T.C.

ULUDAG UNIVERSITY

INSTITUTE OF EDUCATIONAL SCIENCES

DEPARTMENT OF PRIMARY EDUCATION

DEPARTMENT OF MATHEMATICS EDUCATION

A COMPARATIVE STUDY ON THE PLACE OF CODING EDUCATION ON SECONDARY SCHOOL CURRICULUM AND TEXTBOOKS OF TURKEY, THE UK AND RUSSIA

MASTER OF ARTS THESIS

BY

Özdemir TİFLİS

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Supervisors

Assist. Prof. Dr. Bahtiyar BAYRAKTAR

Assist. Prof. Dr. Menekşe Seden TAPAN BROUTIN

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JULY,2018

YÖNERGEYE UYGUNLUK ONAYI

"Türkiye, İngiltere ve Rusya ortaokul müfredat ve ders kitaplarında kodlama eğitimi konusunun yeri üzerine karşılaştırmalı bir çalışma" adlı yüksek lisans tezi, Uludağ Üniversitesi Eğitim Bilimleri Enstitüsü tez yazım kurallarına uygun olarak hazırlanmıştır.

Tezi Hazırlayan

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EĞİTİM BİLİMLERİ ENSTİTÜSÜ
YÜKSEK LİSANS/DOKTORA İNTİHAL YAZILIM RAPORU

ULUDAĞ ÜNİVERSİTESİ
EĞİTİM BİLİMLERİ ENSTİTÜSÜ
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Tez Başlığı / Konusu: A comparative study on the place of coding education in secondary school curriculum and textbooks of Turkey, the UK and Russia.

Yukarıda başlığı gösterilen tez çalışmamın a) Kapak sayfası, b) Giriş, c) Ana bölümler ve d) Sonuç kısımlarından oluşan toplam 114 sayfalık kısmına ilişkin, 25/07/2018 tarihinde şahsım tarafından *Ithenticate* adlı intihal tespit programından (Turnitin)* aşağıda belirtilen filtrelemeler uygulanarak alınmış olan özgünlük raporuna göre, tezimin benzerlik oranı % 3. 'tür.

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ULUDAĞ ÜNİVERSİTESİ EĞİTİM BİLİMLERİ ENSTİTÜSÜ MÜDÜRLÜĞÜNE,

İlköğretim Anabilim Dalı'nda 810830003 numara ile kayıtlı Özdemir TİFLİS'in hazırladığı "Türkiye, İngiltere ve Rusya ortaokul müfredat ve ders kitaplarında kodlama eğitimi konusunun yeri üzerine karşılaştırmalı bir çalışma" konulu Yüksek Lisans çalışması ile ilgili tez savunma sınavı, 05/07/2018 günü 15.00 /16.00 saatleri arasında yapılmış, sorulan sorulara alınan cevaplar sonunda adayın tezinin/çalışmasının (**başarılı/~~başarısız~~**) olduğuna (oybirliği/oy çokluğu) ile karar verilmiştir.

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Dedication

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Özdemir TİFLİS

05/07/2018

Acknowledgements

The teaching of coding, which forms the basis of the 21st century skills, is of great interest in our country as well as in the world. In our country, if we consider the beginning of a short time ago of coding education, developed countries have to examine this issue and to compare them with Turkey will contribute to the development of coding education in our country. In this study, the determination of the place of coding training in computing and computing curriculum textbooks in Turkey, UK, and Russia is made. The similarities and differences between the coding trainings in these three countries were evaluated using CIPP and Gagne's Nine Events of Instruction.

First of all, I would like to thank sincerely to my supervisor Assist. Prof. Dr. Bahtiyar BAYRAKTAR, and to my co-supervisor Assist. Prof. Dr. Menekşe Seden TAPAN BROUTIN for their endless guidance and encouragements throughout the whole process of this research. I have always felt their support which enabled me to create the study. Finally, I would like to thank Prof. Dr. Rıdvan EZENTAŞ, Prof. Dr. Muhamet Emin ÖZDEMİR, Assist. Prof. Dr. Çiğdem ARSLAN due to their contribution to the acceptance of the jury member of the thesis.

Özdemir TİFLİS

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Özet

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Danışman : Dr.Öğr.Üyesi Bahtiyar BAYRAKTAR

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TÜRKİYE, İNGİLTERE VE RUSYA ORTAOKUL MÜFREDAT VE DERS KİTAPLARINDA KODLAMA EĞİTİMİ KONUSUNUN YERI ÜZERİNE KARŞILAŞTIRMALI BİR ÇALIŞMA

21. yy becerilerinin temelini oluşturan kodlama öğretimi dünyada büyük ilgiyle takip edilmektedir. Son dönemde, disiplinler arası öğretim yaklaşım olan STEM eğitiminin bir getirisi olarak kodlama eğitiminin önemi ve diğer disiplinlerle olan ilişkisi daha çok önemsenmektedir. Türkiye'de olduğu gibi kodlama konusunun sadece bilişim dersiyle ilişkisi olduğu düşüncesi kodlama eğitiminin önündeki en önemli engellerdendir. Kodlama dersinin temelini oluşturan matematik dersi kodlamanın öğrenilmesi noktasında olmazsa olmazdır.

Kodlama eğitimi konusunda başarısını kanıtlamış ülkeler göz önüne alındığında matematiğin önemi anlaşılmaktadır. Bu çalışmada; kodlama eğitiminin Türkiye, İngiltere ve Rusya'da ki bilişim müfredatlarında ve bilişim ders kitaplarında ki yerinin tespiti yapılmıştır. Bu üç ülkede ki kodlama eğitimleri arasındaki benzerlik ve farklılıklar CIPP modeli ve Gagne'nin öğretim durumları modeli kullanılarak değerlendirilmiştir. Çalışmada, 5.sınıf bilişim teknolojileri ve yazılım dersi öğretmen kılavuz kitabı, matrix computing for 11-14, 8th Informatics course book kitapları ve müfredat olarak bilişim teknolojileri ve yazılım 2017 Turkiye müfredatı, computing in the National Curriculum Key Stage 3, 2014 Ingiltere müfredatı, the informatics 2012 Rusya müfredatı kullanılmıştır. Bu çalışmayla Türkiye'de Milli Eğitim Bakanlığı tarafından uygulanan müfredat ve ders kitabının yeterliliği değerlendirilmiştir. Ayrıca, Türkiye'de ki kodlama eğitimi ile Ingiltere ve Rusya'da ki müfredat ve ders kitapları arasındaki benzerlik ve farklılıklar tespit edilip değerlendirilmesi amaçlanmıştır. Çalışmanın sonucunda belirlenen eksiklikler açısından Türkiye'de ki kodlama eğitimi için önerilerde bulunulmuştur.

Anahtar sözcükler: Bilişim teknolojileri ve bilgisayar egitimi, CIPP modeli, kodlama eğitimi, Gagne'nin öğretim durumları modeli, matematik eğitimi.

Abstract

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Thesis: A comparative study on the place of coding education in secondary school curriculum and textbooks of Turkey, the UK and Russia.

First Supervisor: Assist. Prof. Dr. Bahtiyar BAYRAKTAR,

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A COMPARATIVE STUDY ON THE PLACE OF CODING EDUCATION IN SECONDARY SCHOOL CURRICULUM

The teaching of coding which is the foundation of the 21st century skills is followed with great interest in the world. Recently, as a result of STEM education, which is an interdisciplinary teaching approach, the significant of coding education and its relation with other disciplines is more important. As in Turkey, it is the most important mistakes in front of the coding training that thinks that coding is related only to the informatics course.

The mathematics that forms the basis of the coding course must be at the point of coding education. When countries with proven success in coding education are examined, the importance given to mathematics is understood.

In this study, the determination of the place of coding training in computing and computing curriculum textbooks in Turkey, UK, and Russia is made. The similarities and differences between the coding trainings in these three countries were evaluated using CIPP model and Gagne's Nine Events of Instruction. In study, as the textbooks Information Technologies and Software Course 5th Grade Teacher's Guide (online book), Matrix Computing for 11-14, 8th Informatics course book and as the curriculum, The Information Technologies and Software Curriculum for Turkey in 2017, Computing in the National Curriculum Key Stage 3 for England in 2014, the informatics curriculum for Russia in 2012 were used. With this study, the adequacy of curricula and textbooks in Turkey were implemented by the Ministry of Education was evaluated.

In addition, the similarities and differences of curricula and textbooks in Turkey, England and Russia compared and evaluated. As a result of the study, identified deficiencies in terms of suggestions for coding training in Turkey.

Keyword: CIPP model, coding education, Gagne's model of instructional design, information technology and computing, mathematics education

List of Abbreviations

CIPP: Context, input, process, product

CS: Computer science

DfE: Department for Education

ISTE: The International Society for Technology in Education

MEB: Ministry of National Education

NRC: American National Research Council

NRC: American National Research Council

OECD: Organisation for Economic Co-operation and Development

PISA: Programme for International Student Assessment

STEM: Science, technology, engineering, and mathematics

UK: United Kingdom

USA: United States of America

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"The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn."

— Alvin Toffler

Chapter 1

1. Introduction

This chapter provides an overview of the statement of a problem, the purpose of this study and the significance of the study to the research being undertaken. It discusses the reasons why we have chosen to investigate this particular area of interest and how it relates to context.

1.1. Statement of the Problem

Increasing scientific and technological developments have recently created significant changes in almost every sphere of daily life. Therefore, societies and states must strive to improve and modernize themselves in order to continue their existence and keep pace with the changes (Sjoberg, 2002).

Education, the core element that deeply affects life, is one of the most important fields that provide the adaptation to the changes created by scientific and technological developments. In a society, the development of individuals, increasing the quality of their life and appearance of their creativity features are revealed by an effective and qualified education (Muijs & Reynolds, 2017).

In recent years, productivity has increased by the improvements in the field of education and the importance of education has been felt more (Atılgan, 2007). According to Gözütok (2003), regulations and emerging innovations in educational sciences are meaningful when they are included in education programs.

Science, technology, engineering, and mathematics (STEM) education, which is the most popular teaching approach of today, have been moving in the direction of making important developments in the 21st-century education field; and is also considered as one of the greatest educational reform movements of the last decade (Corlu, Capraro & Capraro, 2014).

The STEM is not just a teaching approach; it is also the main axis for the shaping of the 21st-century society and economy (Karal, Sılbır & Yıldız, 2017). The successes of technology-based platforms such as Apple, eBay, Uber, Amazon, and Alibaba have created a new economic paradigm. The key factors behind these successful companies are problem-solving skills, creativity, design and software engineering. Therefore the 21st-century economy is shaped by the STEM skills. However, if the software cannot be taught with problem-solving skills and critical thinking skills, people cannot have a high value-added economy. Therefore, it is necessary to achieve the coding education with problem-oriented and pedagogical methods that promote the creativity of students. In order for coding education to be taught effectively, it should be taught with a current problem-oriented and an integrated approach to science and mathematics (Aydeniz, 2017).

In recent years, researches on coding education have shown that mathematics is actually one of the main parts of it. The results of studies with Scratch clearly showed the existence of a positive relationship between coding education and mathematical skills (Lewis & Shah, 2012). Coding training helps to develop students with poor mathematical thinking skills, complex computational thinking skills and use complex mathematical ideas (Taylor & Ank, 2010).

From these thoughts, it is necessary for a coding teacher to not only have knowledge about computing education but also be a good mathematics educator who has mastered STEM education. In addition, it is necessary that the curriculum development in coding education

and the textbooks written are in accordance with the content of the coding course and the coding concept.

The didactic transposition theory, asserted in order to transfer knowledge to the best schools, argues that the character of knowledge involves changes and differentiation according to culture, periods and regions. For this reason, scientific knowledge emerging in certain areas is subjected to some desired changes, for it is yet to exist and be included in the curriculum (Chevallard & Bosch, 2014).

In many programs, evaluation studies are important for curriculum development and curriculum planning. Different educational systems, textbooks, training programs and practices should be examined in order to better analyse the current educational programs, teaching approaches of the countries and to find solutions to the existing and possible educational problems (Tyler, 2014).

In Turkey, one of the most remarkable deficiencies of coding education is the thinking behind information technology teaching alone and being considered separate from other subjects. In recent years, the place of mathematics education in information technology teacher training has been reduced even more than the leading education systems in the world. From this idea, Turkey is a country that's going backwards in the world of computing and coding education.

Coding, as a world language, can be taught to children so they can get a share from the digitalized global economic pie and provide solutions against cyber-attacks (Aydeniz, 2017). According to Programme for International Student Assessment (PISA) 2015 and PISA 2012 results, it is possible to see that there is a considerable success of the UK and Russia in Organisation for Economic Co-operation and Development (OECD) countries in terms of computer use and digital skills of students (Peña-López, 2015). According to the PISA results, countries such as the United Kingdom (UK), the United States of America (USA), and Russia

are showing rapid progress in this area by including them in the curriculum of coding education (Akpınar & Altun, 2014, p. 3). Likewise, Turkey has begun to give importance to coding education.

By taking into account the computing curriculums and the textbooks of Turkey, the UK and Russia, we have tried to determine the similarities and differences between the three computing education programs by comparing them in terms of teaching elements and the place of mathematics in coding education. In addition, we have tried to identify and compare similarities and differences between secondary school official textbooks used in schools for coding education programs in all three countries.

1.2. Purpose of the Study

In this research, within the framework of the didactic transposition theory for coding education, it is aimed to assess the similarities and differences between the secondary school curriculums of Turkey, the UK, and Russia in terms of the Stufflebeam (1971) context, input, process, product (CIPP) program evaluation model. In addition, it is aimed to determine similarities and differences according to Gagne (1961) in the coding education textbooks used in these three countries.

According to the didactic transposition theory, knowledge reflected by the school is filtered, transformed, interpreted, and deformed. The process of didactic transposition begins with the choice of knowledge to be transformed and continue with a transfer of knowledge into a creative study (Bosch & Gascón, 2006).

From this point of view, the reason for the CIPP model's preference in assessing instructional differences in school-based knowledge is that it allows stakeholders of the curriculum to improve in different areas such as content, strategy, planning, activity, and evaluation (Yasin, Nurulhuda, Hasan, Yunus & Fauzi, 2015). The CIPP is a model that aims

to improve the functioning and development of the program and to evaluate different areas within itself such as context, input, process and output (Serik & Oral, 2015).

Similarly, according to the didactic transposition theory, textbooks that bridge the gap between the curriculum and the student present the topics to the students in accordance with the curriculum. The topics in the textbook are taught according to certain rules and one of the rules that can be followed is the teaching principles developed by Robert Gagne. He has created an effective teaching theory based on the information processing model. He has identified the stages involved in an effective course and explained what should be the teaching activities that will provide these learning processes (Senemoğlu,2009, p.483). For these reasons, in this research, Gagne's teaching principles have been taken into consideration in the evaluation of coding textbooks.

1.3. Research Questions

The research problem statement is arranged that "What are the similarities and differences between Turkey, the UK and Russia secondary school coding curriculums and textbooks?"

The following sub problems were searched in order to find the answer to the research problem.

What are the similarities and differences between "coding education" in secondary school curriculums and textbooks in Turkey, England, and Russia?

1) What are the similarities and differences between "coding education" in the secondary school curriculum in Turkey, England, and Russia?

1.1) What is the place of "coding education" in the secondary school curriculum in Turkey?

1.2) What is the place of "coding education" in the secondary school curriculum in the UK?

1.3) What is the place of "coding education" in the secondary school curriculum in Russia?

1.4) What are the similarities and differences between the curriculums in Turkey, the UK, and Russia?

2) What are the similarities and differences between “coding education” in secondary school textbooks in Turkey, the UK, and Russia?

2.1) What is the place of “coding education” in secondary school textbooks in Turkey?

2.2) What is the place of “coding education” in secondary school textbooks in the UK?

2.3) What is the place of “coding education” in secondary school textbooks in Russia?

2.4) What are the similarities and differences between the textbooks in Turkey, the UK, and Russia?

1.4. Significance of the Study

Each new age has different problems and therefore, different techniques are developed for the solution of these problems. Computational thinking skills are at the heart of solving techniques that are actively used as a solution to today's important problems. If an individual has a computational thinking skill of any kind, that means she/he has many skills such as solving problems by using the computer or other tools, easily finding answers by algorithmic thinking, asking questions, defining, estimating, collecting and analysing data and sharing research results (Sayın & Seferoğlu, 2016).

