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The Level of Attainment in Turkey Considering the Objectives of Information Technologies and Software Curriculum in the Developed Countries*

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ABSTRACT

In this research, it is aimed to determine the level of attainment of students in Turkey with the common features that are aimed to be acquired by the students in the information technologies and software courses curricula of England, Australia, and the United States, which are developed countries that draw attention to the importance of information technologies and software education from early age. The research was carried out with 468 eighth grade, 450 twelfth grade students and 58 teachers in the province of Kayseri. Descriptive survey model was used in the research. In the scope of the qualitative data collection, teacher interview form was used. As for the quantitative part, "8th Grade Summative Test" and "12th Grade Summative Test" developed for the 8th and 12th grades were used. The results of the study are as follows: (1) 8th grade students could not reach any of the common critical behavioral objectives at the lefvel of 75%, (2) 12th grade students could not reach any of the common critical behavioral objectives at the level of 75%, (3) 8th grade students' reaching levels of common behavioral objectives differed significantly according to the number of years in which information technologies and software courses were taken at school and students' participation in out-of-school learning processes, (4) 12th grade students' reaching levels of common behavioral objectives differed significantly according to the number of years in which information technologies and software courses were taken at school and students' participation in out-of-school learning processes (5) according to teachers' opinions, Turkey's curriculum should be revised according to the today's requirements.

Keywords: Developed countries, information technology education, information technologies and software course curriculum

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1. INTRODUCTION

The rapid developments in science and technology and the innovations that come with them form the heart of the country's economy and directly affect social life. The value that countries attach to science and technology and the policies they adopt in this direction are the main tools in determining the speed and direction of economic and social developments. Developed countries that adopt the idea that digital competence and information technology literacy skills have become an integral part of society aim to bring these skills to students in schools and think that curricula from pre-school to high school should be developed in a way that will provide them with digital skills (Rüßmann, Lorenz, Gerbert, Waldner, Justus, Engel & Harnisch, 2015). These developed countries, which have discovered the power of science and technology, make strategic plans, create the necessary infrastructures, and question their existing systems in depth by using their opportunities to adapt to technological developments. In addition, they carry out studies to raise individuals who will contribute to the development and production of technology in the light of new ideas by trying to bring the human resources, which is the main element of the information society, to the fore. Because today, the wealth of countries is measured by the wealth of human resources, which are equipped with the knowledge and skills required by the today's world, and who produce knowledge and develop new technologies beyond the effective use of technology. In this respect, technological developments that directly affect our lives in the developing and changing world of the 21st century make it necessary to make some changes in the policies of countries regarding technology education.

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It is extremely important to determine the practices and decisions regarding technology education with education policies and to make the necessary changes in existing policies, in terms of clarifying what the priorities are in education and how the education system will be shaped in the future. Developed countries, which aim to transfer knowledge to technology and produce new technologies, aim to develop students' higher order thinking skills with curricula for information technologies and software education, and carry on studies to raise individuals who are innovative, questioning, researcher, interested in science and technology in order to gain the nature of knowledge.

In the 21st century, when knowledge is characterized as a power factor for the individual and society, innovative approaches should be used to raise individuals who can distinguish the information needed by reaching the right sources from the complex information, make a meaningful synthesis by bringing the pieces together, have developed empathy and communication skills, and produce the information. An individual accepted by the contemporary world is someone who accepts the information given to them as it is and does not always wait for others to guide them, but who can interpret the information to make sense of it, draw original conclusions, look at events with a questioning point of view, and produce solutions in the face of problems (Senemoğlu, 2020a).

To gain 21st century skills, students should be taught how to access the source of information and correct information, how to evaluate it, and how to structure this information meaningfully to solve problems (Senemoğlu, 2020b; Vah Til, Van Der Vleuten & Van Berkel, 1997). In this direction, innovations are needed in the field of education in order to gain individuals with the knowledge and skills required by the today's world. Education should be able to take precautions against changing situations and improve its methods by reviewing the features it aims to gain to individuals according to the today's requirements.

In this respect, especially with the continuous developments in information technologies and software, the increase in individual and social needs in a different change day by day reveals the necessity to carry out studies for the development and improvement of curricula in the face of these changes and developments. It is important to keep the programs up-to-date in fields such as science and technology, which have a very dynamic structure, and to implement effective approaches for raising individuals who will produce science and technology. In this context, many countries carry out improvement and development studies in their curricula for the knowledge and skills required by today and the future on the basis of Computational Thinking (Duncan & Bell, 2015; Heintz, Manilla & Färnqvist 2016; Hubwieser, Giannakos, Berges, Brinda, Diethelm, Magenheim, Pal, Jackova & Jasute, 2015; Senemoğlu, 2020b).

1.1. Statement of the Problem

Characterizing the development of new technologies as a power factor for both the individual and the society leads to the increase in the demand for information technologies and software education worldwide and to accelerate the development and improvement studies in information technologies and software curricula at all grades from pre-school to high school in many developed countries. (Falkner, Vivian & Falkner, 2014). In order to meet the changing individual and social needs in the face of the continuity of developments in information technologies, it is necessary to implement qualified curricula that will enable individuals and society to compete with the world. In addition, training qualified teachers who will implement the developed curriculum in accordance with its purpose and enriching the educational environments in terms of tools and equipment are also important variables that should be taken into consideration. A qualified education system has three basic pillars. The first is an effective curriculum, the second is quality teacher training, and the third is a well-equipped brain-friendly teaching-learning environment (Senemoğlu, 2022).

When the approaches to information technologies and software education are examined, it is seen that there are important developments in the world and improvement studies in information technologies and software curricula are intensified at all grades from pre-school to high school in many countries. Computational thinking skill, which is a thinking process in which problems and solutions are formulated by creating an effective structure for problem solving, especially with a computing tool, forms the basis of curricula for information technologies and software education in many countries. Computational thinking, which was introduced as a basic skill expected to be used by everyone in the world in the middle of the 21st century (Wing, 2006), provides an opportunity for students to develop problem-solving strategies so that they can better understand, analyze and develop solutions to complex problems, and to apply these strategies in the virtual or real world. (CSTA, 2011).

Computational thinking is defined as a rich thinking system that formulates problems, divides them into parts, offers solutions and combines many skills with the help of the basic principles of computer science (NRC, 2010). Computational thinking skill is considered as a basic skill that should be acquired not only for individuals who use the computer in their professional life, but also for everyone. ISTE (2016) emphasizes that computational thinking skill is basically a problem-solving approach that provides students with the opportunity to apply in other courses as well as their advancement in computer science and improves the thinking process through information technologies. In societies that are technologically advanced and have wide opportunities, it is a serious disadvantage that individuals cannot transfer information to technology in a meaningful way and that there are no basic principles in education in this regard. These societies do not know how to use borderless technology more effectively, how to solve problems with computers, how to make their lives easier and how to use their time more efficiently (Wing, 2008). However, it is very important to become a more developed society, by creating this awareness and turning technology into an opportunity and providing individuals with the skills they need to use frequently throughout their lives.

Efforts to include computer science in education processes from pre-school to high school in the world are concentrated in countries such as Australia, England, United States, China, Israel, Singapore, and South Korea (Wing, 2016). The UK Department of Education has created a national level curriculum guide for computer science. The aim is to "apply quality computer science education that enables students to use computational thinking to understand and change the world" (Department for Education, 2013). The program focuses on the following goals for the 5–16 years old:

- Understand and apply the fundamental principles and concepts of computer science, including abstraction, logic, algorithms, and data management.
- Developing practical solutions for similar problems by writing computer programs to analyze and solve problems in computer environment,
- Applying and Evaluating information and communication technologies, including new or unfamiliar technologies, to solve problems
- Acting as responsible, competent, confident, and creative users of information and communication technology.

