacy of information technology (IT) teachers working in secondary schools about coding
S25	(Guleryuz, Dilber & Erdogan, 2020)	To reveal the views of science teachers on coding education within the scope of STEM applications.
S26	(Talan 2020)	To examine the studies on the use of robotic applications in education in terms of different variables.
S27	Arslankara & Usta, 2020)	To determine whether secondary school students do any learning activities on Information Technologies and Software (BTS) during their summer holidays and whether they have learning losses at the return of summer vacation.
S28	(Guyen & Cakir, 2020)	To determine the opinions of classroom teachers who received in-service training on robotic coding applications.
S29	(Caliskan, 2020)	To examine the effect of robotic programming education on middle school students' problem solving skills.
S30	(Korucu & Bicer, 2020)	In this study, which aims to examine secondary school students' attitudes towards robotic coding, it is aimed to examine students' attitudes towards robotic coding in terms of different variables.
S31	(Haymana & Ozalp, 2020)	To examine the effects of robotics and coding education on the creative thinking skills of primary school 4th grade students.
S32	(Eskici, Mercan & Hakverdi, 2020)	To examine the effects of coding education prepared for secondary school students on the learning environment and mental images of students.
S33	Kilickiran, Korkmaz, & Cakir, 2020)	To determine the effect of robotic coding education on the problem-solving skills of gifted students at primary school level and their self-efficacy regarding block-based coding.
S34	(Sonmez & Sahinkayasi, 2021)	To examine the demographic information of the teachers who carry out Maker Movement (MH) and Robotic Coding (RC) activities in Turkey, the problems experienced in these activities and their suggestions for their solutions.
S35	(Eroglu & Hamzaoglu, 2021)	To investigate the effect of robotic coding activities on secondary school students' attitudes towards science in the force and energy unit.
S36	(Demir, 2021)	To examine the place of coding education in developing problem solving skills of special education students.
S37	(Yalcin & Akbbulut, 2021)	To be able to demonstrate how the STEM approach can be integrated into robotics and coding education
S38	(Ramazanoglu, 2021)	To examine the effects of robotic coding practices on secondary school students' attitudes towards computers and their self-efficacy perceptions towards computational thinking skills.
S39	(Secim, Durmusoglu & Ciftcioglu, 2021)	To investigate the opinions of preschool children about educational robots using robot drawings.