One of the training types for students to gain computational thinking skills in secondary school period is coding education. Unfortunately, researchers on this subject are minorities in Turkey. However, curriculums in countries such as Finland, New Zealand, England, Russia, the USA, which are the pioneers in education, are enriched with the aim of supporting the students to make a positive contribution to their future life (Akpınar & Altun, 2014, p. 3).
In this study, it is important to compare the current computing curriculums and the secondary school textbooks for coding education, to determine their similarities and differences, to better understand them and to contribute to the new education-teaching practices plus the ones yet to be made in the future for coding education.

Chapter 2

2. Literature Review

A literature review is an evaluation report of the knowledge found in the literature related to a selected area of study. In this section, there is theoretical knowledge about the “Didactic transposition theory”, “CIPP evaluation model”, “Model of instructional design”, “Coding education” and “Computing curriculums in Turkey, the UK and Russia” constituting the theoretical framework of this research.

2.1. Education, Education Systems and Evaluation

Today, the rapid change and development of knowledge deeply affects every moment of daily life. Teaching information to individuals, which is the most important point related to knowledge, is one of the biggest problems (Freitas, 2014). While many approaches and methods to teach information have lost their validity, some have been further developed.

One of the most popular of these is the Didactic Transposition Theory. Another important point is that information is put into a curriculum in the light of these theories. For this reason, Gagne's teaching principles model and the CIPP model will be used at the point of inclusion in the curriculum and books. Each country adapts knowledge to the curriculum in accordance with its own structure (Kaya & Ergun, 2012). Finally, in this study, coding education in computing curriculums of Turkey, the UK, and Russia will be analysed.

2.1.1. Didactic transposition theory. Chevallard (1985) defines that “the knowledge is accepted as logical and reasonable by institutions and society “. From this point of view, according to the characteristics of different periods and areas, it is seen that the yet to be included changes and differentiations between the concepts of knowledge are inevitable. Scientific knowledge emerges from the studies of scientists, universities and research groups in certain periods and in certain areas is subjected to some desired changes before it has existed in the curriculum. These changes occur with the influence of many factors on various

functions during the transferring of scientific knowledge into teaching information in school (Chevallard & Bosch, 2014).

The intentional transfer of knowledge was first introduced in 1982 by Chevallard as the notion of "Didactic Transposition Theory". He (1985) described the basis of this theory as "all of the transpositions that a knowledge has undergone to become a taught knowledge." This definition has caused the distinction of knowledge as taught knowledge and scientific knowledge plus the study on the investigation of both.

The concept of didactic transposition, which was originally founded on mathematics education, aims to reveal the differences between what is taught, information to be taught and what is believed to exist between taught knowledge and scientific knowledge (Komis, 2001). The taught knowledge at school is filtered, transformed, interpreted, deformed (Johnaert, 1988). The didactic transposition process that brings scientific knowledge to the level of instructional knowledge continues far from school, turning into a creative study that starts with the selection of information to be transformed and makes it teachable while preserving its function and power (Bosch & Gascón, 2006).

Yves Chevallard (1985) used "the concept of noosfer" to explain who made those transpositions. There are universities, teachers, inspectors and book writers that are interested in pedagogical problems. Noosfer products are formal programs, textbooks, teacher guidebooks, didactic materials, and so on. All of these are the basic elements involved in the transition of information to teach knowledge at school of scientific knowledge (Yıldırım & Şahin, 2009).

As a result, it is very important to renew and update the books and training programs, which are the most important stakeholders in the transpose of information produced by noosfer and then given to the students. The most important step in the renewal of programs is evaluation and there are many evaluation models, CIPP model is one of the most popular.

2.1.2. Stufflebeam CIPP (context- input- process- product) program evaluation model. One of the common concepts to be considered in educational definitions is the "purpose" (Tyler, 2014, p.4). The aims of teaching and needing a change in the period can be determined by following certain principles, philosophies, and orders. This determination can only be made with a program. Training programs are a means of reaching the goals that will lead to the change in the behaviour of the individual. The Bartlett and Burton (2014) define the program as "the formation and implementation of an educational design that must be learned and taught in schools and other institutions." Tyler (2014, p.4) defines the curriculum as a means of achieving within all of its dimensions and focusing on the main aims of education.

Program development is generally the process of designing, implementing, and evaluating training programs and re-organizing them with the data obtained (Erden, 2009). The importance of designing and implementing the training program in order to attain qualified programs is also if the program is assessed with appropriate methods and the evaluation results are reflected in the program design (Gözütok, 2017).

The process of program development and evaluation in education is intrinsic and the success of training programs depends on the questioning of the effectiveness of the programs (Osborne, 2003). Many methods have been developed for evaluating programs; one of the most important of them is the Stufflebeam CIPP model.

The CIPP evaluation model first developed by Daniel Stufflebeam is a comprehensive evaluation model that guides the formative and total evaluation of systems, institutions, products, personnel, programs, and projects. Basically, the CIPP model is a regular approach that meets the professional standards of the evaluation process defined by the Joint Committee on Standards for Educational Evaluation (Stufflebeam & Shinkfield, 2007, p.326).

In this very comprehensive model, four areas of context, input, process, and product need to be determined in relation to planning, structuring, implementation and reorganization (Ornstein & Hunkins, 2014, p. 34).

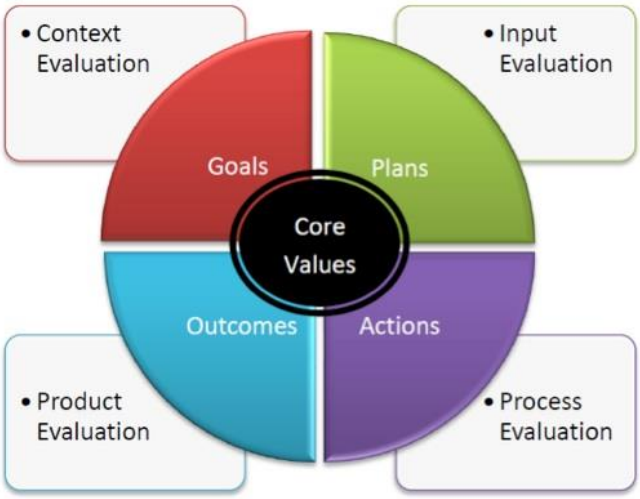


Figure 2.1

Components of Stufflebeam's CIPP Model (2003)

The evaluation stages of the CIPP model are explained below.

2.1.2.1. Context. This is the phase in which all the factors related to the program are analysed. The aim of this phase is to provide the required collection of goals and targets (Ornstein & Hunkins 2014, p.412). According to Fitzpatrick, Sanders, and Worthen (2004), the contextual assessment indicates that the program should define the environment and aim to describe the existing and necessary conditions in the world.

2.1.2.2. Input. In the input evaluation, the main moving point is advised about the changes needed by the program (Stufflebeam & Coryn, 2014). At this stage, the decision makers or institutions decide on the functioning of the plans, the strategies necessary for the solution and the auxiliary materials (Guerra- Lopez, 2008). In other words, in order to reach the goals of the program, decision-makers are provided with the necessary resources and information on how to use these resources (Pang, 2014).

2.1.2. 3. Process. Process assessment designed to provide information throughout the implementation of the program (Stufflebeam & Shinkfield, 2007), in which the program is executed according to the designed state, the program is developed as stated in the execution conditions, and the program managers are asked to take structural decisions that should be taken while the program is being designed. The objective performance of the process evaluation should be monitored (Guerra- Lopez, 2008). The level of attainment of the program's target group allows deciding on the satisfaction of the program, the program activities or elements applied, the quality of the equipment ((Stufflebeam & Shinkfield, 2007).

2.1.2. 4. Product. This is the phase that allows the program to determine how helpful it is to achieve the stated goals. Based on this comparison, it is decided whether the program can be continued or not. This is the phase that allows the program to determine how helpful it is to achieve the specified objectives. (Ornstein & Hunkins, 2014, p. 414).

Curriculum assessment is crucial to revealing deficiencies and improving the current curriculum. However, in an education system, it is not enough to assess only the curriculum. Textbooks that allow the curricula to communicate with schools should also be assessed. Therefore, as another important model, the model of instructional design which is used to increase the quality of textbooks, is the principle put forward by Gagne.

2.1.3. Gagne's model of instructional design. One of the indispensable tools of educational programs, the textbook is the oldest and most used of the teaching-learning tools. Many models and theories are considered in evaluating the appropriateness of textbooks, and one of the most important ones is Gagne's teaching principles (Khadjooi, Rostami & Ishaq, 2011).

Gagne has created a nine-step process called situations that relate to and describe learning situations. These nine learning steps serve to create the framework of the course as well as serve as a basic tool in educational situations (Gagne, 2000, p.108).

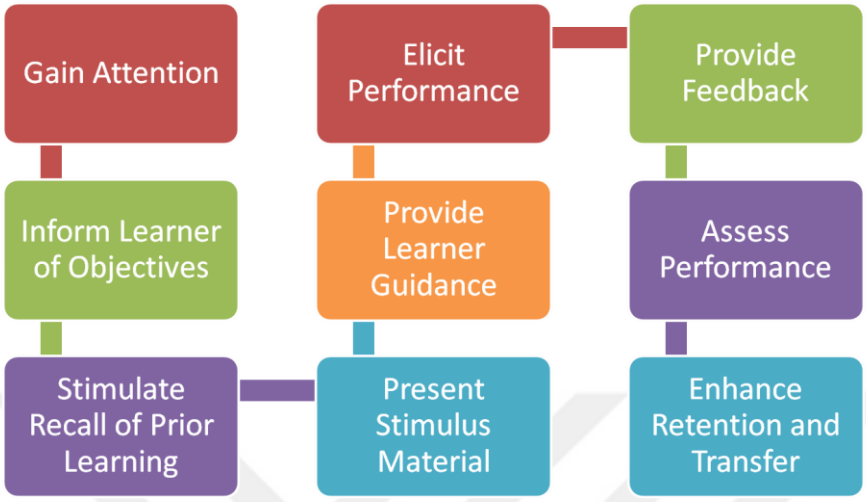


Figure 2.2

Gagne's model of instructional design

These steps can be summarized as follows:

2.1.3.1. Gain attention. For the purpose of teaching to be realized, the student's attention must be drawn to the teaching material and for this purpose the teacher can benefit from visual (picture, film, table, map, etc.) and verbal (example chosen from daily life) stimulants (Erden & Akman, 1996). Along with this, verbal stimuli such as "Listen carefully here", " Here is very important" or " Study carefully" to be given at a certain point of the subject; visual stimuli such as underlining, writing with a coloured pencil are also frequently preferred to draw attention (Senemoğlu, 2009, p.474).

2.1.3.2. Inform learners of objectives. If the student is informed about what he/she will learn by the teacher before teaching, the learner will be ready to learn and direct the perceptual selectivity. With knowing what to learn at the beginning of the training, the student

chooses what is important to the stimuli presented (Erden & Akman, 1996). For this reason, it is very important for the student to know what to learn.

2.1.3.3. Stimulate recall of prior learning. The theory of information processing says that it must be associated with foreknowledge of information so that the short-term memory can be coded in a meaningful way over a long period of time. For this reason, before the new information is given, it is necessary to remind the foreknowledge about this knowledge. This way, the student can learn faster and easier by coding new knowledge in a meaningful and organized way to the long-term memory (Senemoğlu, 2012, p.475). This means that students should be associated with prior knowledge so that their knowledge can be coded in a meaningful way.

2.1.3.4. Present the content. According to Gagne, if verbal information is to be learned, books, notes, audio messages related to that subject can be used as a material, if mental skills are learned, if things like symbols, objects, models, examples, real beings, or events that represent the concept can be shown, if a cognitive strategy is taught, it may be explained verbally, and the teacher may demonstrate this strategy. A number of stimuli are offered to learners during learning and various teaching methods and techniques can be used with this presentation. The student selects these stimuli presented and attempts to encode into long-term memories by interfering with organizations of information (Erden & Akman, 1996).

2.1.3.5. Provide learner guidance. In the learning environment, it is necessary to provide the students with the desired behaviours and to guide them to create the environment of success. For this purpose, clues should be given to what should be considered during student learning, where to integrate new knowledge into pre-learning so that they can perform meaningful coding (Erden & Akman, 1996). In general, the ways in which the learning guide is organized are related to teaching information, other types of

information and memory supporters. In other words, guidance is provided to enable students to learn meaningfully at this stage of instruction (Senemoğlu, 2012, p.476).

2.1.3.6. Elicit performance. When new behaviours are acquired, it is necessary to determine how this behaviour is gained. Discovery of behaviour can be accomplished by written questions or verbal questions (Erden & Akman, 1996). The student who is supposed to understand the concept is asked to talk about what he/she learned by using expressions like “Show now”, “Do”, “Say”. The discovery of the behaviour is necessary for the student to learn that he has also earned what was taught (Fidan, 1996, p.88).

2.1.3.7. Provide feedback. Assuming of the learning occurs when the right behaviour occurs. This phase of teaching activities gives information about the correctness or inaccuracy of the behaviour that the student has learned. In this way, the correct behaviour of the student is reinforced and for the wrongs, information is given to correct them without losing time (Senemoğlu, 2012, p.478).

2.1.3.8. Assess performance. The demonstration of performance, which is reflective of new learning, clearly demonstrates the ability. However, confidence in the performance of a student depends largely on the performance of the student in many cases. The teacher should prepare the problem situations with sufficient reliability and validity about the new learning rule of the learner and ensure that the learner uses the new knowledge in a variety of rules. As a result, it is necessary to evaluate the performance of the new learners in various situations (Senemoğlu, 2012, p. 479).

2.1.3.9. Enhance retention and transfer to the job. In order to ensure the permanence of newly learned information and to be remembered easily, the information must be organized well in a long-term memory and repeated at regular intervals (Erden & Akman, 1996). Each external teaching activity will support one or more elements of the learning

process. If organized in this way, learning will take place effectively and there will be a permanent change in behaviour (Senemoğlu, 2012, p. 479).

2.2. Computational Thinking and Coding Education

The scientific and technological advances of the 21st century have brought about significant changes and innovations in the individuals and in their life. These innovations have increased the diversity of the skills and have made the skills more tightly linked to each other. One of the most important reflections of this is coding education and computational thinking skills (Burnett, 2016). In this section, the knowledge about coding education and computational thinking skills that form the basis of the main research responsibility will be clarified.

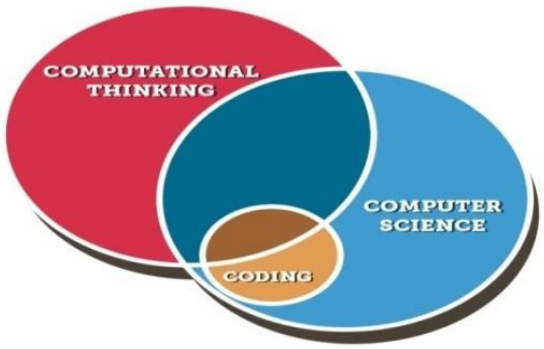


Figure 2.3

The relationship between coding, computer science, and computational thinking

2.2.1. Computational thinking. The concept of "Computational thinking", a new form of thinking, was first used by Papert (1996) in a book about mathematics education. Then, the concept of computational thinking as a new approach to problem-solving in the literature was first described by Jeannette M. Wing. Wing (2006) defines computational thinking as "an approach to solving problems, designing systems, and understanding human behaviour that draws on the concepts fundamental to computer science".

Computational thinking ability is not a way of thinking that suggests a person is like a machine, but it is based on the basics of the computer's working principle, that people have mathematical thinking, abstraction, information analysing and organizing, presenting visual data, establishing cause-effect relations, algorithmic thinking (Barr, Harrison & Conery, 2011).