In countries that provide information technologies education based on coding and programming, the reason of the course is stated as developing students' higher order thinking skills, introducing them to the technology world of today and the future, and encouraging employability (Balanskat & Engelhardt, 2014). Sade and Coll (2003) list other reasons of information technologies and software education as the effect of technology on the development of the country's economy, and an indispensable part of individual development and cultures. It is emphasized that providing coding and programming education at the earliest possible age, depending on the developmental characteristics of individuals, is an important element in developing higher order thinking skills of children. In addition, out-of-school learning processes should also be emphasized. Out-of-school learning processes can be defined as processes that enable students to relate course subjects to real life and increase their interest, as they are processes in which students are active and learn by doing. Therefore, out-of-school learning processes define a process related to formal education that allows the learning process to go outside the school in order to achieve the behavioral objectives of the relevant course (Yavuz Topaloğlu, 2016).

When information technologies and software courses in developed countries are examined, the computer science curriculum of the United States, which is the pioneer of developments in science and technology, has important technological institutions and companies in the world, has many patents and has computer science K-12 standards, draws attention. In addition, the curricula of England and Australia, which have important places in the global economy, produce knowledge, allocate a significant part of their budgets to education systems, and attach importance to information technologies and software education, were also examined within the scope of the research.

The reports published by the members of the International Federation for Information Processing (IFIP) community show that especially the UK and Australia are not alone in the importance they attach to information technologies and software courses in their core curriculum. In thirteen national reports on education and technology published since 2015, it is stated that many countries carry out important studies on information technologies and software education within the scope of compulsory education programs (Passey, 2015). It is stated that developed countries that currently provide information technologies and software education have also improved their curricula according to the knowledge and skills required by the today's world.

The education system of a country should support the development of individual and social values, increase the quality of life, that is, the positive progress of individuals and society, by implementing curricula aimed at developing thinking skills, which are the essence of education. Many countries attach importance to the development of thinking skills in their education systems and try to implement new methods and approaches for this. They see this as a necessity for raising individuals who will enable the development of science and technology, especially in the light of new ideas. Because today, as in every field, countries are in great competition with each other in the production of science and technology. The factor that supports competition is the human resources factor that can understand, use, and produce science and technology. In order to raise individuals who will enable the development of science and technology, education processes must be arranged in accordance with science and technology. Competitive countries, which are aware of this, include information technologies and software courses in their education processes and attach importance to the content of these courses.

Science and technology also bring important opportunities for countries that aim to build a strong future. When we look at the successes of developed countries in areas such as technology and economy, we see that education systems lead individuals to question, that individuals can transfer the features they have gained to daily life by using their thinking skills and produce new information. Considering the results of TIMMS (Trends in International Mathematics and Science Study) and PISA (Programme for International Student Assesment), which are exams that comprehensively measure the ability to use knowledge and skills, as indicated in the Human Development Index results, the countries with high living standards and economic levels are at the top, while Turkey is at the bottom. These developed countries attach importance to the qualified training of individuals in order to ensure the welfare of the society and organize their education systems according to scientific and technological developments. In addition, these countries have qualified policies to eliminate the deficiencies identified. As the strongest source of their economy, they work to keep their technological infrastructure up-to-date and to raise individuals who will produce new technologies. Developed countries have started to develop and implement curricula that include current knowledge and skills in computer science, especially computer programming, for the education of new generations. It is noteworthy that the common point of this increasing demand for information technologies and software education in the world and the emerging consensus is based on the effective and efficient use of technology, problem solving and product development (Gülbahar & Kalelioğlu, 2018). Considering all of these it is known that they apply qualified curricula to raise well-equipped individuals and aim to be a society that produces.

When the information technologies and software course in Turkey is examined, it is not possible to apply the course properly due to reasons such as the school's facilities, infrastructure problems, insufficient level of readiness of the students, and the weaknesses of the curriculum (Fırat Durdukoca & Arıbaş, 2011). In addition, the fact that the course was not evaluated with any scores and was not included in the school reports in the past years caused the students to develop negative attitudes towards the course and to ignore the course (Eyidoğan, Odabaşı & Kılıçer, 2011; Henkoğlu & Yıldırım, 2012; Öztürk & Yılmaz, 2011; Topuz, 2010; Yeşiltepe, 2012). Despite some changes in the name of the course and the curriculum over the years, the course continued to be an elective course. Problems such as inadequacies in the technical infrastructure and equipment in the information technology laboratories, deficiencies in students' pre-learning (Uzgur & Aykaç, 2016), the use of a computer by more than one student, and the inadequacy of the curriculum are shown as the reasons why students cannot gain the features targeted in the program. These problems cause the lessons to be inefficient and the students cannot reach the behavioral objectives. Students' interest in information technologies is decreasing and the course does not meet their expectations. Teachers try to solve the problems in various ways, but it is stated that the laboratories in the schools are very inadequate, there are often hardware problems, and the curriculum cannot be implemented as desired (Berkant & Çolak, 2021; Gülcü, Aydın & Aydın, 2013). Although the name of the course has been changed to information technologies and software, it is a sad fact that the curriculum of the course and the teaching-learning environments in which it is applied are still behind the times.

Establishing a strong infrastructure in the information technology laboratories to provide the knowledge and skills required by the today's world, enriching it in terms of technological tools and equipment, and making the course a compulsory course at every grade will contribute to the implementation of the curricula as targeted. It is of great importance for Turkey to create the future by eliminating the deficiencies identified in this direction, enabling our students to produce knowledge and transfer it to technology, and to implement curricula that will enable them to compete with the world (Senemoğlu, 2020b). In this respect, it is thought that it is critical to examine the systems of education of developed countries, which have high schooling and literacy rates, high economic and success levels, and are the source of innovations in science and technology, and compare them with the current situation in Turkey, revealing the similarities and differences regarding the objectives and identifying the deficiencies.

Research on how to teach students the basic concepts such as critical thinking and problem solving in the general structure of modern education systems and how education systems can be improved in order to make it a lifelong process has gained importance. In previous studies, studies on teaching methods in the field of programming education drew attention, and studies were carried out at high school and university level on problem solving and critical thinking skills, but studies on analyzing the curricula of developed countries in this area and determining the level of students in Turkey to reach the common features of the curricula of developed countries are very limited. In this context, this research will contribute to the development of the information technologies and software course curriculum and to the studies to increase the quality of the teaching service. It is thought that it will direct the studies for suggestion purposes in terms of raising generations who not only consume technological knowledge and tools, but also can transfer knowledge to technology and produce new technologies.

Within the scope of the research, the general structure and features of the information technologies and software programs of the United States, which pioneered in developing the features/standards that the information technologies and software curriculum should have, and England, Australia, which made important initiatives in information technology education, were examined. In Turkey and developed countries, common and different features that are aimed to be gained by students in the curriculum of information technologies and software courses have been determined (Tarım & Senemoğlu, 2020) and the level of students' attainment of the determined common features with the curriculum implemented in Turkey has been determined. It has been tried to determine the clues for the reasons of the features that cannot be gained.