As a matter of fact, the International Society for Technology in Education (ISTE) (2015), says these subordinate skills must be understood correctly in order for computational thinking skills to be understood correctly:

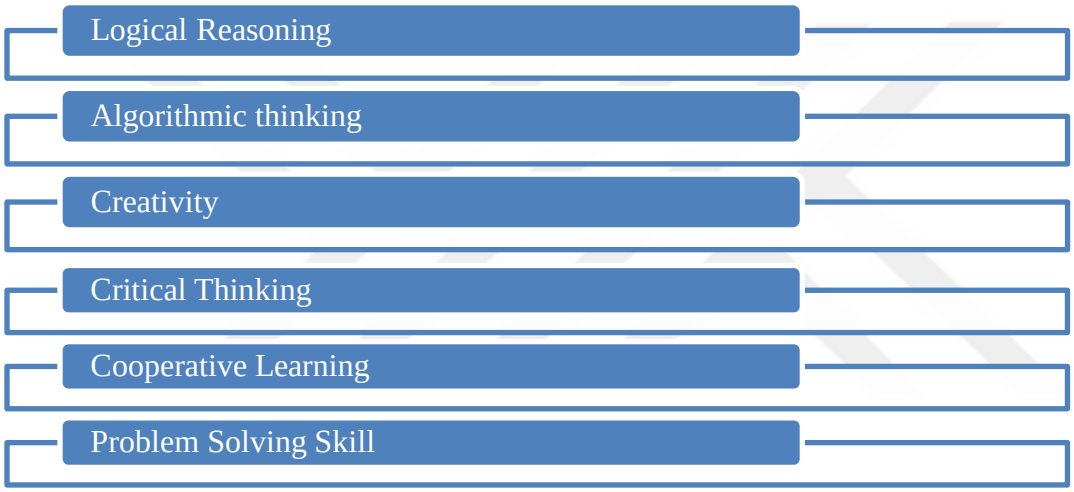


Figure 2.4:

The steps of computational thinking skills

Logical reasoning involves the use of personal information and internal models to predict and draw predictions, as well as to provide the ability to analyze facts by thinking in a logical and correct way (Voogt, Fisser, Good, Mishra &Yadav, 2015).

Algorithmic thinking is the ability to understand, apply, evaluate and produce algorithms (Brown, 2015). According to the American National Research Council (NRC) "... the general framework of algorithmic thinking is that functional analysis, repetition, simple data organization (registration, sequence, listing), generalization and parameterization, algorithm

and program, top and bottom designs, correction" (Hromkovič, Kohn, Komm & Serafini, 2016).

Creativity is the production of new information from the existing information and from the relations among these information (Yanpar-Yelken, 2009).

Critical thinking can be defined as an effective, regular, and functional process in which an individual can effectively use his or her own ideas to better understand the ideas of other individuals and to defend those ideas when necessary (Chaffe, 1994).

Cooperative learning is defined as the creation of small clusters in an academic way in the direction of a common goal, the learning of clusters by helping each other, and the awarding of cluster success by different methods (Caycı, Demir, Başaran &Demir, 2007).

Problem solving skills are defined as the behavioural, cognitive, and emotional responses that people experience during their lifetime to meet their needs (Shewchuck, Johnson, &Elliott, 2000).

2.2.2. Coding education. One of the methods used in the teaching of computational thinking has caused the inclusion of coding courses in elementary and secondary education programs in many countries where it is thought that coding is a 21st-century skill that every student must gain. While some countries add coding education as a compulsory course to the curriculum, some countries have begun to be encouraged to be part of teaching activities, even though they are not officially part of the curriculum (Grover & Pea, 2013; Mannila, Dagiene, Demo, Grgurina, Mirolo, Rolandsson & Settle, 2014). Recently, when the importance of coding education is increasingly understood, "coding, algorithm, programming, computational thinking" are heard in every area of daily life.

Coding education began in the 60's with the use of Logo programming language and in recent years, it has been revived with visual programming languages such as code, code.org, and Scratch (Calao, Moreno-León, Correa, & Robles, 2015). The environments were designed

to have features appropriate to child's developmental levels (Fessakis, Gouli &Mavroudi, 2013). The primary goal in these settings is to improve learning outcomes and motivate learners by using coding as a tool to improve other skills, rather than the teaching of coding (Resnick, 2013).

2.2.3. What kind of study is done for the coding course? Today, coding education is increasingly becoming a part of the curriculum in many countries, with children of all ages and levels.

Estonia was probably the first country to take the planned step of teaching the coding education to students (Olson, 2012). In September 2013, England took a bigger step and became the first country to be taught coding in primary schools. Students have begun to take algorithms and basic programming lessons from the age of 5 (Dredge, 2014).

Like many other countries, Australia has included coding in its training program. In the Spanish education program, one hour of coding class per week is compulsory. In the United States, technology companies have begun hiring 20,000 teachers to introduce coding courses yet to begin at schools (Olson, 2012).

Apart from being taught as a lesson, many events are organized to encourage coding education. For example, 15 million students and teachers from all over the world participate in the “Hour of code” event held every December in the scope of “Computer science education week”. Microsoft is aiming to reach more educators and more children with the support provided by the Coder dojo foundation, which teaches thousands of children in 57 countries (Wong, Zhu & Huen, 2016).

Although the coding of the new curriculum to be taught lessons in Turkey is decided too late, The Ministry of National Education introduced coding technologies and teaching materials prepared for teachers and students.

2.2.4. Why should coding course be taught in schools? Today, not only Computer Science Software Engineering, but all engineering disciplines and mathematics departments are teaching computer programming courses. When we learn how to deal with the programming of computers and other machines, we learn how to solve problems and computational thinking. The ability to write algorithms on the code side gives us the ability to look at problems from different directions and find the best shortcut solution (Grover & Pea, 2013).

The founders of the world's largest companies and the most famous programmers argue that everyone should learn how to programme from a young age. Being able to write codes or create algorithms improves the problem solving skills, the interest in computer science, and the computer programming skills of children plus provides opportunities such as research laboratories, software development, and many other industries (Crow, 2014).

2.3. Related Research

In recent times, the view that students all over the world should learn coding at an early age is often mentioned. Because, the 21st century needs to be found in individuals; basic skills such as problem solving, creativity, algorithmic and computer thinking can be gained by teaching coding and computer science (Shin, Park & Bae, 2013; Karabak & Gunes, 2013; Monroy-Hernández & Resnick, 2008). When field studies are examined, it is seen that there are many researches on this subject.

Taylor, Harlow, and Forret (2010) investigated the effect of programming in the development of mathematical and technological thinking, in a study called “Using a computer programming environment and an interactive whiteboard to investigate some mathematical thinking”; It has been found that programming education is effective in teaching mathematical

subjects, developing problem solving strategies, collaborative, systematic and creative thinking.

In the “Learn to code to learn” study, the coding skill was emphasized. Coding education improves the mathematical and computational skills of individuals. When individuals learn coding education, they can learn learning strategies, designing projects, and establishing links between ideas. These skills are not only for computer specialists, but also for everyone from all ages (Resnick, 2013).

According to Dasso, Funes, Riesco, Montejano, Peralta, and Salgado (2005), “Teaching programming” research, the development of problem solving skills in different areas is targeted by programming. Findings regarding the contributions of programming to mathematical skills and the development of problem-solving skills are strong (Dasso et al., 2005).

According to “Computational thinking and thinking about computing”, mathematical thinking cannot be distinguished from the nature of programming because it is based on the mathematics of computer science, like all sciences. Since the systems that interact with the real world are installed in the program, it requires computer scientists to think not only mathematically but also computational thinking wise (Wing, 2008).

“Developing mathematical thinking with Scratch” research has shown that integrating computational thinking in a numerical mathematics class significantly improves students' understanding of mathematical processes compared to a control group that does not learn how to apply computational thinking to mathematics classes. (Calao et al.,2015)

“The profession of it beyond computational thinking” focuses on computational thinking, exploring how to use mathematical algorithms to develop many aspects of abstraction and

how to propose solutions to problems of different magnitudes. In particular, Denning mentions the function of mathematics at the base of the programs (Denning, 2009).

In the study “Opportunities and challenges in technology-rich classrooms: Using the Scratch software”, Scratch software proved to be an interesting and relatively easy to use area for mathematical thinking and problem solving. It has also proven to be an effective tool for promoting communication and collaboration and the students in the digital class were able to quickly access and understand their programming skills and used mathematical thinking in problem-solving approaches (Otrel-Cass, Forret & Taylor, 2009).

“Scratching below the surface: mathematics through an alternative digital lens?” research has clearly indicated that the scratch program is helping children to engage in mathematical ideas and improve the direction of mathematical thinking through the digital learning objects of Scratch in order to facilitate conceptual thinking in a particular mathematical field (Calder & Taylor, 2010).

“Learning algorithmic thinking with tangible objects eases transition to computer programming” is a study describing the importance of learning algorithms at an early age. As a result, simple algorithms have been introduced to the students with some material. It has been observed that the mathematical skills and problem solving skills of children who have acquired coding skills have improved through the use of scratch (Futschek & Moschitz, 2011).

“Curriculum guidelines for undergraduate degree programs in computer science” research has compared the curriculum and books of high school and college computing courses between the USA and the UK. In the study done, the importance of mathematics, mathematical thinking and problem solving skills is emphasized and the prominence in the

programs is explained (Topi, Valacich, Wright, Kaiser, Nunamaker, Sipior & De Vreede, 2010).

The study by OECD on the OECD countries entitled “Students, computers and learning” has examined skills such as accessing computers to countries, the ability to use computers, and the ability to use computers in mathematics classes (Peña-López, 2015).

“Learning effects of pedagogical robots with programming in elementary school environments in Korea.” named study, a teaching strategy was developed to help learners express their learning content, including Korean, mathematics and music, in the movement of the educational robot (Park, Kim, Oh, Jang & Lim, 2015).

The study, titled “Computer science (CS) in the context of compulsory education curriculum: Implications for future research”, addresses six main arguments for broader introduction of the current practice in the school curriculum, the influence of researchers, schools, teachers and learners, the situation and evidence of current debates in various countries (Passey, 2017).

Chapter 3

3. Methodology

Wellington (2015, p.33) defines methodology as "the activity or business of choosing, reflecting upon, evaluating and justifying the methods one uses." From the methodology, one can ascertain that the researcher has at least a general approach to the research. The aim of the methodology is to identify and analyse methods and to shed light on the limitations and sources (Dörnyei, 2007). In this chapter, the methodology utilized to find answers to the research questions will be described in detail.

3.1. Research Model

This research is a cross national comparative education research. According to Treloar and Graham (2003), cross-national comparisons are the most commonly used methods, especially when the researcher compares his-her own country to other countries. Briefly, comparative research is the research and comparison of existing differences and similarities for analysis. In this research, the current coding education in computing programs and textbooks in the secondary schools of Turkey, the UK, and Russia are compared in terms of the similarities and differences between the coding courses.

This study is a descriptive research based on qualitative data analysis techniques since it aims at determining an existing situation. In qualitative research, qualitative data collection methods such as observation, interview and document analysis are used. Qualitative research is a qualitative process that reveals perceptions and events in a natural and realistic situation (Yıldırım & Şimşek, 2006, p.39).

3.2. Data Collection Method

Observation, interview, focus group interview and document analysis methods are widely used to collect data in qualitative researches. Document analysis was used as a qualitative

research method for this study. In qualitative research, document analysis is used as a data collection technique. Data collection by analysing written documents containing information related to the subject examined within the scope of the research is called document analysis (Yıldırım & Şimşek, 2006, p.188).

3.3. Data Collection

In this study, the data sources that computing textbooks and current computing curriculums use in the secondary schools of Turkey, UK, and Russia are used as documents. Then, the collected data is analysed by using the document analysis method.

The Information Technologies and Software Curriculum for Turkey in 2017, Computing in the National Curriculum Key Stage 3 for England in 2014, the informatics curriculum for Russia in 2012 was used in the evaluation.

3.4. Analysis Method

At the end of the research process, the collected data is subjected to descriptive analysis and content analysis. This research was designed as a descriptive model for visual scanning. Descriptive studies illustrate the situation as it is (Cohen, Manion & Morrison, 2005).

The collected data in the descriptive analysis approach is summarized and interpreted according to the previously determined theme. In the descriptive analysis, the direct citation is frequently given to reflect the events or observe them. The purpose of such analysis is to present the findings to the reader in an organized and interpreted way. The data obtained for this purpose is described systematically and clearly. These illustrations are later explained and interpreted, cause-effect relationships are examined, and some results are reached. The association, meaning and the making of future predictions of the emerging themes are among the dimensions of the researcher's interpretation (Sutton & Austin, 2015).

The themes formed according to the CIPP model of the curriculum that countries adopt as the basis for computer education;

- *The possession of the necessary equipment for the coding courses in the program,*
- *The adequacy of the course hours for the coding course in the program,*
- *The sufficiency of the coding course in the program in terms of theoretical information.*
- *The usage of current teaching methods and applications in the program.*
- *The materials to be used in the program will attract attention,*
- *The course plans in the program will be well organized,*
- *The materials used in the program will facilitate the learning of the students and remind them of the level of the prior knowledge,*
- *The learning activities used in the program are student-oriented,*
- *If necessary, the subject can be reviewed in the courses,*
- *The lessons in the program include group activities,*
- *In the coding lessons of the program, there are adequate exercises on each new topic,*
- *Teaching and learning processes have measurable achievements and assessment tools, and high level thinking skills of learners.*
- *The objectives of the computing program are to meet the sectoral needs,*
- *The program is designed to provide a basis for responding to future needs,*

In addition, the similarities and differences between the computer textbooks used at schools in Turkey, the UK and Russia were formed as sub-themes according to Gagne's model of instructional design steps; gain attention, inform learners of objectives, stimulate recall of prior learning, present the material, provide guidance for learning, elicit performance (practice), provide feedback, assess performance, enhance retention and transfer.

3.5. Validity and Reliability

Qualitative research is based on the validity and reliability of the criteria proposed by researchers such as Creswell (2007), Miles and Huberman (1994) and Şimşek and Yıldırım (2011) to assess the suitability and quality of the research.

A document review has been done for the validity of this research. In this scope; articles, theses, textbooks, newspapers and books were examined. On the other hand, in the data collection phase, the researcher showed great care to act flexibly, spend a lot of time in the field, establish close contact with the experts of the subject and establish a trust-based interaction. In particular, researcher has worked with experts in the field of studying Russian and English sources. In the phase of data analysis and evaluation, the relationships between the main and sub themes obtained from the collected data and their connections with each other are meticulously examined. In addition, the research design, methodology, data collection, findings, and evaluations of the achieved results are presented in detail.

In addition, in order to ensure the consistency of the research, it has been tried to stick to the nature of the collected data as much as possible. Within the scope of the research's verifiability, the researcher sought to clarify his neutral position. Thus, the results obtained are unaffected by individual assumptions and prejudices, making it possible to depend on the total collected data. On the other hand, the researcher has received approval for all the processes of his work from the expert reviewer. In this direction, raw data, coded data, perceptions, notes and conclusions underlying the results of the research were sent by two experts. These persons, who have general knowledge of the subject of the work and specialize in qualitative research being turned into a confirmatory study by comparing the results obtained by the researcher with raw data.

Chapter 4

4. Analysis and Interpretation of Data

In this section, the analysis results of the secondary school computer courses curriculums of Turkey, England, and Russia by the CIPP model evaluation are given in order to determine the place of the coding education in computing programs. In addition, the analysis of the textbooks used in these three countries has been viewed by considering Gagne's model of instructional design. Collected data from the studies is arranged according to the sub problems.

4.1. Analysis of the computer teaching curriculum in terms of the CIPP model

In this section, Turkey, UK and Russia's computing curriculums are evaluated according to the CIPP model to search for answers to sub-research problems related to "What are the similarities and differences in coding education the secondary school curriculum in Turkey, England, and Russia?"

4.1.1. What is the place of "coding education" in the secondary school curriculum in Turkey? Turkey's information technologies and software curriculum has recently undergone changes and a program started to be implemented in the second half of 2017. Turkey has been reshaped by integrating coding education into this curriculum. Below, Turkey's information technologies and software curriculum has been analysed by following the steps of the CIPP model.

- *The possession of the necessary equipment for the coding courses in the program,*

The information technology and software draft curriculum in Turkey whilst on planned application only 4 pilots provinces (Gaziantep, Samsun, Mersin, and Erzurum) at the beginning of 2017, then, the new computing curriculum into coding training started to be

implemented throughout the country by Ministry of National Education (MEB) at the beginning of 2017 - 2018 academic year.

The learning and teaching of information technology and software course is a process that needs to be supported by different technological infrastructures. For this reason, it is expressed in the curriculum program in which different activities and applications are planned so that the students can learn without computers in the schools where the technical infrastructure is lacking (MEB, 2017). In this context, it is seen that the developed teaching contents are supported through the Educational Information Network (EBA) system.

- *The adequacy of the course hours for the coding course in the program,*

In Turkey, the information technology and software courses are planned a mandatory two hours per a week for 5th and 6th grade and in grades 7 and 8 to be taught as an elective course is expressed as 2 hours per week (MEB, 2017).