It is thought that the results of the research will lead to the development of more effective curricula and improvement of existing curricula by determining the status of the information technologies and software course curriculum in Turkey. It is hoped that identifying common features in the curriculum of information technologies and software courses in developed countries and examining these features in comparison with the curriculum in Turkey will contribute to curriculum development studies. In addition, it is thought that obtaining the determinations regarding the reasons for the features that cannot be gained is necessary in terms of putting forward suggestions for the improvement of the information technologies and software course curriculum in Turkey.

1.2. Purpose of the Study

In today's world, where science and technology are developing at an incredible rate, modern education systems should be designed to explore the nature of knowledge and to produce science and technology to provide students with the knowledge and skills required by the today's world and to ensure that these skills continue throughout their lives. In order to adapt to the changing world in the 21st century and even to direct change, it is necessary to raise qualified individuals based on the needs of the age. This can only be achieved by renewing the education system within the framework of 21st century skills (Uçak & Erdem, 2020). The primary aim of modern education is to create appropriate conditions and environments to raise individuals who can access information quickly by questioning, who are productive, have higher order thinking skills, can use new technologies efficiently, and can develop new systems and technologies. The fact that computer science is encountered in every field today indicates that individuals should move to a position that can produce new technologies beyond using these technologies at a good level. An education system created according to the today's requirements should aim to get qualified and versatile outputs from the system focusing on goals that integrate with each other (Tarım & Senemoğlu, 2020).

In recent years, discussions on information technologies and software education in schools have emerged regarding the need to include education in compulsory school programs. Until now, a significant part of the programs for information technologies in many countries were carried out for the applications of existing technologies and the subjects related to information and communication technologies were emphasized within the scope of the use of these applications in the curricula. Recently, after the content-oriented discussions, curricula for information technologies have started to focus on the basis of computer science, which includes more algorithm development and programming with the basic principles of problem solving, associating technology with daily life, and creativity. In this direction, many developed countries are trying to keep up-to-date and develop their information technologies curricula based on computational thinking. It is argued that computational thinking is a skill that should be developed in all individuals. In addition, it is emphasized that it provides the basis for preparing for advanced subjects of computer science and developing programming skills (Lu & Fletcher, 2009; Wing, 2008).

It is considered important to determine the level of attainment of 8th and 12th grade students in Turkey for the common features determined in the curriculum of countries with high schooling and success rates, which are the pioneers of developments in science and technology, in terms of developing the information technologies and software curriculum in Turkey and detecting its deficiencies. In parallel with this situation, it is thought that the results of the research will contribute to the determination of the features that should be emphasized in the curriculum in order to raise individuals well-equipped, and to the improvement of the curriculum and educational activities.

The increasing importance of computational thinking skills in K-12 education around the world and the need for qualified manpower for computer science have enabled many countries to conduct various studies in this field and to develop or improve their compulsory or elective curriculum at certain levels. When we examine the developed countries such as England, Estonia, Finland, New Zealand, Norway, Sweden, South Korea, Australia, Hong Kong and the United States, it is seen that they are at the top of global competitiveness, innovation and technology patent world rankings and they are trying to regulate their education policies in this direction.

With this research, the level of attainment of the students with the information technologies and software curriculum applied in Turkey was determined for the features that the developed countries, which draw attention with their level of development in the fields of education and technology, aim to gain students in the information technologies and software curriculum. It is thought that the results obtained will contribute to the studies on the development of the curriculum and increasing its effectiveness. It is thought that the results of the research make important contributions to the determination of the features that need to be emphasized in the curriculum and the regulation of the teaching service so that individuals can acquire the knowledge and skills required by the today's world. In this context, it is hoped that the results of the research will guide the curriculum development studies that will be carried out for the purpose of raising individuals, which will transfer knowledge to technology, have computational thinking skill and produce knowledge.

1.3. Problem of the Study

In line with the explanations, the main problem of the research is considered as "what is the levels of attainment of the students in Turkey with the common features that are aimed to be acquired by the students in the information technologies and software courses until the end of the 8th and 12th grades in developed countries?".

1.3.1. Sub-problems of the study

In line with the problem of the study, answers were sought for the following sub-problems:

1. What is the level of attainment of 8th grade students in Turkey with the common features that are aimed to be acquired by students in information technologies and software courses until the end of 8th grade in developed countries?
2. What is the level of attainment of 12th grade students in Turkey with the common features that are aimed to be acquired by students in information technologies and software courses until the end of 12th grade in developed countries?

3. Does the level of 8th grade students' attainment to the common features of information technologies and software courses in developed countries show a significant difference according to

   3.1. gender,

   3.2. the total number of years the information technology and software course were taken at school, and

   3.3. participation in out-of-school learning processes related to information technologies?

4. Does the level of 12th grade students' attainment to the common features of information technologies and software courses in developed countries show a significant difference according to

   4.1. gender,

   4.2. the total number of years the information technology and software course were taken at school, and

   4.3. participation in out-of-school learning processes related to information technologies?

5. What are the opinions of the teachers in terms of the factors affecting the acquisition of common features regarding the structure of the information technologies and software course curriculum?

2. METHODOLOGY

In this research, descriptive survey model was used since it was aimed to determine the common features that are aimed to be acquired by the students until the end of the 8th and 12th grades in the information technologies and software courses of the developed countries England, Australia and the United States (California, Massachusetts and Florida states) and it was aimed to determine the level of attainment of the students with the curriculum implemented in Turkey (Karasar, 2006).

2.1. Participants

The population of the research consists of 468 eighth grade and 450 twelfth grade students studying in secondary schools and high schools affiliated to the Ministry of National Education in the central districts of Kayseri province. In addition, 58 information technologies and software teachers working in these schools are included in the research population. Due to the transition to distance education in schools affiliated to the Ministry of National Education during the Covid-19 pandemic, research data had to be collected via the online remote data collection system. For this reason, in determining the sample, convenient sampling method, which is one of the non-random sampling methods, which allows the study group to be determined from the people who can be reached, by providing maximum savings and by considering the easier situations, was used (Cohen & Manion, 1989; Fraenkel, Wallen & Hyun 2012; McMillan & Schumacher, 2014; Ravid, 1994).

2.2. Data Collection Tools

To obtain data on the sub-problems within the scope of the research, summative tests have been developed for 8th and 12th grade students to determine at what level the students in Turkey have attain the common features that are aimed to be acquired by the students in the information technologies and software curriculums of England, Australia and the United States. An interview form was created to determine the opinions of teachers about the general structure of information technologies and software course curriculum in terms of the factors affecting reaching the common features of developed countries.

In the research, summative tests were developed for 8th and 12th grade students in order to determine the level of attainment of 8th and 12th grade students in Turkey with the common features that are aimed to be acquired by students in the information technologies and software courses curriculum in developed countries England, Australia and the United States. In the development process of the tests, firstly, the themes in the information technologies and software courses of the developed countries were examined and the common features that were aimed to be acquired by the students were determined (Tarım & Senemoğlu, 2020). In the next stage of the test development process, tables of specification were prepared regarding the critical common behavioral objectives that are aimed to be acquired by the students until the end of the 8th and 12th grades within the scope of the information technologies and software courses curriculum of developed countries.

Considering the developmental characteristics of the students, test items were prepared with four options at the 8th grade level and five options at the 12th grade level, and two separate tests were created in a mixed structure with multiple choice, completion, open-ended and likert type questions. During the preparation of the tests, the consistency of the test items with the objectives, their clarity, and their suitability for age and grade were taken into consideration. The suitability of the meaning given by the root of the question in terms of its power to represent the question and including the necessary information was examined. After receiving expert opinions and making the necessary corrections, 40 items at the 8th grade level and 42 items at the 12th grade level were prepared. Item analyzes were made on the data obtained from the testing forms and the difficulty index and index of distinctiveness of the items were calculated. In order for both tests to have an average difficulty of 0.55, attention was paid to include questions with item difficulty between 0.20 and 0.80 in the final forms (Özçelik, 1989). By selecting the items with appropriate item difficulty and distinctiveness index, the final forms containing 35 items in the 8th Grade Summative Test and 32 items in the 12th Grade Summative Test were created. In the final forms of the summative tests, the reliability co-efficient of KR-20 was calculated as 0.93 for the 8th Grade Summative Test and 0.90 for the 12th Grade Summative Test.

In this research, a semi-structured teacher interview form was prepared to determine the opinions of teachers about the general structure of information technologies and software curriculum in terms of the factors affecting reaching common features in developed countries. During the preparation of the interview form, the literature was examined, and expert opinions were taken. In line with the data obtained, the final interview form was prepared. In the direction of the opinions and suggestions received, some questions in the interview form were restated and some questions were rearranged. The teacher interview form consists of 8 open-ended questions.

Inductive analysis, one of the content analysis techniques, was applied in the analysis of the data obtained with the interview form. It is aimed to code the data obtained with inductive analysis and to determine the relationships between these data (Miles & Huberman, 1994; Yıldırım & Şimşek, 2008). During the analysis of the data, the data obtained with the teacher interview form were first put into a table. Then, codes for these data were created. Finally, the codes that were found to be related to each other were brought together and the themes were determined. The data obtained to ensure the reliability of the codes created by the researcher were coded by another researcher and the codes made were compared.

2.3. Data Collection

To collect data for the study, the following steps were taken:

1. Ethical permission was obtained from Hacettepe University (02/12/2020 - 35853172-101.02.02) for the implementation of the research.
2. Within the scope of the research, the curricula of England, Australia, California, Massachusetts and Florida were examined, and their Turkish translations were made in order to determine the common and different features that are aimed to be gained by the students in the information technologies and software curriculum of Turkey and developed countries. The themes in the programs of Turkey and developed countries are grouped according to grade levels. Common features that are aimed to be acquired by the students until the end of the 8th and 12th grades in the curricula of developed countries have been determined, and by creating tables of specification for these features, the programs implemented in Turkey and developed countries have been compared in terms of common and different features.
3. Testing forms of data collection tools were created as a result of writing the test items, the opinions of the experts, and having the test items planned to be included in the testing forms read aloud to the students in order to examine the common features determined.
4. Pilot studies were made to purposeful groups consisting of 8th and 12th grade students studying at a private secondary school and a private high school in Kayseri. The results obtained from the testing forms were analyzed and the final form of the measurement tools was prepared.
5. An online remote data collection system has been prepared. The questions in the final measurement tools were uploaded to the system and the necessary controls were made about the system before the data collection process.
6. After the completion of the testing forms and the preparation of the remote data collection system, the final versions of the "8th Grade Summative Test" and "12th Grade Summative Test" were applied to 8th and 12th grade students studying at secondary and high schools affiliated to the Ministry of National Education via the online distance data collection system. Teacher interview form was applied to the information technologies and software teachers working in these schools. The obtained data were made ready for analysis in electronic environment.

2.4. Data Analysis

In the analysis of the data obtained for the first and second sub-problems, the percentage of correct answers to the questions in the summative tests applied to determine the level of attainment of the 8th and 12th grade students in Turkey to the determined common behavioral objectives were calculated. In the analysis of the data obtained for the third and fourth sub-problems, it was aimed to determine whether the level of attainment the behavioral objectives of 8th and 12th grade students in Turkey differs significantly according to gender, the total number of years the information technology and software course was taken at school, and their participation in the information technology and software related out-of-school learning processes.

Multi-Factor ANOVA was desired to analyze the effect of more than two independent variables on the dependent variable, but the necessary conditions for Multi-Factor ANOVA could not be met. Therefore, to answer the third and fourth sub-problems; the t-Test was used to determine whether the level of students' attainment to common features of developed countries differs according to gender. One-Way Analysis of Variance (ANOVA) was used to determine whether there was a significant difference between the total number of years the information technology and software course was taken at school and the participation in out-of-school learning processes related to information technology and software.

Content analysis was carried out in the analysis of the data obtained by the interview form within the scope of this sub-problem to determine the views of teachers in terms of the factors affecting the acquisition of common features regarding the structure of the information technologies and software course curriculum. The data obtained were brought together and codes and themes were created according to their relationship with each other. The data were described and interpreted in line with these themes. The sub-problems mentioned above and their associated data collection methods, tools and analyzes are summarized in Table 1.

Table 1.
Techniques Used in Data Collection and Analysis with Sub-Problems

Sub-Problems	Data Collection Methods and Tools	Data Analysis
1. What is the level of attainment of 8th grade students in Turkey with the common features that are aimed to be acquired by students in information technologies and software courses until the end of 8th grade in developed countries?	8th Grade Summative Test	Percentage of Items Answered Correctly
2. What is the level of attainment of 12th grade students in Turkey with the common features that are aimed to be acquired by students in information technologies and software courses until the end of 12th grade in developed countries?	12th Grade Summative Test	Percentage of Items Answered Correctly
3. Does the level of 8th grade students' attainment to the common features of information technologies and software courses in developed countries (Summative Test Scores) show a significant difference according to a. gender, b. the total number of years the information technology and software course were taken at school, a. and participation in out-of-school learning processes related to information Technologies?	Summative Test	Independent Samples T-test One-Way Analysis of Variance (ANOVA) One-Way Analysis of Variance (ANOVA)
4. Does the level of 12th grade students' attainment to the common features of information technologies and software courses in developed countries (Summative Test Scores) show a significant difference according to c. gender, d. the total number of years the information technology and software course were taken at school, e. and participation in out-of-school learning processes related to information Technologies?	Summative Test	Independent Samples T-test One-Way Analysis of Variance (ANOVA) One-Way Analysis of Variance (ANOVA)
5. What are the opinions of the teachers in terms of the factors affecting the acquisition of common features regarding the structure of the information technologies and software course curriculum?	Teacher Interview Form	Content Analysis

3. FINDINGS

In this section, the findings obtained by analyzing the collected data to explain the sub-problems of the research and comments on these findings are given.

3.1. Findings Concerning the First Sub-Problem

The first sub-problem of the research is to obtain results for determining the level of attainment of 8th grade students in Turkey with the common features that developed countries aim to gain students in information technologies and software courses until the end of the 8th grade.

In order to determine the level of attainment of 8th grade students in Turkey with the common features that are aimed to be gained by students in developed countries, the Summative Test was applied to the students who continue their education in secondary schools in the study group of the research. To determine the level of attainment of the common characteristics/behavioral objectives of developed countries, the percentages of correct answers to the items in the 8th Grade Summative Test were calculated.

The results obtained express the level of attainment of the behavioral objectives. The attainment levels of the common critical behavioral objectives determined within the scope of the common themes in the information technologies and software courses curriculum of developed countries are presented in Table 2.