This course is about 50 hours in the 6th grade in the acquisition of computational thinking (Problem Solving Concepts and Approaches, Programming) was calculated as 32 hours in grades 5, 7, and 8. Coding course covers 44% of the information technologies and software course curriculum (MEB, 2017).

- *The sufficiency of the coding course in the program in terms of theoretical information,*

In Turkey's Information Technologies and Software course curriculum, students try to learn from coding courses; explain basic concepts and functions of a computer system, solve a given problem using the appropriate steps, use operators to solve a given problem, explain the concept of the algorithm, develop an algorithm for the solution of a problem, explain a flow diagrams components and functions, draw a flowchart for an algorithm, develop algorithms using linear logic structure, develop an original project that includes all coding constructs, develop algorithms that use all the coding schemes (MEB, 2017).

- *The usage of current teaching methods and applications in the program,*

Information technology and software courses in Turkey have theoretical knowledge that is enriched with strong possibilities of the application. For this purpose project study, design learning, teaching-learning, cooperative learning methods and techniques are used. In addition, problem solving and project based teaching approaches are applied in this context (MEB, 2017).

- *The materials to be used in the program will attract attention,*

According to the information technology and software courses in Turkey, the learning environment is aimed at motivating learners and arranging learning appropriately to attract students to the topic. Teachers and students decide together how this arrangement will affect their studies. It is aimed to organize the educational environment so that the students have more interaction with the learning environment and thus acquire rich learning experiences. It is requested that the teacher should offer appropriate choices for the individual differences of the students, to give directions and to help each student to make his-her own decision (MEB, 2017).

- *The course plans in the program will be well organized,*

The lesson plans in information technology and software course curriculums are prepared clear and organized considering the times and practice. The theoretical and practical hours of the courses are distributed in a balanced way. In the 5th, 6th, 7th and 8th grades, the unit based approach was taken for the course. There are five basic units at the class level. They are information and communication technology, ethics and security, communication, research and cooperation, digital product creation, computational thinking (MEB, 2017).

In addition to this, regarding coding teaching under the topic of computational thinking; developing an understanding of algorithm design, gaining skills in verbal and visual expression, problem solving, sequential logic, decision structure, using loops and function

structures, and selecting and implementing appropriate programming and coding approaches to solve problems (MEB, 2017).

- *The materials used in the program will facilitate the learning of the students and remind them of the level of the prior knowledge,*

When the different teaching methods used in Turkey's information technologies and software curriculum is examined, it is stated that they are suitable for the level of the students and the coding teaching. In addition, students are given the opportunity to remember the old information so that they can relate their old knowledge to their new knowledge more effectively (MEB, 2017).

- *The learning activities used in the program are student-oriented,*

When Turkey's information technology and software course curriculum is examined, it is seen that the majority of it is student centred. According to MEB (2017), the role of the teacher; to guide the student to facilitate learning, to take necessary precautions to ensure that the student is participating in the learning process, and to constantly motivate the student to choose both individual and group study. It should provide opportunities for students to share their products and projects with their peers.

- *If necessary, the subject can be reviewed in the courses,*

Information technology software course curriculum in Turkey has given opportunities for students to practice what they've done do on their computer or tablet; it is using the current programming platform (MEB, 2017). In addition, the state-created EBA program provides students with access to video and written documents, enabling them to review.

- *The lessons in the program include group activities,*

When Turkey information technology and software course curriculum investigation, teaching, cooperative, and problem solving weight gains are felt. Social coding platforms based on sharing and co-development are also used in the curriculum. In these platforms,

students and teachers can share their personal or group software with other Internet users, collaborate on a project and produce new projects from existing projects. In this context; computers, tablets or robot kits are used as equipment in the information technologies and software courses. In addition, events and drama processes without computer use are being designed and implemented for schools that do not have technical facilities (MEB, 2017).

- *In the coding lessons of the program, there are adequate exercises on each new topic,*

Information technology and software course curriculum in Turkey, where it is possible to find multiple exercises related to a topic. It is observed that the current coding programs, textbooks, projects, social networks and EBA provide practise material for the student (MEB, 2017).

- *Teaching and learning processes have measurable achievements and assessment tools, and high level thinking skills of learners,*

Assessment should be considered as part of the learning and teaching process. Turkey`s information technology and software evaluation process-oriented approach is embraced in the computing lesson. All activities and demonstrations performed by students within or outside the classroom to produce a cognitive or psychomotor product seem to be addressed within the assessment. In this process, the projects developed by the students are observed by the electronic product file approach (MEB, 2017).

- *The objectives of the computing program are to meet the sectoral needs,*

The basic philosophy of computing programs is focused on the more efficient use of technology, algorithm development, problem-solving, collaborative study and product development. It has been stated that the development of digital skills, the digital transposition in the world and the realization of economic growth, the increase of the welfare of the citizens and the development of the digital economy strategy have been seen as a necessity. For this reason, the search for a computer education model that has the skills for the 21st century has

an obligation, can solve problems, has advanced decision-making skills, and allows individuals to think critically and innovatively (MEB, 2017).

- *The program is designed to provide a basis for responding to future needs,*

Information technologies and software course curriculum, especially, is aimed at teaching 21st-century skills like mathematical thinking, analytical thinking and problem-solving skills.

When students learn the concepts and principles of computer science in the future, the ever-changing technological development will be better prepared. In this context, students can understand and apply the basic concepts of computer science including abstract thinking, logic, algorithms and data representation with the help of information technologies and software course teaching program (MEB, 2017).

4.1.2. What is the place of "coding education" in the secondary school curriculum of the UK? The UK computing course curriculum is a program that was implemented in 2014 with recent changes. The British computing curriculum has been reshaped into coding education. The analysis of the UK computing lesson curriculum was analysed following the steps of the CIPP model.

- *The possession of the necessary equipment for the coding courses in the program,*

The new National Curriculum Program, as well as the computing curriculum, entered into force in England in September 2014. It is stated that it is one of the most important plans of the British government. The Ministry of Education has not identified a comprehensive computing education program and it seems that the schools have taken the initiative to detail the program (Kemp, 2014).When examining the computing curriculum, all classes have an interactive whiteboard and visualizing machine used to teach, digital cameras and mini iPads for recording documentary activities and the work of the students and teachers during computing lessons. In addition, it appears that schools use a number of subscriptions to support teaching and learning. It mainly uses programming and Microsoft office programs

(such as Word or PowerPoint) to present a majority of digital literacy units. Finally, there is the Computing At School, a government-funded working group that promotes computer teaching at schools, and it is a part of the computing curriculum (Department for Education [DfE], 2013).

- *The adequacy of the course hours for the coding course in the program,*

Computing education in secondary school students (aged 11-14) are recommended as 1 hour per a week and some schools can take opportunities to teach computing within other subjects (DfE, 2013).

- *The sufficiency of the coding course in the program in terms of theoretical information,*

When the UK computing curriculum is examined; It is seen that the program has theoretical knowledge such as abstraction, logic, understanding of algorithms related to the coding lesson, designing different algorithms to solve a problem, analysing a given problem, and determining the relationship between mathematics and computer science (Dredge, 2014).

- *The usage of current teaching methods and applications in the program,.*

In the context of the UK computing education program, topics were organized as prerequisites for each other and current programs are being followed. It seems that the curriculum is all about daily life and the activities and programs used are new. Problem-based learning methodology in all subjects seems to allow students to develop powerful computational skills and to answer questions using various algorithms (Williamson, 2016).

- *The materials to be used in the program will attract attention,*

In the UK computing curriculum, it is seen that the materials used in the coding course are related to daily life. It has been stated that selected projects and applications, teaching materials (Compact disc, video, flashcards), sources (visual and auditory) are available at

schools to attract the students. In addition, the examples and subjects created in the UK curriculum are simple and interesting (Dredge, 2014).

- *The course plans in the program will be well organized,*

In the UK curriculum, it appears that informational issues that encourage students to think about a broad, balanced and integrated curriculum that includes computer science, information technology and digital literacy are presented (DfE, 2013).

Topics in the UK computing curriculum; it is seen that designing and evaluating numerical abstraction models of real-world problems , the behaviour of physical systems, understanding some key algorithms that reflect the digital thinking, using logical reasoning to compare the benefits of alternative algorithms for the same problem, using multiple programming languages to solve various computational problems, designing and developing modular programs that use procedures or functions (Dredge, 2014).

- *The materials used in the program will facilitate the learning of the students and remind them of the level of the prior knowledge,*

In the UK's computing curriculum it has been pointed out that there are many other activities and studies to improve the teaching and learning of the subject. In addition, many different teaching methods are applied to enrich the teaching environment of the program, teaching is becoming easier because the British computing curriculum has been designed as a continuation of previous years, and it seems that the students are reminded of the level of the prior knowledge (Williamson, 2016).

- *The learning activities used in the program are student-oriented,*

In the UK computing curriculum, it is stated that the role of the teachers in learning is very important and their most important task is to guide the learning process of the students. The coding lesson shows the diversity of applications and presentation of additional resources, indicating that the student has a lot of tasks. Namely, curriculum a document that does not say

how to teach teachers only offers a few methods to them. For this reason, it is possible to say that the UK computing curriculum adopts a student-centred approach (Kemp, 2014).

- *If necessary, the subject can be reviewed in the courses,*

In the UK, a computing curriculum is provided in many different sources for the purpose of reviewing the subject as well as current activities. The topics of the program are again in the form of continuation of each other, and it is seen that projects are given in terms of reinforcing the subjects in the lessons (Dredge, 2014).

- *The lessons in the program include group activities,*

In the UK, the computing curriculum includes more group activities as required by educational attitudes. It states that in the computing curriculum, activities are planned as requested by groups of small student communities, and students learn to collaborate.

- *In the coding lessons of the program, there are adequate exercises on each new topic,*

In the UK's computing curriculum, it is possible to exercise more than one subject; many exercises can be done through the internet and programs. Furthermore, it has been seen that there are enough projects in the courses of the program in terms of the reinforcement of the subjects (Kemp, 2014).

- *Teaching and learning processes have measurable achievements and assessment tools, and high level thinking skills of learners,*

When the UK computing curriculum is examined, the coding lesson process can be easily accessed by the teacher, and the student is easily accessible because it is possible to see that the teacher is able to interfere with all the computers from his-her own computer. In addition, the process can be followed by the trainer as the activities are usually focused on cooperative learning (Dredge, 2014).

Through the use of very different projects which are applied to the students and enable various results to be obtained, it is possible to evaluate the progress of the individual projects created in the digital environment.

- *The objectives of the computing program are to meet the sectoral needs,*

While the curriculum is being developed in England, the needs of the industry are also taken into account. For example, in 2017, STEM policy and industry 4.0 were taken into account and plans to make an additional investment of 406 million pounds in training. Coding education students, who are considered as a result of STEM education, provide great benefits at the point of training the individuals who need the industry. It enables them to develop as active participants at a level appropriate to the future workplace and in the digital world. In addition, many sectors seem to allocate large budgets to computing education, especially in the engineering sector (such as 5G network, artificial intelligence, electric car charge point, etc.) (Energy and Industrial Strategy, 2017).

- *The program is designed to provide a basis for responding to future needs,*

The UK computing program is intended to provide students with 21'st century skills and to provide them with a quality education that fosters creativity and equips them with knowledge and skills to change the world. That is, the computing program aims to improve children's critical thinking skills, problem-solving skills, information literacy skills, and socio emotional and cognitive development characteristics (Kemp, 2014).

4.1.3. What is the place of "coding education" in the secondary school curriculum in Russia? The Russian informatics course curriculum is a program that was implemented in 2012 with the latest changes. Below, the analysis of the Russian informatics curriculum was analysed by following the steps of the CIPP model.

In this step answering the following questions was sought.

- *The possession of the necessary equipment for the coding courses in the program,*

Informatics education in Russia has been carried out since 1985, especially since 2012 when 5 to 9-grade levels were starting to be implemented (Kiryukhin & Tsvetkova, 2016).

In the informatics education curriculum in Russia, it is stated that the Russian government provides materials and technical opportunities for the education process for students and teachers within the scope of informatics course. In particular, laboratories of digital (electronic), traditional measurements, virtual laboratories, online information resources, information and communication technology laboratories are provided (Khenner & Semakin, 2014).

- *The adequacy of the course hours for the coding course in the program,*

In Russia, according to the curriculum of informatics education, computer lessons are given as one hour per a week for an informatics lesson at secondary school in general education.

In the primary school, informatics is taught as a mathematics and technology course while informatics is taught at secondary school as a separate course. A total of 70 hours, as 1 hour per week, are given for secondary school. Also, informatics course is taught as a compulsory course in the 8th and 9th grade as 1 hour per week (Pereira, Aleksandr & Popova, 2018).

- *The sufficiency of the coding course in the program in terms of theoretical information,*

The Russian informatics curriculum seems to aim at providing students with coding theoretical sub-themes; the development of algorithmic thinking, the development of algorithmic writing skills, the knowledge of algorithmic structures, the knowledge of logical values and operations, the knowledge of programming languages, the formalization of knowledge, and the development of algorithms (Khenner & Semakin, 2014).

- *The usage of current teaching methods and applications in the program.*

When Russian informatics curriculum is examined, it appears that all subjects related to the informatics course are given in detail. In addition, while using informatics programs, current teaching methods, project studies, design learning, cooperative learning methods, and techniques are used. In this context, problem-solving and project-based teaching approaches have been applied (Benaya, Dagiene & Gal-Ezer, 2015).

- *The materials to be used in the program will attract attention,*

In Russia informatics curriculum, it aims attention of students by selected topics to current and other disciplines. In addition, it is seen that logo training, multimedia projects, project-based training and activities are designed to draw attention to informatics course (Pereira, Aleksandr & Popova, 2018).

- *The course plans in the program will be well organized,*

In the Russian informatics curriculum, the course hours and the subjects to be studied are clearly stated. It is seen that the computer course is prepared by considering it's relation with the other courses, and therefore, the course hours are provided and the necessary time is regulated for the application of the course and the theory (Kiryukhin & Tsvetkova, 2016).

- *The materials used in the program will facilitate the learning of the students and remind them of the level of the prior knowledge,*

The curriculum of the Russian informatics course was designed as a continuation of the previous year, not as a review of last year. The materials used in the program are aimed to facilitate the learning of the students (Khenner & Semakin, 2014).

- *The learning activities used in the program are student-oriented,*

When the Russian informatics curriculum is examined, it is seen that most of the students are provided with student-centred education and it seen that cooperative teaching and group learning are emphasized (Benaya, Dagiene & Gal-Ezer, 2015).

- *If necessary, the subject can be reviewed in the courses,*

According to the Russian informatics program, it is possible to exercise more than one related to a subject. The courses in the program provide projects for the reinforcement of the subjects and provide opportunities for the participation of the students (Khenner & Semakin, 2014).

- *The lessons in the program include group activities,*

In the Russian informatics curriculum, it is stated that the students are encouraged to study with the group during the cooperative learning and problem-solving stages and they also design the group activities. Therefore the structure of the informatics curriculum is compatible with group learning (Kiryukhin & Tsvetkova, 2016).

- *In the coding lessons of the program, there are adequate exercises on each new topic,*

According to the Russian informatics program, it is possible to practice and apply more than one subject and projects can be given in terms of strengthening the topics of the courses. In other words, it is stated to have sufficient practice opportunity in the lessons for the participation of the students (Benaya, Dagiene & Gal-Ezer, 2015).

- *Teaching and learning processes have measurable achievements and assessment tools, and high level thinking skills of learners,*

Russia seems to have provided more flexibility at the point of evaluation of the curriculum. Since the courses in the informatics curriculum are nested, the knowledge in the courses can be transferred to courses. For this reason, information in the informatics courses can be evaluated in other courses (Khenner & Semakin, 2014).

In addition, the informatics curriculum in Russia allows alternative evaluation tools (portfolio, project-performance assignments) to be used actively in the evaluation process.

- *The objectives of the computing program are to meet the sectoral needs,*

The Russian informatics curriculum is designed to solve the problems that arise in the sector. It seems to have taken into account sectoral needs in programs designed for the informatics course for many years. In particular, the adoption of the informatics education system in Russia according to new approaches shows that it aims to provide great benefit at the point of raising the necessary workforce in a sectorial sense (Benaya, Dagiene & Gal-Ezer, 2015).

- *The program is designed to provide a basis for responding to future needs,*

Russia informatics curriculum aims to gain 21st-century skills such as algorithmic thinking, scientific thinking, mathematical thinking, and problem-solving. The multifaceted development of the students has been ensured, especially since the curriculum is integrated with other courses and is an integrated event format. According to the Russian informatics curriculum, it is emphasized that the way to follow current developments is based on the training of quality informatics courses. It is aimed to educate the students as qualified people who can respond to their needs in the future (Khenner & Semakin, 2014).

4.1.4. What is the place of "coding education" in the secondary school curriculums of Turkey, the UK and Russia? Below, the findings of the analysis of the three countries computing curriculums were compared by following the steps of the CIPP model. In this step answering the following questions were sought.

- *The possession of the necessary equipment for the coding courses in the program,*

The fact that the informatics education in Russia has been applied for many years and it contains coding education shows that it provides an important benefit for the informatics curriculum. It can be said that this process has an important place in the progress of coding education, in having a strong education system, in providing the necessary infrastructure and in the development of the informatics curriculum.

Similarly, although the new curriculum in England was published in 2014, the impact of coding and STEM education has been felt for the last 10 years. Moreover, the fact that the national curriculum has a flexible structure and the curriculum is filled up by schools shows that coding education is based on a strong base in the UK. It seems that the computing curriculums have the necessary infrastructure and educational materials.

On the other hand, in Turkey, information technology and software curriculums are yet to be implemented having started in 2017, there are many problems. In particular, the in-service training of computer teachers, the physical structure of computer laboratories and the necessary infrastructure services in schools have not yet been provided.

Table 4.1

The possession of the necessary equipment for the coding courses in the program

	Curriculums of Turkey	**Curriculums of UK**	**Curriculums of Russia**
The possession of the necessary equipment for the coding courses in the program		- Experience - Flexible structure - Necessary infrastructure - Educational materials	- Experience - Necessary infrastructure - Educational materials

- *The adequacy of the course hours for the coding course in the program,*

In Turkey, Information Technology and Software was decided as two hours per week while the course was decided as one hour in England and Russia. If it is considered that the curriculum structures in Russia and England are flexible, one hour of lectures per week can be covered easily.

- *The sufficiency of the coding course in the program in terms of theoretical information,*

England, Turkey, and Russia's topics and gains curriculums have been seen sufficient for coding training. It is stated that curricula provides all the theoretical information about the coding course to the students and they have a theoretical background to make the connection between the other courses.

- *The usage of current teaching methods and applications in the program,*

Emphasized in the curriculums of Turkey, Russia, and England, teaching methods appear to be conducive to uncover students' abilities and potential of current and classroom environment. It can be said that the content of the methods succeeded in directing the students to learning, researching, observing, independent and creative thinking. Russia and England curriculum is more involved with the other courses. But Turkey is not as flexible as the other two countries when it comes to the relationships among disciplines.

Table 4.2

The usage of current teaching methods and applications in the program

	Curriculums of Turkey	**Curriculums of UK**	**Curriculums of Russia**
The usage of current teaching methods and applications in the program	- The content of the methods succeeded in directing the students to learning, researching, observing, independent and creative thinking	- The content of the methods succeeded in directing the students to learning, researching, observing, independent and creative thinking - More involved with the other courses	- The content of the methods succeeded in directing the students to learning, researching, observing, independent and creative thinking - More involved with the other courses

- *The materials to be used in the program will attract attention,*

It is said that the selected topics, projects, and practices for Turkey, the UK, and Russia curriculums are interesting to students. However, Turkey does not appear to have sufficient infrastructure to make the applications of each region of the country, although it's included in the curriculum.

Table 4.3

The materials to be used in the program will attract attention

	Curriculums of Turkey	**Curriculums of UK**	**Curriculums of Russia**
The materials to be used in the program will attract attention	- Topics, projects, and practices	- Topics, projects, and practices - Adequate practice for each region of the country	- Topics, projects, and practices - Adequate practice for each region of the country

- *The course plans in the program will be well organized,*

Turkey, England, and Russia`s curriculum plans were prepared in the course of considering the times and application forms related to the gains. In addition, the theoretical and practical hours of the courses were distributed in a balanced way and the theoretical information given during the course was tried to be applied.

- *The materials used in the program will facilitate the learning of the students and remind them of the level of the prior knowledge,*

According to the curriculums of Turkey, the UK and Russia, it is expressed that there is more than one kind of coding program and the learning of the student is facilitated because it is taught how to do programming with the form. In addition, the UK curriculum facilitates

teaching because it has been designed as a revision and an extension of the past years. Russia, on the other hand, is different from the UK in that it is the continuation of the previous year. However, Turkey's curriculum is seen that it enables coding refers to those including just enough for the 5th and 6th grade.

Table 4.4

The materials used in the program will facilitate the learning of the students and remind them of the level of the prior knowledge

	Curriculums of Turkey	**Curriculums of UK**	**Curriculums of Russia**
The materials used in the program will facilitate the learning of the students and remind them of the level of the prior knowledge	- Just for the 5th and 6th grade	- All grade - Revision and an extension of the past years	- All grade - The continuation of the previous year

- *The learning activities used in the program are student-oriented,*

In the UK curriculum, the role of the teacher in learning is excessive, but the diversity of applications and the presentation of additional resources suggest that the student has too many tasks. On the other hand, even if it seems that Turkey and Russia have a teacher-centred curriculum, largely focusing on the subject is expected from students.

- *If necessary, the subject can be reviewed in the courses,*

In Turkey, Russia, UK`s curriculums, students are able to easily make their applications again because they record their applications. The three curriculums provide access to current

and critical applications of computer courses from around the world. In addition, students with EBA programs created by the ministry of education in Turkey offers the possibility of accessing what they want to learn when they want to review it. In addition, in Russia, coding is used actively in other courses and students can repeat their coding lessons.

Table 4.5

If necessary, the subject can be reviewed in the courses

	Curriculums of Turkey	**Curriculums of UK**	**Curriculums of Russia**
If necessary, the subject can be reviewed in the courses	- Recording applications - Current and critical applications - EBA programs	- Recording applications - Current and critical applications	- Recording applications - Current and critical applications - Using actively in other courses

- *The lessons in the program include group activities,*

According to Turkey, UK and Russia's curriculums, it is stated that the selected students for cooperative teaching and in problem-solving activities are encouraged to study in groups. Namely, three curriculums have included group activities.

- *In the coding lessons of the program, there are adequate exercises on each new topic,*

In Turkey, Russia and England, curriculums have the possibility of creating individual and group activities that can exercise their students. In addition, the three countries curriculums provide the opportunity to practice more than one thing, through the internet and programs, related to a topic. In Turkey, students, with the EBA program created by the ministry of education, may review whatever they want to learn by accessing it easily.

- *Teaching and learning processes have measurable achievements and assessment tools, and high level thinking skills of learner*

Turkey, Russia and Britain's curriculums can be easily evaluated by teachers because the students are producing a product and the teacher can monitor the process. In the program, assignments are given in the form of reinforcing qualifications. The programs allow students to participate actively in class. The number of exams applied during the program is sufficient.

- *The objectives of the computing program are to meet the sectoral needs,*

The UK determines the needs of the industry and it shapes the computing curriculum of the students. The program is designed to provide a basis for responding to future needs. In Russia, it can be said that the course and the sector are intertwined as a result of development and future-oriented policies, especially in areas related to computers and mathematics. However, computing programs in Turkey is an area that cannot be said to be of much sectoral impact.

Table 4.6

The objectives of the computing program are to meet the sectoral needs

	Curriculums of Turkey	**Curriculums of UK**	**Curriculums of Russia**
The objectives of the computing program are to meet the sectoral needs		- Needs of the industry	- Needs of the industry - Future-oriented policies

- *The program is designed to provide a basis for responding to future needs,*

The main purpose of the computing curriculum in secondary schools in Turkey, England, and Russia; is to acquire the integrity of the personality of the learner, to prepare for the adult world, to form the philosophy of life, to be self-confident, to develop social relations, successful and strong individuals. It is also seen that computing programs teach students to love mathematics and develop critical thinking skills, problem-solving skills, knowledge-using skills, and cognitive development characteristics of the student.

4.2. Analysis of the Computer Teaching Textbooks in Terms of the Gagne's Model of Instructional Design Steps

In this section, Turkey, the UK and Russia's textbooks are assessed according to the Gagne's model of instructional design steps to search for answers to sub-research problems related to "What are the similarities and differences of coding education in secondary school computing textbooks in Turkey, England and Russia?"

4.2.1. What is the place of "coding education" in secondary school textbooks in Turkey? Below, the secondary school computer course online book was published, in 2017, by the national ministry of education in Turkey and it is evaluated according to Gagne's nine steps of instructions given.

The identification of the book TR

Title of Book: Information Technologies and Software Course 5th Grade Teacher's Guide

Authors: Prof. Dr. Yasemin Gülbahar Güven, Assoc. Dr. Filiz Kalelioğlu, Assoc. Dr. Serhat Bahadır Kert, Aydın Kaplan, Bülent Koçak, Esin Burcu İliş, Gökhan Karaosmanoğlu, Orhan Gazi Demirci, Tanju Köse, Yaprak Kaymak Özgür

Publishing House: MEB publishing

Release Date: 2017

4.2.1. 1. Gaining attention. First, when looking at the book TR in terms of coding education, it seems that mainly the visual stimuli is used to draw the attention of the students in the entrance sections of the coding subjects. For example, it is desired to draw attention of students by supporting “Block-based programming” activity on “Programming is a children's play” with pictures (Güven et al., 2017, p.192).

(Block-based codes make communication easy.)

Figure 4.1

Images related to block-based programming

Secondly, in book TR, students can reveal their knowledge, skills and attitudes with the help of diagrams, tables and maps about coding education. For example, students were asked to draw their attention to “lost in labyrinths” By giving them maps to make Blockly game-based programming applications (Güven et al., 2017, p.198).

Figure 4.2

Images related to algorithm

Moreover, it is seen that the book TR gives a story to attract the attention of students to the coding subjects in accordance with the needs and levels of the students, while providing new information. For example, in the study of “Solve puzzle”, “Problems of a wolf, lamb, and grass” was presented to the students; a story was presented in which students can be encouraged by relating to learning new information. This story aims to teach the process of problem solving, problem solving steps and daily life problems (Güven et al., 2017, p.136).

Furthermore, in the book TR, while presenting new information about coding education to the student, daily life examples were given about the topic in order to understand and draw the attention of the student. For example, in the topic of “Solve puzzle”, it is wanted to draw attention to the problem-solving processes with the daily life example of “You will cook but no salt at home” (Güven et al., 2017, p.135).

Lastly, in the book TR, debate questions about the coding education topics were created and students were asked to attract their attention. For example, in the subject of “Solve puzzle”, it is desirable to draw the attention of the students with debate questions such as “What is the best solution?” (Güven et al., 2017, p.136).

4.2.1. 2. Informing the learner of the objective. In the book TR, coding subjects are given keywords so that the students are informed about the contents of the coding education by looking at the keywords. For example, on the subject of “Story of an algorithm “, keywords are given to the students before entering the subject (Güven et al., 2017, p.162).

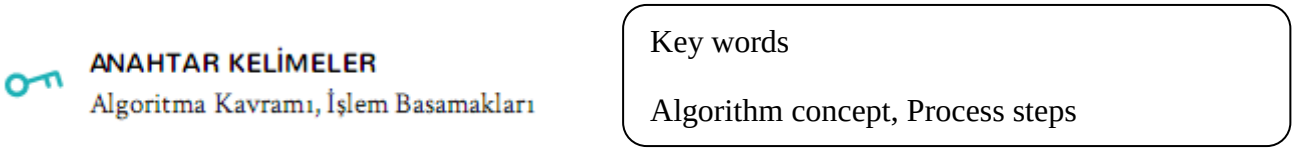


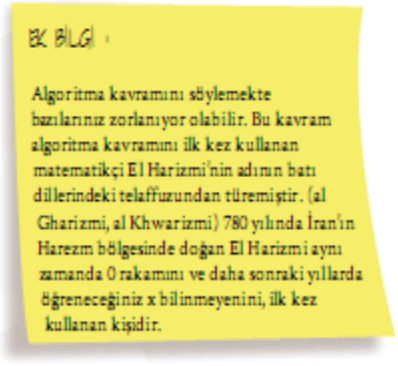
Figure 4.3

Keywords

4.2.1. 3. Stimulating recall of prerequisite learning. In the book TR, students are asked to insert new information about coding education into the new knowledge so that it relates to the previous information. In the topic “We can solve problems with Blockly”, Students were asked to answer the question “What did we learn with Blockly?” and aimed to relate the old knowledge to the new knowledge (Güven et al., 2017, p.217).

In the book TR, the debate questions asked about the prior coding lesson ensure that the students will remember the previous information about coding education and have an idea about the new content of the coding course. For example, in the topic of “Story of an algorithm “, students were informed about the contents of the coding by asking “What is meant by the word algorithm in the story?” (Güven et al., 2017, p.77).

4.2.1.4. Presenting the stimulus material. Looking at the book TR, it is seen that the coding knowledge that is considered important within the coding subject is given as an 'Information box', 'Note-taking', and students are asked to attend with this information. For example, on the subject of “Story of an algorithm”, students were given the note of teaching “August beetle and ant” application (Güven et al., 2017, p.164).



Additional information

Some of you may be struggling to say the concept of algorithm. This concept creates from the pronunciation of the name of El Harizmi, the mathematician who used the concept of algorithm for the first time, in the western languages. (al Gharizmi, al Khwarizmi) El Harizmi, who was born in the Khwarazm district of Iran in 780, is also the first to use the number 0 and the x unknown, which you will learn in the following years.

Figure 4.4

Additional information

In the book TR, tables and diagrams of coding teaching are included. Thus, students code their new learning in long-term memory by associating it with what they have already learned about coding education. For example, in the subject of “Changing flow', there is a diagram to guide the students (Güven et al., 2017, p. 171).

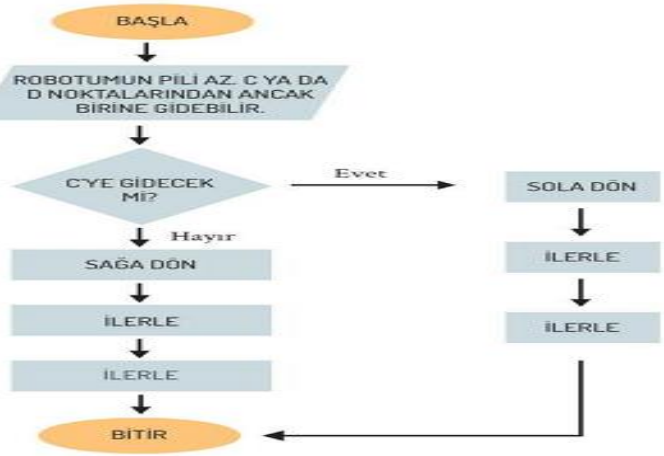


Figure 4.5

Exemplary flow chart

Besides, the questions are directed at the students in the coding topics of the book TR and they are easily answered by the students. This makes it easier for the students to understand the questions and makes them easier to understand by using different sentences. For example, on the subject of “I am getting acquainted with the informatics” and the activity of “Sculpture and sculptor” was given to the students. Through this activity, students are asked to ask easy questions and the meaning of the learners is facilitated (Güven et al., 2017, p.22).

4.2.1. 5. Providing learning guidance. While the book TR presents new coding knowledge, the students are guided with examples of the subject in order to understand and relate the old knowledge to the new knowledge. For example, the “Block-based programming” activity, the topic of “Programming is a simple job”, is presented to the

students with an example that can guide them to associate the new knowledge with the old knowledge (Güven et al., 2017, p.193).

When looking at the book TR, it is seen that the information is considered important within the coding subject given as “Information box”, “Note-taking” to guide the students. For example, in the coding subject of “Programming is a simple job”, the students were informed about the contents of the subject by giving additional information to the students about “Story of an algorithm” and the students tried to prevent wrong and incomplete learning (Güven et al., 2017, p.164).

The book TR presents multiple representations (such as visual diagrams, symbols and tables) that are closely related to conceptual thinking in order to provide deep understanding of computational thinking and coding education so that the concepts and ideas stay in the mind of students. Establishing a relationship between multiple impressions helps to improve understanding. For example, in the topic of “Solve puzzle”, students are given a conversation about the “Hanoi Towers” (Güven et al., 2017, p.139).