Table 2.
Levels of Attainment of 8th Grade Students' Behavioral Objectives

Theme	Behavioral objectives	Item No	Levels of Attainment of Behavioral Objectives
Problem Solving, Algorithms and Programming	1. Knowing the concepts of algorithm, flowchart, programming, constant and variable	1.1	.43
		1.2	.44
		1.3	.46
		1.4	.53
		1.5	.40
	2. Explaining flowchart shapes	2.1	.25
		2.2	.44
		2.3	.25
		2.4	.33
		2.5	.28
	3. Calculating outputs with different variable values in the algorithm	7.1	.49
		7.2	.60
		7.3	.66
		7.4	.49
	4. Correctly sort the given algorithm expressions for a particular solution	4	.59
	5. Designing algorithms involving mathematical operations and calculating their results	14	.35
	6. Calculating outputs in programs with conditional expressions	11	.40
	7. Applying function structures in programs	17	.34
	8. Designing algorithms involving multiple decision structures	23	.35
	9. Implementing codes in a block-based programming tool	19	.37
	10. Using reasoning skills when applying algorithms	9	.39
	11. Distinguish variable types based on their properties	13	.40
	12. Breaking down the problem into simpler parts and designing sub-solutions for each part	22	.44
	13. Analyzing algorithms involving loop structure	15	.32
	14. Realizing that different algorithms can be designed for more than one solution to a problem	21	.16
	15. Creating an algorithm for solving a problem	6	.40
	16. Developing algorithms and programs for the solution of a specific problem	25	.23
	17. Explain the purpose of the given algorithm or program	8	.47
	18. Evaluating codes in a block-based programming tool	18	.38
	19. Debugging by examining whether the algorithm is working correctly	5	.50
			Mean = .40

Table 2. Continuation

Levels of Attainment of 8th Grade Students' Behavioral Objectives

Theme	Behavioral Objectives	Item No	Levels of Attainment of Behavioral Objectives
Computer Systems	20. Classifying input and output devices	26	.31
	21. Knowing the basic concepts of computer system and explaining its functions	29.1	.19
		29.2	.32
		29.3	.26
		29.4	.35
		29.5	.37
	22. Description and classification of storage units by capacity	28.1	.40
		28.2	.28
		28.3	.34
		28.4	.27
	23. Explaining how numbers are represented in binary form and applying operations on binary numbers	24	.38
			Mean = .32
Computer Networks	24. Explaining the components that make up a network system	32.1	.18
		32.2	.34
		32.3	.33
		32.4	.28
		32.5	.32
	25. Explaining the properties of network topologies	31.1	.54
		31.2	.30
		31.3	.32
		31.4	.19
	26. Comparing network types	30	.50
			Mean = .33
Ethics and Safety	27. Knowing and applying ways to ensure personal security on the Internet	34	.43
	28. Explaining the measures that can be taken against cyber crimes	35	.48
	29. Distinguishing positive and negative behaviors in the internet environment	33	.25
			Mean = .39
			Mean of Test = .37

When Table 2 is examined, it is seen that the 8th grade students could not reach the behavioral objectives covering the knowledge, comprehension, application, analysis, synthesis, and evaluation steps for the Problem Solving, Algorithms and Programming theme related to the information technologies and software course at the specified criterion level (0.75). Similarly, it was determined that none of the behavioral objectives for Computer Systems, Computer Networks, Ethics and Security themes could be reached at the specified criterion level (0.75). Considering the themes of each behavioral objective determined within the scope of the common objectives of information technologies and software courses of developed countries, it was observed that the behavioral objectives for the themes of Problem Solving, Algorithms and Programming (0.40), Computer Systems (0.32), Computer Networks (0.33), Ethics and Security (0.39) and the behavioral objectives for the whole test (0.37) could not be reached at the criterion level.

3.2. Findings Concerning the Second Sub-Problem

The second sub-problem of the research is to obtain results for determining the level of attainment of 12th grade students in Turkey with the common features that developed countries aim to gain students in information technologies and software courses until the end of the 12th grade.

In order to determine the level of attainment of 12th grade students in Turkey with the common features that are aimed to be gained by students in developed countries, the Summative Test was applied to the students who continue their education in secondary schools in the study group of the research. To determine the level of attainment of the common characteristics/behavioral objectives of developed countries, the percentages of correct answers to the items in the 12th Grade Summative Test were calculated.

The results obtained express the level of attainment of the behavioral objectives. The attainment levels of the common critical behavioral objectives determined within the scope of the common themes in the information technologies and software courses curriculum of developed countries are presented in Table 3.

Table 3.
Levels of Attainment of 12th Grade Students' Behavioral Objectives

Theme	**Behavioral Objectives**	**Item No**	**Levels of Attainment of Behavioral Objectives**
Problem Solving, Algorithms and Programming	1. Knowing the concepts of algorithm, flowchart, programming, constant and variable	1.1	.41
		1.2	.48
		1.3	.38
		1.4	.63
		1.5	.41
	2. Applying linear logic structure in programs	2	.42
	3. Calculating outputs with different variable values in the algorithm	10	.40
	4. Calculating operation results in algorithms containing loop and condition statements	3	.34
	5. Testing outputs with flowchart against changing values	9	.35
	6. Testing algorithms involving multiple decision structures	15	.28
	7. Breaking down the problem into simpler parts and designing sub-solutions for each part	19	.45
	8. Demonstrating algorithms using flowcharts and/or pseudocode	11	.32
	9. Distinguish variable types based on their properties	7	.32
	10. Realizing that different algorithms can be designed for more than one solution to a problem	18	.28
	11. Using reasoning skills when applying algorithms	20	.39
	12. Debugging and fixing the algorithm by examining whether the algorithm is working correctly	12	.46
	13. Testing the results of program codes against different variable values	6	.48
	14. Sequencing algorithm steps for solving a particular problem	4	.36
	15. Implementing basic boolean logic	13	.25
	16. Applying basic boolean logic (for example AND, OR, and NOT) in the programming process	14	.30
	17. Developing original algorithms for solving problems in daily life	17	.21
			Mean = .38

Table 3. Continuation

Levels of Attainment of 12th Grade Students' Behavioral Objectives

Theme	Behavioral Objectives	Item No	Levels of Attainment of Behavioral Objectives
Computer Systems	18. Classifying input and output devices	21.1	.38
		21.2	.29
		21.3	.38
		21.4	.20
		21.5	.27
		21.6	.22
	19. Sorting the capacities of storage volumes	22.1	.43
		22.2	.44
		22.3	.41
		22.4	.40
	20. Explaining how numbers are represented in binary form and applying operations on binary numbers	16	.43
	21. Explaining the components that affect the performance of computers with their properties	31	.35
	22. Comparing computer systems by features	23	.35
	23. Comparing the hardware components that make up the computer system according to their advantages and disadvantages	30	.20
			Mean = 0.34
Computer Networks	24. Comparing network types	25	.43
	25. Distinguish the components that make up a network system according to their properties	28	.28
	26. Comparing properties of network topologies	26	.43
	27. Comparing network connection types according to their advantages and disadvantages	29	.27
			Mean = 0.34
Ethics and Safety	28. Distinguishing positive and negative behaviors in ensuring personal security in the internet environment	32	.69
			Mean of Test = .36

When Table 3 is examined, it is seen that the 12th grade students could not reach the behavioral objectives covering the knowledge, comprehension, application, analysis, synthesis, and evaluation steps for the Problem Solving, Algorithms and Programming theme related to the information technologies and software course at the specified criterion level (0.75). Similarly, it was determined that none of the behavioral objectives for Computer Systems, Computer Networks, Ethics and Security themes could be reached at the specified criterion level (0.75). Considering the themes of each behavioral objective determined within the scope of the common objectives of information technologies and software courses of developed countries, it was observed that the behavioral objectives for the themes of Problem Solving, Algorithms and Programming (0.38), Computer Systems (0.34), Computer Networks (0.34), Ethics and Security (0.69) and the behavioral objectives for the whole test (0.36) could not be reached at the criterion level.

3.3. Findings Concerning the Third Sub-Problem

The third sub-problem of the research is to obtain results on whether there is a significant difference between the 8th grade students' reaching levels to common features of information technologies and software courses in developed countries, according to gender, how many years they have taken information technologies and software courses at school and their participation in out-of-school learning processes related to information technologies and software.

In order to answer this sub-problem, the t-Test was used to determine whether there is a significant difference between students' level of reaching common features (summative test score) for information technologies and software courses in developed countries and gender. In addition, One-Way Analysis of Variance (ANOVA) was used to determine whether there was a difference between the total number of years the information technology and software course was taken at school and the participation in out-of-school learning processes related to information technologies and software.

The findings related to this sub-problem, which aims to examine the level of students' attainment of the common features in terms of various variables, are presented below, respectively.

Gender. In the research, it was examined whether there is a significant difference between 8th grade students' level of reaching common features of information technologies and software courses of developed countries and their gender. Accordingly, the independent samples t-Test was used and the results are presented in Table 4.

Table 4.
Arithmetic Mean, Standard Deviation, and t-Test Results of 8th Grade Students' Summative Test Scores by Gender

Groups	n	$\bar{X}$	sd	df	t	p
Female	256	22.27	8.04	466	1.476	.523
Male	212	21.14	8.52			

When Table 4 is examined, it is seen that there is no significant difference between the level of reaching the common features of information technologies and software course of 8th grade students according to gender ($t_{(466)}$=1.476, p>0.05).

The Total Number of Years the Information Technology and Software Course Is Taken at School. One-Way Analysis of Variance (ANOVA) was used to determine whether students' level of reaching common features of information technologies and software courses in developed countries differs significantly compared to the total number of years in which the information technologies and software courses were taken at school.

First of all, the arithmetic mean and standard deviation values of the students' summative test scores were calculated according to the total number of years the information technology and software course was taken at the school. The obtained values are presented in Table 5.

Table 5.
Arithmetic Mean and Standard Deviations of 8th Grade Students' Summative Test Scores According to the Total Number of Years Taken in Information Technologies and Software Course at School

Total Number of Years	n	$\bar{X}$	sd
4	41	33.07	8.20
3	73	23.92	7.82
2	227	21.89	7.67
1	127	16.62	4.55

Table 6 shows the ANOVA results for the arithmetic mean of the students' summative test scores according to the total number of years the information technology and software course was taken at the school. Levene statistic value for homogeneity of variances was calculated as 10,793, and it was seen that variances were not homogeneous (p<0.05). Therefore, instead of the F statistic in the ANOVA table, Welch's F statistic and its p value are reported in Table 6.

Table 6.
ANOVA Results of 8th Grade Students' Summative Test Scores According to the Total Number of Years Taken in Information Technologies and Software Course at School

Source of Variation	Sum of Square	df	Mean Square	Welch's F	p
Between Groups	8943.838	3	2981.279	67.965	0.000
Within Groups	23018.392	464	49.609		
Total	31962.231	467			

The results of the analysis presented in Table 6 show that there is a significant difference between the 8th grade students' reaching levels of the common features of information technologies and software courses in developed countries in terms of the total number of years they have taken the information technology and software course at school, Welch's $F_{(3, 464)}=67.965$, $p<0.05$.

In other words, the scores the students get from the summative test change significantly depending on the total years they took the information technology and software course at school. The Dunnett C multiple comparison test results, which were conducted to determine the difference between which total years in terms of summative test scores, are given in Table 7.

Table 7.
Dunnett C Test Results of Summative Test Scores of 8th Grade Students According to the Total Number of Years Taken in Information Technologies and Software Course at School

Total Year	3	2	1
4	9.155*	11.183*	16.451*
3		2.028	7.296*
2			5.268*

*The difference between the means is significant at the 0.05 level.

When the Dunnet C test results given in Table 7 are examined, it is seen that the summative test scores ($\bar{X}$ =33.07) of the students who took the information technologies and software course for 4 years at the school are significantly higher than the summative scores of the students who took the information technologies course for 1 year ($\bar{X}$ = 16.62), 2 years ($\bar{X}$ =21.89) and 3 years ($\bar{X}$ =23.92). It was determined that the summative scores ($\bar{X}$ =23.92) of the students who took information technologies and software courses for 3 years are also significantly higher than the scores ($\bar{X}$ = 16.62) of the students who took this course for 1 year. It is seen that the summative scores ($\bar{X}$ =21.89) of the students who took information technologies and software courses for 2 years are significantly higher than the scores ($\bar{X}$ = 16.62) of the students who took this course for 1 year.

In this case, it can be said that students who have taken information technologies and software courses at school for a longer time are more successful in terms of reaching the common features in the information technologies and software courses curriculum of developed countries.

Participation In Out-Of-School Learning Processes Related to Information Technologies and Software. One-Way Analysis of Variance (ANOVA) was used to determine whether the students' reaching level of the common features of information technologies and software courses in developed countries differs significantly according to their participation in out-of-school learning processes (courses, private lessons, etc.). First of all, the arithmetic mean and standard deviations of the students' summative scores were calculated according to their participation in out-of-school learning processes. The obtained values are presented in Table 8.

Table 8.
Arithmetic Mean and Standard Deviations of 8th Grade Students' Summative Test Scores According to Their Participation in Out-of-School Learning Processes

Participation in Out-of-School Learning Processes	n	$\bar{X}$	sd
12 Months and Longer	30	34.00	7.90
6-12 Months	36	31.19	7.61
0-6 Months	39	19.92	7.60
Never	363	20.01	6.84

Table 9 shows the ANOVA results for the arithmetic means of the students' summative test scores according to their participation in out-of-school learning processes. The Levene statistic value regarding the homogeneity of the variances was calculated as 2.417, and it was determined that the homogeneity of the variances was achieved (p>0.05).

Table 9.
ANOVA Results of 8th Grade Students' Summative Test Scores According to Their Participation in Out-of-School Learning Processes

Source of Variation	Sum of Square	df	Mean Square	Welch's F	p
Between Groups	8947.833	3	2982.611	60.133	0.000
Within Groups	23014.397	464	49.599		
Total	31962.230	467			

The results of the analysis presented in Table 9 show that there is a significant difference between the 8th grade students' reaching levels of the common features of information technologies and software courses in developed countries in terms of their participation in out-of-school learning processes, $F_{(3, 464)}=60.133$, $p<0.05$.

In other words, the scores the students get from the summative test change significantly depending on the students' participation in out-of-school learning processes. The results of the Bonferroni multiple comparison test performed to determine between which groups there is a difference in terms of summative test scores are presented in Table 10.