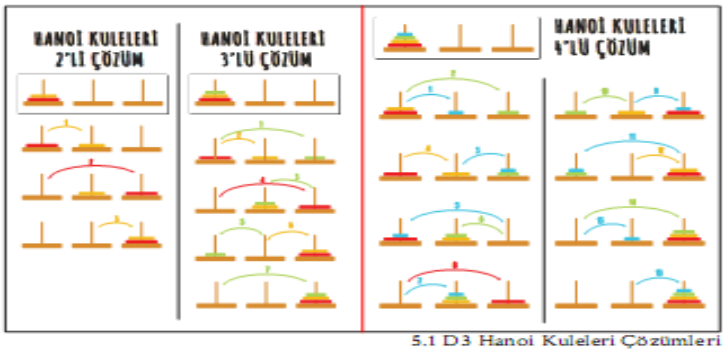


Figure 4.6

Hanoi Towers Solutions

4.2.1. 6. Eliciting the performance. A large part of the book TR has included many activities. It is aimed to increase motivation to uncover the behaviours of the students through activities. For example, in the coding topic “Find the best solution”, students are given the activity “What do you want to play now?” (Güven et al., 2017, p.30).

The book TR was mainly given a place for questions at the end of the coding subject. While looking at the debate questions in the book TR, it seems that there are questions that encourage students to interpret and think about coding education. For example, in the topic of “Programming a storm”, questions were directed at students and their thinking was provided (Güven et al., 2017, p. 83).

1. Günlük yaşamınızda hiç "bilgisayarda programlama yapmak" ifadesiyle karşılaştınız mı?
2. Sizce bilgisayarda programlanarak yapılmış neler vardır?

1. Have you ever faced the expression “Programming on a computer" in your daily life?
2. What are the things that were made by programming on a computer in your opinion?

Figure 4.7

Debate questions

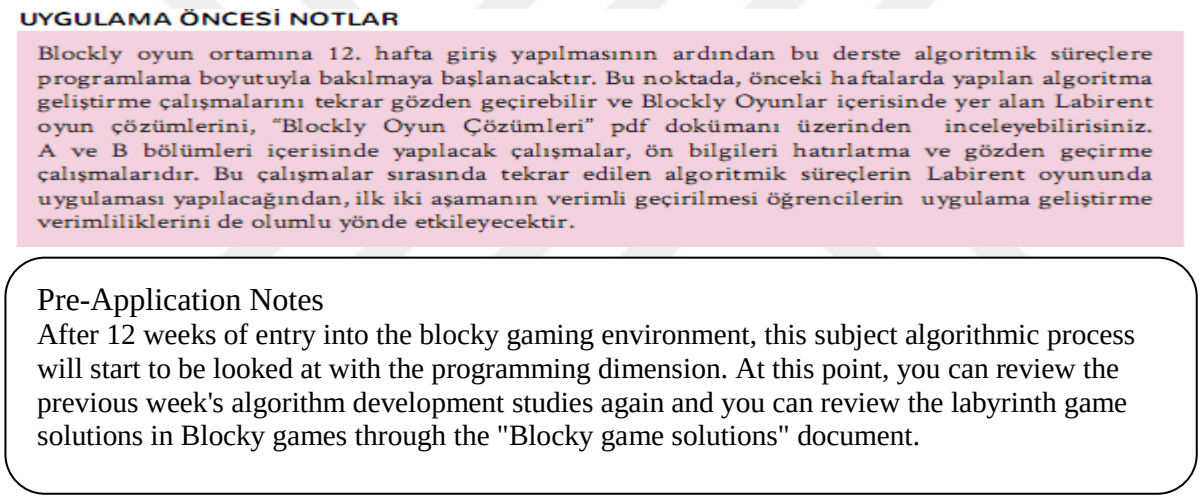
4.2.1. 7. Providing feedback. There is no feedback about coding education in the book TR, as the questions are not answered while the coding topics are being processed. However, the book TR workbooks are provided to students with answers and explanations for feedback purposes.

4.2.1. 8. Assessing the performance. In the book TR, questions at the end of the coding units and coding sections like “What did we learn?” are helpful in evaluating the students. For example, evaluation questions were asked in order to ensure that the students' learned that

they were correct, incomplete or inaccurate on the topic of “What did we learn with Blockly?” (Güven et al., 2017, p.217).

The coding questions in the book TR are at the level of students. It seems that students are involved in questions of analysis, synthesis, and evaluation in order to investigate high-level cognitive behaviors.

4.2.1. 9. Enhancing retention and transfer. In the book TR, there are questions in order to transfer the coding knowledge of the students. For example, in the topic of “Lost in labyrinth”, there is a warning to remind students of their prior knowledge before they learn something new (Güven, et al., 2017, p.197).



UYGULAMA ÖNCESİ NOTLAR

Blockly oyun ortamına 12. hafta giriş yapılmasının ardından bu derste algoritmik süreçlere programlama boyutuyla bakılmaya başlanacaktır. Bu noktada, önceki haftalarda yapılan algoritma geliştirme çalışmalarını tekrar gözden geçirebilir ve Blockly Oyunlar içerisinde yer alan Labirent oyun çözümlerini, “Blockly Oyun Çözümleri” pdf dokümanı üzerinden inceleyebilirisiniz. A ve B bölümleri içerisinde yapılacak çalışmalar, ön bilgileri hatırlatma ve gözden geçirme çalışmalarıdır. Bu çalışmalar sırasında tekrar edilen algoritmik süreçlerin Labirent oyununda uygulaması yapılacağından, ilk iki aşamanın verimli geçirilmesi öğrencilerin uygulama geliştirme verimliliklerini de olumlu yönde etkileyecektir.

Pre-Application Notes
After 12 weeks of entry into the blocky gaming environment, this subject algorithmic process will start to be looked at with the programming dimension. At this point, you can review the previous week's algorithm development studies again and you can review the labyrinth game solutions in Blocky games through the "Blocky game solutions" document.

Figure 4.8

Pre-application notes

The activities to be carried out in sections A and B are preliminary reminders and surveillance exercises. Since the algorithmic processes that are repeated during these studies are applied in the labyrinth game, the efficient passing of the first two stages will also positively affect the application development efficiency of the students.

In the book TR, there are diagrams about coding education in the form of concept maps for students to increase their permanence. For example, when students learn about the “Lost in the labyrinth”, maps are given to remind them of their knowledge (Güven et al., 2017, p.198).

Örnek adres tarifi:

1. Otelden çık.
2. Sola dön.
3. Sağ tarafında Kestane Sokak'ı görene kadar yol boyunca ilerle.
4. Sağa dön.
5. Kestane Sokak boyunca ilerle.
6. Heykeli karşında göreceksin.

Address Direction Example:
1. Exit the hotel.
2. Turn left.
3. Advance along the road until you see Kestane Street on your right.
4. Turn right.
5. Advance along Kestane Street.
6. You will see the statue.

Figure 4.9

Example address

In the book TR, the coding events discussed are topics that students often come across in real life. To do this, it is necessary to include questions or events at the end of each topic. For example, when students learn about "let's make a musical instrument"; they are given real life examples that will remind them of their current knowledge (Güven et al., 2017, p. 166).

4.2.2. What is the place of "coding education" in secondary school textbooks in the UK? In this section, the evaluations of the secondary school computing textbooks in England are given according to Gagne's model of instructional design steps.

The identification of the book UK;

Book Title: Matrix Computing for 11-14

Authors: Alison Page, Diane Levine, Steve Bunce, Areti Bizior.

Publishing House: Oxford University Press

Place of Publication: Oxford

Publication date: 2017

4.2.2.1. Gaining attention. It is seen that the book UK contains many pictures about coding education to attract attention. For example, `Data and the CPU` has been given to students in order to draw their attention to their behaviours in the heading “Sending coded”(Page, 2017, p.62).

Figure 4.10

Examples from daily life

The book UK describes real life examples and stories about coding education to attract the attention of student. For example, in the “Information technology” unit, a historical story about “Data and the CPU ` was presented to attract the attention of the students on “Sending coded” (Page et al., 2017, p.63). In addition, simple diagrams are given and the topic is explained directly in the book UK. For example, in the subject of “Plan and process”, students are asked to draw the students' attention by giving the diagram” A computer process turns into data” (Page et al., 2017, p.119).

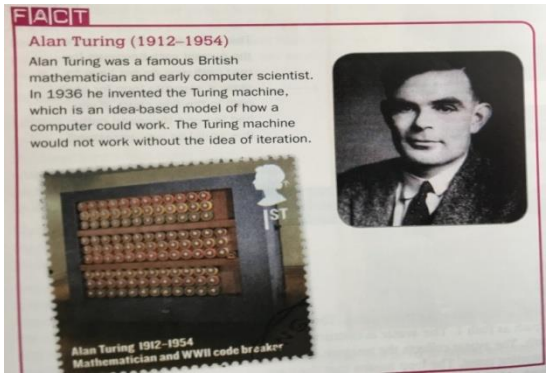


Figure 4.11

Alan Turing

In the book UK, debate questions about the coding topics have been created and students are asked to take attention. For example, in the topic of 'Introducing python', the students are given the discussion questions related to the coding topic “Talk about ...” and they attract the attention of the students when they enter the subject (Page et al., 2017, p.90).

Figure 4.12

Computer

4.2.2.2. Informing the learner of the objective. In the book UK, the keywords of the coding topic are given to inform the students. For example, on the subject of “Introducing

python", there are keywords that will help students to remember their prior knowledge (Page et al., 2017, p.91).

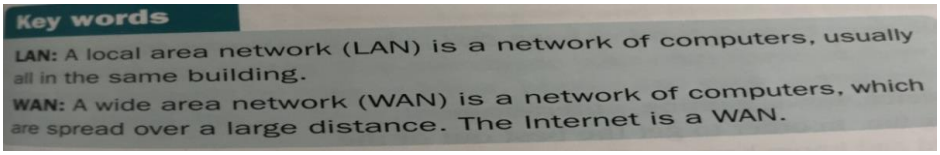


Figure 4.13

Key words

4.2.2.3. Stimulating recall of prerequisite learning. In the book UK, while presenting new information to the students, coding questions are given about the prior knowledge so that it's associate with the new knowledge. For example, in the "Data and the CPU` unit, when the student is active in the" Sending code "event, the information the student remembers can be learned by asking the students to associate old information with new information (Page et al., 2017, p.62).

In the book UK, debate questions are raised about the coding topics and students are asked to remember their old knowledge. For example, in the topic of "Introducing python", the students are given the discussion questions related to the topic "Talk about ..." and students are aimed to remember their old knowledge when they enter the coding subject (Page et al., 2017, p.90).

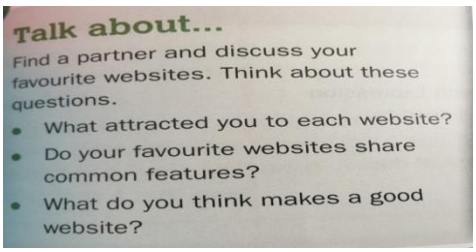


Figure 4.14

Talk about.

4.2.2.4. Presenting the stimulus material. In the book UK, it seems that there is are activities, keywords, warnings, etc., about coding education which can help as information or guidance, in order to prevent the possible and future misunderstandings that may arise in the student. For example, in the "Computational thinking" unit, "Comment, program" keywords were given and the students were taught how to learn information about the subject (Page et al., 2017, p.27).

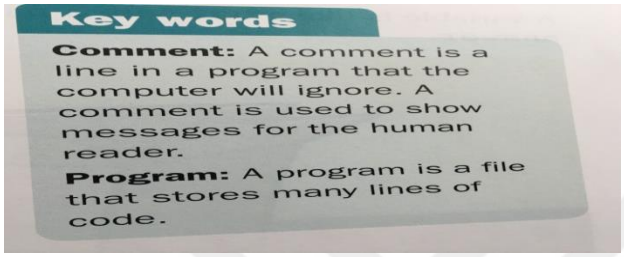


Figure 4.15

Key words

The book UK gives us tables and diagrams about coding education that recall prior information that the student will place, associate, and incorporate into the new coding knowledge. For example, in the "Introducing python" unit, a "Logical operator" table was given to the students in the "Keep score" study for the students, and a table was presented to associate old information with new information (Page et al., 2017, p.114).

In addition to questions about pictures or subject interpretation in the book UK, there are also questions about how to make students feel cognitive behaviour. For example, at the end of the "Creative Communication" section, "Now do you it" and "Test yourself" sections provide students information to remember old knowledge. (Page et al., 2017, p.163).

4.2.2.5. Providing learning guidance. When the book UK was reviewed, examples were presented to students at the beginning of the coding subject to guide the students before the

coding topics were explained. For example, under “Hardware: understanding input devices” for “Information technology”, achievements have been made to guide students (Page, 2017, p.120).

In the book UK, there is are activities, keywords, warnings, etc., about coding education that can help as information or guidance to prevent misleading learning that may possibly occur in the student. In order to prevent future misunderstandings, “Information box, Note taking etc.” events are used in the book UK. For example, in the “Computational thinking” unit, “Loop, iteration” keywords were given and students were guided while learning the subject (Page et al., 2017, p.27).

In the book UK, coding tables and diagrams are included in order to guide the students. Thus, students associate their new learning with what they have already learned and prevent wrong learning. For example, in the “App inventor” unit teachers were provided with a “Test and evaluate” table to guide their students (Page et al., 2017, p. 57).

4.2.2.6. Eliciting the performance. The book UK was mainly devoted to events at the end of the coding subject. When you look at events in the book UK, it seems that there are activities that encourage students to realize think and interpreted. For example, in the “Introducing python” unit, there is a section called “How to ...” which is required to be made by the students on “Your answer: right or wrong” (Page et al., 2017, p.108).

In addition to coding questions about pictures or subject interpretation in the UK, there are also questions about how to make students feel cognitive behaviour. For example, at the end of “Creative communication” unit, “Now do you it” and “Test yourself” activities are provided to students in order for them to realize that their learning is correct, incomplete or incorrect (Page and dig., 2017, p.163).

4.2.2.7. Providing feedback. At the end of the learning-teaching process, when the desired behaviour occurs, it is assumed that the learning has taken place. However, the student should be informed about the correctness of the behaviour. There is no coding feedback in the book UK.

4.2.2.8. Assessing the performance. The questions at the end of the units and the students' exercises that are the subject of the book UK are used for the evaluation of the students. For example, the questions at the end of the "Creative communication" unit assess the students' learning and make them aware that their information is correct, incomplete or incorrect (Page et al., 2017, p.162).

4.2.2.9. Enhancing retention and transfer. In the book UK, coding questions are provided to the students at the end of the coding topics and the coding units. For example, in the "Information technology" students learn about what they have learned by testing themselves in the "What have you learned about information technology" section (Page et al., 2017, p.144).

In the book UK, there is a collection of coding events that students often meet in real life. The coding activities given to the students are provided with the repetition of the information about daily life, the permanence of the coding information and the transfer of the coding information to real life. For example, students are asked to create an ID card for themselves in the "App inventor" unit "Design an ID card" (Page et al., 2017, p.34).

In the book UK, when the students present new coding information, they are given maps of the previous knowledge that they will place and associate with the new knowledge. For example, in the case of "Lost in the labyrinth", the application of the "Remember algorithm" is associated with what was previously learned and as a result the old information is reminded.

4.2.3. What is the place of "coding education" in secondary school textbooks in Russia? In this section, the evaluation of the secondary school computing textbooks in Russia is given according to Gagne's model of instructional design steps.

The Identification of Book RU:

Book Title: 8th Informatics course book

Authors: I. G. Semakin, L. A. Zalogova, S. V. Rusakov, L. V. Shestakova

Publishing House: Binom. Information Lab, 3rd edition

Place of Publication: Moscow

Publication Date: 2015

4.2.3.1. Gaining attention. The book RU focuses on visual items and the visual stories are told about the coding subjects. For example, there are pictures of students in the "Information transmission in computer networks" section (Semakin et al., 2015, p.9).Thus , it is desired to draw the attention of the student.

KS Island

Local network

Internet

Hardware

Information services

Figure 4.16

Transmission of information in computer networks

In the book RU, there are tables and diagrams related to the coding subjects. Thus, the attention of the students is attracted and the students are able to concentrate on the coding topic better. For example, in the “Internet search routes” section, students are asked to draw their attention to the subject by giving them a table and a diagram related to the “information transmission in computer networks” (Semakin et al., 2015, p.32).