Table 10.
Bonferroni Test Results of 8th Grade Students' Summative Test Scores According to Their Participation in Out-of-School Learning Processes

Participation in Out-of-School Learning Processes	6-12 Months	0-6 Months	Never
12 Months and Longer	2.806	14.077*	13,994*
6-12 Months		11.271*	11.189*
0-6 Months			-.082

When the Bonferroni test results presented in Table 10 are examined; It is seen that the summative test scores of the students who participated in the out-of-school learning processes for 12 months or more ($\bar{X}$ =34.00) were significantly higher than the students who never participated ($\bar{X}$ =20.01) and participated 0-6 months ($\bar{X}$ =19.92). It was determined that the scores of the students who participated in out-of-school learning processes for 6-12 months ($\bar{X}$ =31.19) were significantly higher than the students who never participated ($\bar{X}$ =20.01) and attended 0-6 months ($\bar{X}$ =19.92). However, summative test scores ($\bar{X}$ =19.92) of students who participated in out-of-school learning processes for 0-6 months do not differ significantly from summative test scores ($\bar{X}$ =20.01) of students who never participated.

3.4. Findings Concerning the Fourth Sub-Problem

The fourth sub-problem of the study is to obtain results on whether there is a significant difference between the 12th grade students' reaching levels to common features of information technologies and software courses in developed countries, according to gender, how many years they have taken information technologies and software courses at school and their participation in out-of-school learning processes related to information technologies and software.

In order to answer this sub-problem, the t-Test was used to determine whether there is a significant difference between students' level of reaching common features (level determination test score) for information technologies and software courses in developed countries and gender. In addition, One-Way Analysis of Variance (ANOVA) was used to determine whether there was a difference between the total number of years the information technology and software course was taken at school and the participation in out-of-school learning processes related to information technologies and software.

The findings related to this sub-problem, which aims to examine the level of students' attainment of the common features in terms of various variables, are presented below, respectively.

Gender. In the research, it was examined whether there is a significant difference between 12th students' level of reaching common features of information technologies and software courses of developed countries and their gender. Accordingly, the independent samples t-Test was used, and the results are presented in Table 11.

Table 11.
Arithmetic Mean, Standard Deviation, and t-Test Results of 12th Grade Students' Level Determination Test Scores by Gender

Groups	n	$\bar{X}$	sd	df	t	p
Female	259	15.70	6.67	448	.286	.075
Male	191	15.53	5.81			

When Table 11 is examined, it is seen that there is no significant difference between the level of reaching the common features of information technologies and software course of 12th grade students according to gender ($t_{(448)}$=.286, p>0,05).

The Total Number of Years the Information Technology and Software Course Is Taken at School. One-Way Analysis of Variance (ANOVA) was used to determine whether students' level of reaching common features of information technologies and software courses in developed countries differs significantly compared to the total number of years in which the information technologies and software courses were taken at school. First of all, the arithmetic mean and standard deviation values of the students' level determination test scores were calculated according to the total number of years the information technology and software course was taken at the school. The obtained values are presented in Table 12.

Table 12.
Arithmetic Mean and Standard Deviations of 12th Grade Students' Level Determination Test Scores According to the Total Number of Years Taken in Information Technologies and Software Course at School

Total Number of Years	n	$\bar{X}$	sd
5+ yıl	42	26.90	5.33
3-4 yıl	170	17.26	5.48
1-2 yıl	238	12.47	3.84

Table 13 shows the ANOVA results for the arithmetic mean of the students' level determination test scores according to the total number of years the information technology and software course was taken at the school. Levene statistic value for homogeneity of variances was calculated as 10,404, and it was seen that variances were not homogeneous (p<0.05). Therefore, instead of the F statistic in the ANOVA table, Welch's F statistic and its p value are reported in Table 13.

Table 13.
ANOVA Results of 12th Grade Students' Summative Test Scores According to the Total Number of Years Taken in Information Technologies and Software Course at School

Source of Variation	Sum of Square	df	Mean Square	Welch's F	p
Between Groups	8156,397	2	4078,198	166.773	0.000
Within Groups	9764,102	447	21,843		
Total	17920,500	449			

The results of the analysis presented in Table 13 show that there is a significant difference between the 12th grade students' reaching levels of the common features of information technologies and software courses in developed countries in terms of the total number of years they have taken the information technology and software course at school, Welch's F $F_{(2, 447)}$=166.773, p<0,05.

In other words, the scores the students get from the summative test change significantly depending on the total years they took the information technology and software course at school. The Dunnett C multiple comparison test results, which were conducted to determine the difference between which total years in terms of summative test scores, are given in Table 14.

Table 14.
Dunnett C Test Results of Summative Test Scores of 12th Grade Students According to the Total Number of Years Taken in Information Technologies and Software Course at School

Total Year	**3-4**	**1-2**
5+	9,640*	14,425*
3-4	-	4.785*

*The difference between the means is significant at the 0.05 level.

When the Dunnet C test results given in Table 14 are examined, it is seen that the summative test scores ($\bar{X}$=26.90) of the students who took information technologies and software courses for 5 or more years at school are significantly higher than the students who took information technologies and software courses for 1-2 years ($\bar{X}$= 12.47) and 3-4 years ($\bar{X}$ =17.26). It was determined that the DBT scores of the students who took information technologies and software courses for 3-4 years were significantly higher than the students who took this course for 1-2 years. In this case, it can be said that the students who take this course for 3-4 years and 5 years or more are more successful in terms of reaching the common features in the information technologies and software courses curriculum of developed countries.

Participation In Out-Of-School Learning Processes Related to Information Technologies and Software. One-Way Analysis of Variance (ANOVA) was used to determine whether the students' reaching level of the common features of information technologies and software courses in developed countries differs significantly according to their participation in out-of-school learning processes (courses, private lessons, etc.). First of all, the arithmetic mean and standard deviations of the students' summative scores were calculated according to their participation in out-of-school learning processes. The obtained values are presented in Table 15.

Table 15.
Arithmetic Mean and Standard Deviations of 12th Grade Students' Summative Scores According to Their Participation in Out-of-School Learning Processes

Participation in Out-of-School Learning Processes	**n**	**$\bar{X}$**	**sd**
12 Months and Longer	33	27.54	6.95
6-12 Months	43	20.55	4.77
0-6 Months	40	14.57	5.03
Never	334	13.94	4.81

Table 16 shows the ANOVA results for the arithmetic means of the students' summative test scores according to their participation in out-of-school learning processes. Levene statistic value regarding the homogeneity of the variances was calculated as 5.208, and it was determined that variances were not homogeneous ($p<0.05$). Accordingly, Welch's F statistic and the related p value were reported instead of the F statistic in Table 16.

Table 16.
ANOVA Results of 12th Grade Students' Summative Test Scores According to Their Participation in Out-of-School Learning Processes

Source of Variation	**Sum of Square**	**df**	**Mean Square**	**Welch's F**	**p**
Between Groups	6717.803	3	2239.267	59.340	0.000
Within Groups	11202.696	446	25.118		
Total	17920.500	449			

The results of the analysis presented in Table 16 show that there is a significant difference between the 8th grade students' reaching levels of the common features of information technologies and software courses in developed countries in terms of their participation in out-of-school learning processes, $F_{(3, 446)}$=59.340, $p<0.05$.

In other words, the scores the students get from the summative test change significantly depending on the students' participation in out-of-school learning processes. The Dunnett C multiple comparison test results, which were performed to determine between which groups there was a difference in terms of DBT scores, are presented in Table 17.