Information source

Coding device

Protection from the noise

Рис. 1.3. Схема технической системы передачи информации

Noise, sound

Deciphering information receiver

Connection channel

Figure 4.17

The diagram of the technical information transmission system

In the book RU, gains were given at the beginning of the coding subject. Thus, the attention of the students is attracted and the students are able to concentrate on the coding topic better. For example, students were asked to draw attention to the subject by giving information about the “Knowledge modelling” (Semakin et al., 2015, p.49).

Основные темы параграфа:

- *таблицы типа «объект—свойство»;*
- *таблицы типа «объект—объект»;*
- *двоичные матрицы.*

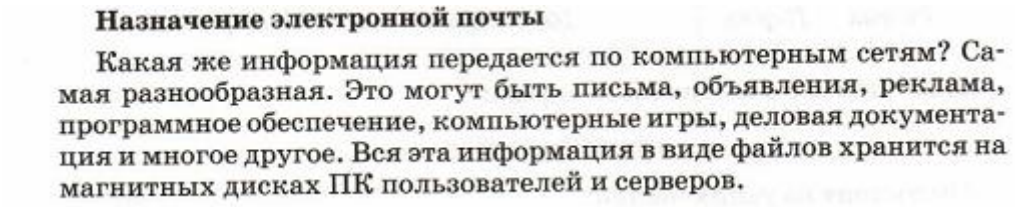
- Object property table
- Object property table
- Binary matrices

Figure 4.18

Headers in the under section

4.2.3.2. Informing the learner of the objective. In the book RU, students are informed about the content of the coding course by asking questions at the beginning of the coding course. For example, in the “Computer networks” unit, “What kind of information is

transmitted through computer networks about E-mail and other services" is asked to the students, so that the students are informed about the course objectives (Semakin et al., 2015, p. 13).



Назначение электронной почты

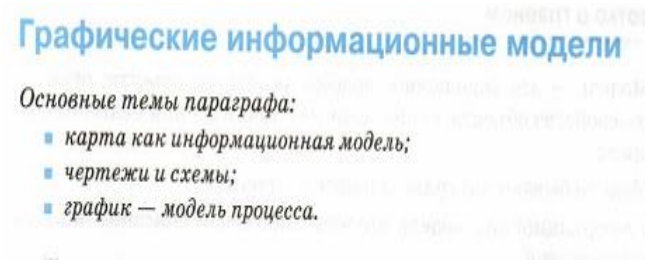
Какая же информация передается по компьютерным сетям? Самая разнообразная. Это могут быть письма, объявления, реклама, программное обеспечение, компьютерные игры, деловая документация и многое другое. Вся эта информация в виде файлов хранится на магнитных дисках ПК пользователей и серверов.

Is it possible to send information via computer? All kinds of letters, special information and games are kept on file-shaped discs.

Figure 4.19

Content of the email

The book RU also gives coding examples and coding maps of the previous information that the student will place and associate with the new knowledge while presenting new coding topics. For example, students are given examples of "Graphic information". Thus, it is possible to remember what students learned previously (Semakin et al., 2015, p.46).



Графические информационные модели

Основные темы параграфа:

- *карта как информационная модель;*
- *чертежи и схемы;*
- *график — модель процесса.*

- Sub-topics
- Map information model
- Lines and diagrams
-Graphic process model

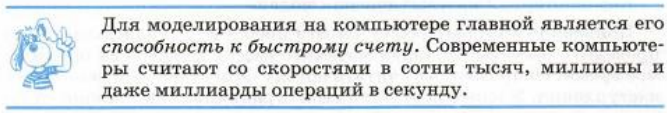
Figure 4.20

Graphical information

4.2.3.3. Stimulating recall of prerequisite learning. The book RU also provides stories about prior coding knowledge that the student will add to the new knowledge, while presenting new coding information. For example, the student has been told about the history

of numbers and number systems. Thus, it is possible to remember what students learned previously (Semakin et al., 2015, p.51).

4.2.3.4. Presenting the stimulus material. When we look at the Book RU, information is given in the form of 'Information Box' and 'Note taking' in places where it is considered important in the coding subject, and students are asked to prevent the flow of misleading information. For example, students have been told about the topic of “Modelling information on a computer” (Semakin et al., 2015, p.55).


Для моделирования на компьютере главной является его *способность к быстрому счету*. Современные компьютеры считают со скоростями в сотни тысяч, миллионы и даже миллиарды операций в секунду.

The main feature of the computer for modelling is fast calculation. Today's computers do millions of transactions every second.

Figure 4.21

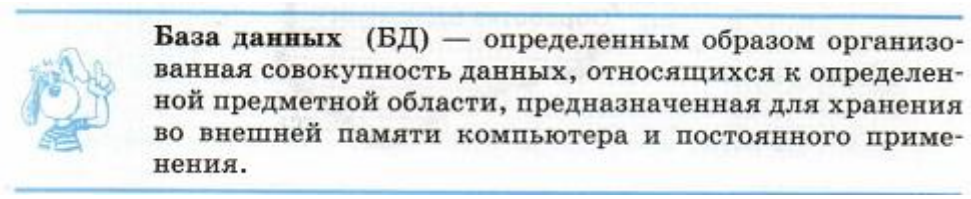
Key words

When you look at the book RU, you can see that it is aimed to give more meaning to the learners by giving examples about the coding topic while it is being processed. For example, “Examples of a simulation model” includes examples for students to take lessons from and then apply to their daily lives (Semakin et al., 2015, p.57).

The Book RU seems to include coding tables and diagrams that can be help to prevent possible coding misunderstandings that may arise in the student. For example, “What is a database management system?” (Semakin et al., 2015, p.63).Thus, students code the new things they have learned into their long-term memory by associating it with what they have already learned.

4.2.3.5. Providing learning guidance. In the book RU, there are activities and warnings that may help as information or guidance to prevent misunderstandings about coding that may possibly occur in the student. For example, in the topic of “Storage and processing of

information in databases", students are given information notes for guidance purposes. (Semakin et al., 2015, p.82).



База данных (БД) — определенным образом организованная совокупность данных, относящихся к определенной предметной области, предназначенная для хранения во внешней памяти компьютера и постоянного применения.

Storing different data in a specific area together with external memories.

Figure 4.22

Database

Included tables and diagrams in Book RU that can guide to prevent possible misconceptions and misleading. For example, "What is a database management system?" (Semakin et al., 2015, p.91).

Таблица 3.2. Результат выборки двух полей из БД

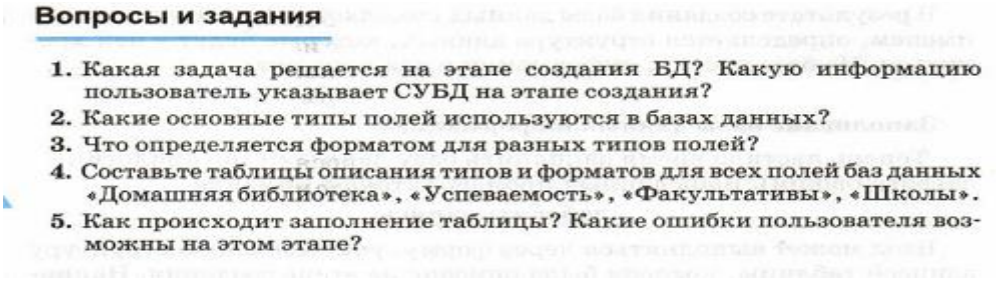
АВТОР	НАЗВАНИЕ
Беляев А.Р.	Человек-амфибия
Кервуд Д.	Бродяги Севера
Тургенев И.С.	Повести и рассказы
Олеша Ю.К.	Избранное
Беляев А.Р.	Звезда КЭЦ
Тынянов Ю.Н.	Кюхля
Толстой Л.Н.	Повести и рассказы
Беляев А.Р.	Избранное

Figure 4.23

Data selected in a particular condition in the database.

4.2.3.6. Eliciting the performance. At the end of each coding topic in the book RU, coding questions were mainly given. While looking at the questions in the book RU, it is seen that

there are activities that encourage students to think. For example, in the “Creating and filling databases” questions were asked about students' behaviours (Semakin et al., 2015, p.94).



Вопросы и задания

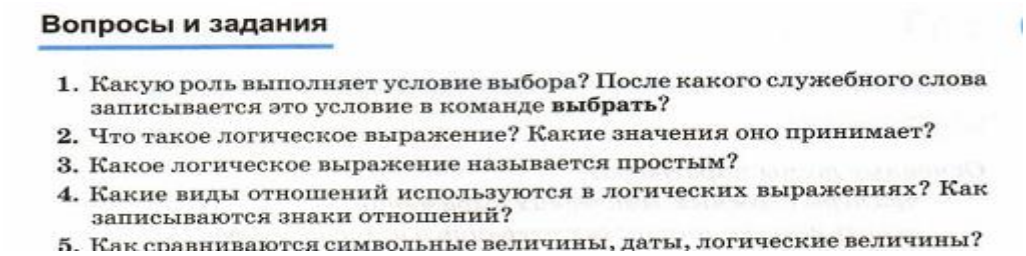
1. Какая задача решается на этапе создания БД? Какую информацию пользователь указывает СУБД на этапе создания?
2. Какие основные типы полей используются в базах данных?
3. Что определяется форматом для разных типов полей?
4. Составьте таблицы описания типов и форматов для всех полей баз данных «Домашняя библиотека», «Успеваемость», «Факультативы», «Школы».
5. Как происходит заполнение таблицы? Какие ошибки пользователя возможны на этом этапе?

Figure 4.24

Questions and assignments

4.2.3.7. Providing feedback. There is no coding feedback in the Book RU, as the answers to the questions about the coding topic are not answered while the coding topics are being processed. However, the Book RU exercise books have given answers and explanations for feedback purposes.

4.2.3.8. Assessing the performance. In the book RU, the questions at the end of the units and the students' exercises which are the coding subject of the book become competitors in terms of the evaluation of the students. For example, in order to sort, delete and add entries, questions were asked to the students for evaluation purposes (Semakin et al., 2015, p.107).



Вопросы и задания

1. Какую роль выполняет условие выбора? После какого служебного слова записывается это условие в команде **выбрать**?
2. Что такое логическое выражение? Какие значения оно принимает?
3. Какое логическое выражение называется простым?
4. Какие виды отношений используются в логических выражениях? Как записываются знаки отношений?
5. Как сравниваются символьные величины, даты, логические величины?

Figure 4.25

Questions and assignments

4.2.3.9. Enhancing retention and transfer. In the book RU, there are coding diagrams in the form of concept maps for students to increase their permanence in their memories. For example, when students learn about “Graphic information models”, they are given some reminiscent of foreknowledge (Semakin et al., 2015, p.57).

In the book RU, while presenting new information, the student gives activities, questions and examples about the previous information that she-he will add to the new knowledge and relate to the old information. For example, students were given coding questions about the `Knowledge modelling” issue. Thus, remembering what was learned previously is provided for the students (Semakin et al., 2015, p.56).

4.2.4. What are the similarities and differences between the textbooks of the three countries? In this section, the evaluation of the secondary school computing textbooks of Turkey, the UK and Russia are given according to Gagne's model of instructional design steps.

4.2.4.1. Gaining attention. When Book UK and Book TR are examined, it is seen that coding photographs and coding pictures are included to attract the students attention. The pictures in book UK are mostly about daily life. It is seen that when the pictures are given in the book TR, the amount of attention the students pay to it is above their age level. In the book UK, photographs are directly transferred. On the other hand, the coding pictures in the book RU are very rarely used and aren’t related to everyday life.

The book TR, book RU and book UK have maps, charts, diagrams and tables that are available for students interested in the coding subject. (Especially the Book RU is more enriched in this regard than the other books). Thus, the attention of the students was drawn to try to achieve better intonation.

The book TR, book RU and book UK tells stories to draw attention. Coding stories in the book RU and book UK are biographical stories about real life. But the book TR tells stories that are appropriate for the age level of children.

The book TR, book RU and book UK seem to provide in real life coding examples to attract the attention of the student. Examples in the book RU and book UK are related to real life and the given examples in the textbooks can be easily observedby students in everyday life, as well as by looking at natural phenomena learned in other lessons.

In the book TR and book UK, discussion questions about the subjects were created and the students' attention was aimed. Besides, the question directed at the students is an answer that can be easily given. It is seen that the discussion questions aim both to draw the attention of the students and to activate the senior mental processes of the students with the question.

Table 4.2.4.1

Gaining attention

	Book TR	**Book UK**	**Book RU**
Gaining attention	- Pictures, maps, charts, diagrams and tables about daily life. - Stories are appropriate for the age level of children. - Discussion questions - Given examples in the textbooks.	- Pictures, maps, charts, diagrams and tables about daily life. - Biographical stories about real life. - Discussion questions - Given examples in the textbooks.	- Pictures very rarely used and aren’t related to daily life. - Biographical stories about real life. - Given examples in the textbooks.

4.2.4.2. Informing the learner of the objective. Book TR, book UK and book RU also provide the keywords to inform the students about the coding content. Keywords are also available at the beginning of the book UK, book TR and book RU. Thus, it is aimed that the student learns intensively by establishing an expectation about the subject.

4.2.4.3. Stimulating recall of prerequisite learning. In book TR, book UK and book RU, while presenting new information to the student, questions and examples related to the previous information will be added to the new coding knowledge given. The book TR and book UK have been created as a discussion of topics and to remind students to be informed. This enhances the students' academic self-esteem as it both increases the student's approach to the topic and answers the question.

4.2.4.4. Presenting the stimulus material. When you look at the book TR, book RU and book UK, you can see that they tried to prevent students from misunderstanding anything about coding by giving information in the form of “Information Box”, “Note-taking”. Thus, interventions were made where it was necessary, after which students learned to include that in the presentation of their content.

When looking at the book RU, book UK and book TR, you can see that important daily life coding examples are given in the subject and information about where this information can be used in daily life is presented. Thus, when students learn how to code knowledge, the establishment of a relationship with daily life is provided wherever necessary.

While presenting content in the book TR, book UK, and book RU, they provide questions and activities related to the topics. Book RU has limited activities. For this reason when it comes to presenting book TR, Book UK is more suitable than Book RU.

4.2.4.5. Providing learning guidance. When looking at the subject in book UK, book TR, and book RU, it is aimed to give more meaning and guidance to the learners by giving relevant examples. In addition, daily life examples were given as much as possible.

Activities, warnings and keywords in book UK, book TR, and book RU, as information or guidance, help to prevent misunderstandings about coding that may possibly occur in the student.

While the student is presenting new information in the book TR, book UK, and book RU, there are tables and diagrams, which show sub-concepts related to the coding subject when the topics are being processed. Thus, the students are guided by the teaching process.

4.2.4.6. Eliciting the performance. With the help of the activities at the end of the coding subject in book RU, book TR, and book UK, students are taught to practice what they've learned. In addition, looking at the events in the textbooks have been mainly focused on the questions at the end of each coding topic. When we look at the coding questions in the book RU, it seems that there are questions that encourage students to interpret and think. While the book UK is being processed, coding questions are being raised about the unit related to the subject. "Now do it ...", "If you have time", "Test yourself", as well as in the evaluation questions at the end of the unit. In the book TR, coding questions about the unit related to the coding topic have been included. At the end of the topics and general repetition sections, work books were given to the students.

4.2.4.7. Providing feedback. There is no coding feedback as the questions about the topic are not answered while the topic is being processed in the book RU, book TR, and book UK. However, the workbook was given to the students with answers and explanations in order to provide feedback in the book TR and book RU.

4.2.4.8. Assessing the performance. The exercises, the events, the discussion questions in book TR, book UK and RU seem to be used to reveal the coding learning of the students.

4.2.4.9. Enhancing retention and transfer. Book TR, book UK, and book RU provide an opportunity in terms of evaluation of the students at the end of the coding units and student exercises. The book UK has been raising questions about the unit related to the coding subject. At the end of the lessons, what the student learned in this coding subject, the general repetition sections, as well as the workbooks were given to the students.

Book TR, book UK and book RU helps students to discover what they've learned with the help of events at the end of the topic. While the books are being processed, there are very few activities relating to the topic. The book TR, book RU, and book UK have related maps. (Especially the book RU is more enriched in this regard than the other books). Thus, the students can combine the old knowledge with the new knowledge and the students can become better at concentrating on the coding topic. It provides multiple representations (such as visual diagrams, hand symbols, and tables) that are closely related to the underlying conceptual thought to provide an in-depth understanding of the coding concepts and ideas that are interesting to students. Establishing a relationship between multiple impressions helps to improve one's' understanding.

Table 4.2.4.9

Enhancing retention and transfer

	Book TR	**Book UK**	**Book RU**
Enhancing retention and transfer	- Student exercises - Questions - Maps	- The events - Discussion questions - Maps	- The events - Discussion questions - Maps

Chapter 5

5. Conclusion and Discussion

This section will include the results and recommendations based on the data obtained from the research and the findings of the research. The results of the research are presented under two headings. The first title will be about the discussions about the results of the evaluation and the location of coding education in the computing curriculums of Turkey, the UK, and Russia according to the CIPP model. The second topic will be about the discussion of the results of the analysis of the coding education of the computing textbooks in the three countries according to the Gagne's model of instructional design.

5.1. Consequences of Computer Programs Examined According to the CIPP model

Below, the findings of the comparison between the locations of the coding subject in the computer curriculum of Turkey, the UK, and Russia are discussed by following the steps of the CIPP model.

According to the ACM (2013) report, the success of the curriculum implemented in a country or region has been shown to have a critical role in the availability of necessary equipment and the competence of teachers. The computing curriculum of Turkey, the UK and Russia has the equipment required for the coding subject (tools, equipment, etc.). Especially since Russia and England are thought to be providing coding training for years, it is possible that the need for the necessary equipment is met and the problems of the UK and Russia are solved. However, Turkey has already started a new coding education; it also has problems related to the material, infrastructure and teacher training. Therefore; it can be said that the curriculums of Russia and England are more successful in terms of the context for the coding education.

The determination of the subject hours of a lesson represents the minimum duration for teaching a course. In any institution, the course must be chosen for a longer period than the minimum required, as required by the course (Kim & Baylor, 2008; Passey, 2017). When examined in terms of the adequacy of the staff allocated for coding education in the computing curriculums, coding courses were decided as two hours per week in Turkey and an hour per week in England and Russia. If it is thought that the curriculum structures in Russia and England are flexible, it is considered normal to teach one hour per week. Therefore; two hours of coding lessons in Turkey seems to be more appropriate.

Denning (2009) and Topiet al. (2010) emphasizes that the success of the coding training must teach the students the minimum theoretical knowledge required for coding education. Subjects and learning outcomes in the computing curriculum of England, Turkey and Russia have adequate coding training in terms of theoretical knowledge. When its relationship with the other courses is taken into account, there is not a theoretical problem in the computing curriculums of the UK and Russia.

Although the computing curriculum of Turkey is adequate in terms of theoretical knowledge, there are problems about mathematics and mathematical skills when it comes to coding education. Because the information technology and software course curriculums in Turkey are thought alone, it is obvious that the knowledge the teachers give will create problems in terms of proficiency and practice.

Studies show that the use of more than one teaching method suggests that the learning environment is enriched and supports teaching and learning (Kim & Baylor, 2008; Peña-López, 2015; Passey, 2017). The computing curriculum of Turkey, England and Russia highlighted teaching methods that are suitable for revealing the talents and potentials of the students in the classroom environment. The computing curriculum is more involved with the

other courses in Russia and the UK. It is possible to use many teaching methods because the curricula of these countries are more appropriate and flexible for STEM-based training. It is also expected that the UK and Russia's computing curriculum will enable them to develop their own teaching methods and coding education schemes if they teach coding education in the years to come. Therefore, the computing curriculum of Turkey shows that especially the popular training methods out of the main axis of interdisciplinary courses are located in the processing method. This has a negative effect on the mathematics education, especially on the coding courses. This situation is especially negative effect for mathematics education, which is indispensable for the coding course.

While the coding course is being taught, it has been stated that the students can easily learn and giving examples daily life in order to attract the attention of the students helps them learn easier by attracting their attention (Otrel-Cass, Forret & Taylor, 2009; Topiet al., 2010). The selected topics, projects and applications in the curriculum of Turkey, England and Russia are related to daily life and they can be considered attractive by students. In addition, Turkey's, the UK's and Russia`s coding programs are used in more than one variety in the curriculum and to make programming is made with the way it was aimed, to facilitate the learning of the students and teach coding. In addition, the instruction is facilitated in the UK curriculum as it was designed as a revision and an extended version of the past years. Russia's, on the other hand, is not in the form of the previous year's recap, but it is a continuation of the previous year. However, Turkey's curriculum is thought to provide enough opportunities for other graders which refer to coding issues being covered for only 5 and 6 lessons.

According to Wong et al. (2016) and Park et al. (2015), it must be stated that the lesson plans prepared for the lectures should be clear, understandable and should be easily interpreted by the students and teachers.

Turkey, England and Russia's computing curriculum plans are prepared in connection with acquisitions considering the timetables and the application forms that are arranged in a clear and understandable manner. The theoretical and practical hours of the courses are distributed in a balanced manner. Particularly in the Russian computing curriculum, the theoretical content of the coding course is specified one by one and it is clearly stated which subject will be studied. However, while Turkey has the curriculum, the courses are related to the information technology and software courses only and are not mentioned in relation to the other courses.

According to Futschek and Moschitz (2011) and Peña-López (2015), the teacher has a critical role in coding education. The principal role of the teacher is to guide the student to the student centred course. In the UK curriculum, the role of the teacher in learning is excessive, but the diversity of applications and the presentation of additional resources suggest that the student has too many tasks. On the other hand, Turkey, in which the students may seem largely teacher-centred just like the curriculum of Russia, has been found to consistently expect work from students.

According to Calder and Taylor (2010), Passey (2017) and Park et al.(2015), it must be stated that activities and applications have not played a major role in the success of the learner in the teaching and evaluation of the coding course. In the curriculums of Turkey, the UK and Russia, they can easily re-register the applications they've made for the application of their students. Three computing curriculums also provide access to up-to-date, important coding programs and platforms from all around the world for coding courses. In addition, in Turkey, students with EBA programs created by the ministry of education may repeat what they want when they want it by accessing it easily. The curriculums of Russia and the United Kingdom allow students to repeat because they are actively used in other courses. Turkey can be easily subjected to evaluation by the curriculums of Russia and the UK because teachers can observe

students and teachers in the process can reveal the product. It is seen that assignments are given in the form of reinforcing qualifications related to the subjects covered in the coding course. That is, the computing programs are aimed at enabling students to actively participate in coding.

Resnick (2013) and Peña-López (2015), emphasized the importance of cooperative teaching by emphasizing the importance of the students working in groups while teaching the coding lesson. They also stated that cooperative teaching and the introduction of a product makes it easier for the teacher to assess the process. In the curriculums of Turkey, England and Russia, cooperative problem solving activities are taught, group selected students are encouraged to study and group activities are designed.

Industry 4.0 brings with it an educational-minded revolution of thought, and research in the field of education, like every other field, it has to keep pace with this fast digital change around the world. These changes and developments are naturally reflected in the education system and profoundly affect the understanding and practice of learning and teaching (Karatas, 2016). In England, the needs of the industry are determined and the curriculum of the students is shaped. For example, in 2017, UK decided to invest an additional £ 406 million in mathematics, digital and technical training to make up for the lack of science, technology, engineering and mathematics (STEM) skills. Coding education students, who are considered as motivations for STEM education, provide great benefits at the point of training individuals who are good at the industry. Russia, in particular, is involved with the course and the sector as a result of the development and future-oriented policies that are particularly relevant to computers and mathematics. However, coding education in Turkey is carried out for commercial purposes by more private institutions and courses. Sectoral benefits and coding training in Turkey is hardly addressed the relationship between computing curriculum. It is emphasized that the future of the students is technological and that the connections of the

students with the computer and the technology should be strong. For this reason, it is emphasized that coding education is of great importance to students, to the computing curriculum of Turkey, England and Russia in personal and social guidance, to gain the integrity of the student's personality, to prepare for the adult world, to create a philosophy of cultivating full of life, confident, social, successful and targeted strong individuals.

5.2. Consequences of Computer Textbooks Examined According to Gagne's Instructional Design Model

In this section, the findings of the comparison between the locations of the coding subject in the computer books in secondary school of Turkey, the UK, and Russia are discussed by following the steps of Gagne's instructional design models.

In the last decade, materials used to improve logical thinking, problem solving and digital competence in coding education have increasingly drawn attention from students in terms of increasing their learning potential (DfE, 2013).

When looking at the book UK and book TR, it is seen that there are usually questions of debate about coding education pictures, stories, daily life examples and subjects in order to attract the attention of the students. In other words, in terms of draw attention, three books can be said to be effective for coding education. The pictures in books are mostly about daily life. When the pictures in the book TR were given, the age level of the students was drawn attention, but in the book UK the photographs were directly transmitted. On the other hand, the book RU has very few pictures and is not usually about daily life.

In addition, the book RU and the book UK have biographical stories about real life. The book TR was given stories that are appropriate for the age-group level of children. Finally, the book RU has also encountered questions of debate. It is necessary that the students have to knowledge about the subjects they are expected to reach at the end of the course. When a

student will know what to expect at the end of the course, it is easier for the student to the adaptation of the lesson (Erden & Akman, 2006, p.181). The book TR, book UK, and book RU also provide the keywords about the coding education related lessons thus, the students are informed about the course content. Keywords are also available at the beginning of the Book UK and book TR. All books can be said enough for coding education in terms of informing the students about the learning outcomes of the coding course.

The questions given to motivate and attract attention to the prior knowledge of the students should be such that the students can express their own behaviour. A question may have the characteristics of giving information; attract attention, and reminder (Akyürek, 2004, p.139). While presenting new information in book TR, book UK and book RU, it gives questions and examples about the previous information that it will place into an associate with new knowledge. Discussion questions on the book TR and book UK were created and foreknowledge from the students was wanted to be reminded. This boosts the students' academic self-esteem as it both increases the student's attention to the topic and answers the question. For this reason, the book RU seems to be unsuccessful in terms of reminding of the prior knowledge for coding education as much as other books.

In addition, it is expressed that “Information box” or “Note taking” notes used during the course content, questions, activities, daily life samples, tables, diagrams, and maps have a big role at the point of presentation of course. When we looked at the book TR, book UK book RU, it was useful to present contents to the students by giving “Information box”, “Note taking”, daily life examples, questions about the topic. It is seen that in the computing books, it is easy for the students to associate new information with the previous knowledge and to guide the students through the activities, warnings, and tables with the relevant examples (Sturman & Sizmur, 2011). When looking at the book UK, book TR, and book RU, it is aimed to give more examples, activities, warnings, and elements to guidance about coding

education. In addition, daily life examples were chosen as possible. In this respect, three books are suitable for coding education.

The textbooks prepared according to the computing program should include various activities related to the topic by taking into consideration the different learning styles of the students in the subject expression. The activities and questions in the books should create an opportunity to discover what students are learning about the learning area (Wong et al., 2016; Sturman & Sizmur, 2011). Book TR, book RU, and book UK, with the help of questions and activities related to coding education at the end of the subject, students are given the opportunity to practice what they have learned. However, there are very few activities related to the subject when the book is being discussed. For this reason, book UK and book TR are more suitable for the coding lesson.

Different questions, special exercises, and dialogues can be used for feedback. The extra guidance and answers are also referred to as the feedback form. The formats used for feedback should not be used for notes (Gagne, 1975, p.131). There is no feedback as there are no replies to the given questions regarding the subject of the books. However, in workbook RU and workbook TR, answers and explanations were given to the students for feedback purposes. It was determined that three books examined were not suitable for giving feedback.

The evaluation questions and activities in the textbook provide information about the functionality of the curriculum. The evaluation questions and activities of the computing course provide important information on both the learning situation of the student and the evaluation of the student (Sturman & Sizmur, 2011; Bulut, 2006, p.17). The book TR, book UK and book RU provide significant benefits in terms of evaluation of the student's exercises, which are related to coding questions at the end of the units and the books. Therefore, three books are available for students in terms of evaluation.

For newly learned information to be permanent and easy to remember, they must be coded from a well-organized. In order to remember the information encoded in the long memory, it has to be repeated periodically. For this reason, the questions, activities and exercises in the textbooks enable the students to permanent learning and to transfer their knowledge (Erden & Akman, 2006, p.182).

Activities and questions related to the coding education at the end of the units in book TR, book UK and book RU and workbooks provide an opportunity for permanent learning. While teaching the subjects in the book RU, very few activities related to the topic are included. Finally, the books examined are quite suitable for coding education. Especially book TR and book UK are better prepared than book RU.

As a result, when the curriculums and textbooks of Turkey, England, and Russia are examined, it is clear that the mathematics is at the centre of the coding education. For this reason, it is an obligation to take into consideration the importance of mathematics while preparing the curriculum, building the infrastructure services, preparing the materials, writing books and educating informatics teachers related to coding course. When having a perspective on the coding education of England and Russia and their success in coding education are taken into account, it is possible to say that the current computing education of UK and Russia are appropriate to coding education. Turkey is a country that has recently started coding training therefore it should be carefully examined and evaluated other successful countries while organizing the coding training. Because the coding course is suitable for interdisciplinary teaching (like STEM), and problem solving and mathematical skills are the basis for it. Therefore, while develop the program of coding course in Turkey, the importance of mathematics need to understand better. It also needs to be closely related to mathematics lesson.

5.3. Suggestions

From the academic point of view; this study was carried out in Turkey, England, and Russia. It is beneficial to carry out similar studies on the leader countries in coding education Finland, the USA, Japan and so on. Moreover, this study is only concerned with textbooks and curricula. It may be advisable to study on the thoughts of teachers and school administrators by broadening and diversifying the study. Finally, this study was conducted solely on computing curriculum and computing textbooks. The mathematics course in which the coding course is closely related can be examined in depth.

In terms of education policies; the curriculum and textbooks of mathematics and computing can be evaluated together. In addition, studies on both teacher education and curriculum renewal can be undertaken to solve the problems related to the coding course. In particular, using the flexibility provided by STEM education, re-evaluation of curriculums, textbooks and lesson plans can be developed.

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Curriculum Vitae (CV)

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Sep 2016 – Sep 2017	University of Huddersfield
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Sep 2013 – Current	Uludag University, Bursa, Turkey
	MA in Elementary Mathematics Education
Sep 2005 – Aug 2009	Ataturk University, Erzurum, Turkey
	BA in Elementary Math Teacher

Work Experience:

Sep 2016 – Present	Hatice Gani Erverdi primary school, (Public school)
Position:	Math teacher
Sep 2013 - 2016	Ayse Muzeyyen Tozluoglu Primary School, (Public school)
Position:	Math teacher

Language Skills: English (Advanced Level)

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05/07/2018

ULUDAĞ ÜNİVERSİTESİ

TEZ ÇOĞALTMA VE ELEKTRONİK YAYIMLAMA İZİN FORMU

Yazar Adı Soyadı	Özdemir TİFLİS
Tez Adı	Türkiye, İngiltere ve Rusya ortaokul müfredat ve ders kitaplarında kodlama eğitimi konusunun yeri üzerine karşılaştırmalı bir çalışma
Enstitü	Eğitim Bilimleri Enstitüsü
Anabilim Dalı	İlköğretim Anabilim Dalı/ Matematik Bilim Dalı
Tez Türü	Yüksek Lisans Tezi
Tez Danışmanları	Dr.Öğr.Üyesi Bahtiyar BAYRAKTAR Dr.Öğr.Üyesi Menekşe Seden TAPAN BROUTIN
Çoğaltma (Fotokopi Çekim) izni	☐ Tezimden fotokopi çekilmesine izin veriyorum ☒ Tezimin sadece içindekiler, özet, kaynakça ve içeriğinin % 10 bölümünün fotokopi çekilmesine izin veriyorum ☐ Tezimden fotokopi çekilmesine izin vermiyorum
Yayımlama izni	☐ Tezimin elektronik ortamda yayımlanmasına izin Veriyorum ☒ Tezimin elektronik ortamda yayımlanmasının ertelenmesini istiyorum 1 yıl ☒ 2 yıl ☐ 3 yıl ☐ ☐Tezimin elektronik ortamda yayımlanmasına izin vermiyorum

Hazırlamış olduğum tezimin belirttiğim hususlar dikkate alınarak, fikri mülkiyet haklarım saklı kalmak üzere Uludağ Üniversitesi Kütüphane ve Dokümantasyon Daire Başkanlığı tarafından hizmete sunulmasına izin verdiğimi beyan ederim.

Tarih : 30/07/2018

İmza :