Table 17.
Dunnett C Test Results of 12th Grade Students' Test Scores According to Their Participation in Out-of-School Learning Processes

Participation in Out-of-School Learning Processes	6-12 Months	0-6 Months	Never
12 Months and Longer	6,987*	12,970*	13,596*
6-12 Months		5,983*	6.609*
0-6 Months			0.625

When the Dunnett C test results presented in Table 17 are examined; It is seen that the DBT scores of the students who participated in the out-of-school learning processes for 12 months or more ($\overline{X}$ =27.54) were significantly higher than the students who never participated ($\overline{X}$ =13.94), 0-6 months participation ($\overline{X}$ =14.57) and 6-12 months participation ($\overline{X}$ =20.55). It was determined that the scores of the students who participated in out-of-school learning processes for 6-12 months ($\overline{X}$ =20.55) were significantly higher than the students who never participated ($\overline{X}$ =13.94) and attended 0-6 months ($\overline{X}$ =14.57). However, DBT scores ($\overline{X}$ =14.57) of students who participated in out-of-school learning processes for 0-6 months do not differ significantly from DBT scores ($\overline{X}$ =13.94) of students who never participated.

3.5. Findings Concerning the Fifth Sub-Problem

The fifth sub-problem of the research is aimed at obtaining results to determine the views of teachers about the general structure of the information technologies and software course curriculum in terms of the factors affecting reaching the common features.

Content analysis was carried out in the analysis of the data obtained by using the teacher interview form to examine the features of the general structure of the curriculum within the scope of this sub-problem. In the process of analyzing the data, firstly, the data obtained through the online remote data collection system developed by the researcher was transferred to the spreadsheet program and codes were created. The codes were examined in terms of being related to each other and themes were determined. Sub-problems were described in line with the determined themes.

Percentage and frequency distribution of teachers' views on the first question of the teacher interview form, “What are your thoughts on the behavioral objectives in the information technologies and software curriculum implemented in Turkey and the quality of these behavioral objectives?” is presented in Table 18.

Table 18.
Percentage and Frequency Distribution of Teachers' Views on Behavioral Objectives

Theme	Codes (Views)	f	%
Behavioral Objectives	1. Behaviors that are aimed to be gained are not attainable due to the lack of technical infrastructure in most schools.	42	72.41
	2. Behavioral objectives should be updated in order to focus on software development.	37	63.80
	3. Behavioral objectives are not suitable for students' readiness levels.	35	60.34
	4. Behavioral objectives at the application level should be more involved.	35	60.34
	5. The number of behavioral objectives is too high compared to the weekly course hours.	34	58.62
	6. Behavioral objectives should be revised according to the requirements of the age.	33	56.90
	7. The behavioral objectives are sufficient in terms of quality.	17	29.31

When Table 18 is examined, only 29.31% of the teachers' views show that the behavioral objectives are sufficient in terms of quality. At the beginning of the views expressed by the teachers about the behavioral objectives, most of the behaviors aimed to be acquired are not attainable (72.41%) due to the lack of technical infrastructure in the schools and the behavioral objectives should be updated (63.80%) in order to focus on software development. In addition, it was stated that the behavioral objectives were not suitable for the students' readiness levels (60.34%), the behavioral objectives at the application level should be more involved (60.34%), the number of behavioral objectives is higher than the weekly course hours (58.62%) and the behavioral objectives should be revised according to the today's requirements (56.90%). Some of teachers' views on behavioral objectives are presented below.

> *"I do not think that the behaviors that are aimed to be acquire to students will be achieved due to the need for equipment in schools. In order to acquire these behaviors, students need to be able to practice more with sufficient equipment and technical infrastructure. Necessary equipment and robotics materials should be provided to all schools by the state..." (Teacher-9)*

> *"I think the curriculum should include more behavioral objectives regarding software development. Software topics should not only include robotic coding activities but also focus on information communication technologies and alternative mobile applications..." (Teacher-3)*

> *"The emphasis should be on practical issues rather than theoretical ones, and issues such as programming should be prioritized. Behavioral objectives should be updated for implementation…" (Teacher-22)*

Percentage and frequency distribution of teachers' views on the second question of the teacher interview form, "In the information technologies and software curriculum, it is aimed to train students as informatics literate, critical thinking, and problem-solving individuals. Do you think there are statements about the acquisition of these skills in the program? What can be done to gain these skills?" is presented in Table 19.

Table 19.
Percentage and Frequency Distribution of Teachers' Views on Informatics Literacy and Higher Order Thinking Skills

Theme	Codes (Views)	f	%
Informatics Literacy and Higher Order Thinking	1. The practices aimed at gaining these skills in the program are not sufficient.	50	86.20
	2. information technology laboratory should be enriched in terms of software and hardware.	48	82.76
	3. The program should be updated to include these skills starting from primary school.	46	79.31
	4. These skills are limited in behavioral objective statements.	41	70.69
	5. Students should be provided with workshops on coding and robotics.	34	58.62

When Table 19 is examined, 86.20% of the teachers stated that the information technology and software course curriculum is not sufficient to provide students with informatics literacy and higher order thinking skills, and that the information technology laboratory should be enriched in terms of software and hardware in order to gain these skills (82.76%). In addition, 79.31% of the teachers suggested that the program should be updated within the scope of informatics literacy and higher order thinking skills starting from primary school and stated that these skills were included in a limited level (70.69%) in the behavioral objective statements in the program. In order to support the teaching-learning processes in gaining informatics literacy and higher order thinking skills, the teachers made suggestions (58.62%) that the students should conduct workshops on coding and robotics. Some of the teachers' views on informatics literacy and higher order thinking skills are presented below.

> *"Even though the behavioral objectives in these skills are not sufficient, they are included. However, in order to gain these skills, I think the basics of this course should start from primary school. I think that students' thinking skills will improve over time as they learn new subjects based on what they have learned before..." (Teacher-10)*

> *"These skills are only included in the program on a limited basis. However, it is not possible to realize it as intended due to the conditions of the schools, the grade levels applied and the deficiencies in the application..." (Teacher-12)*

> *"Problem solving, algorithm and programming behavioral objectives are included. However, in order to gain skills, students should be given problem situations and asked to develop solutions to these problems and produce projects. "Informatics class, coding and robotics workshops should work together so that they can learn by doing and experiencing" (Teacher-55)*

Percentage and frequency distribution of teachers' views on the third question of the teacher interview form, "For which grade levels do you think the information technologies and software course subjects in the curriculum implemented in Turkey are more appropriate?" is presented in Table 20.

Table 20.
Percentage and Frequency Distribution of Teachers' Opinions on Eligibility to Grade Levels

Theme	Codes (Views)	f	%
Eligibility for Grade Levels	1. Compulsory course programs should be developed for all grade levels starting from kindergarten.	42	72.41
	2. Subjects should be arranged in a spiral structure starting from primary school.	36	62.10
	3. Course subjects are suitable for current grade levels.	16	27.60

When Table 20 is examined, 72.41% of the teachers suggested that compulsory information technologies and software curriculum should be developed for all grades and grade levels. They also stated that the subjects should be arranged in a spiral structure starting from primary school (62.10%). On the other hand, 27.60% of the teachers stated that the course topics are suitable for the current grade levels. Some of teachers' views on eligibility of the information technologies and software course for the grade levels are presented below.

> *"I think this course can and should be applied at all levels, from kindergarten to university level, under robotic coding or similar names and with varying contents..." (Teacher-24)*

> *"I think the program should be implemented starting from primary school. More basic subjects should be taught in primary school, and more emphasis should be placed on problem solving and programming in secondary school. At the high school level, product development processes should be emphasized by continuing with more complex subjects." (Teacher-5)*

> *"The program is generally suitable for 5th and 6th grades, but students cannot learn the basics of many subjects until they reach secondary school. Readiness levels are not appropriate in secondary school. Subjects have to be taught more intensively, for example, in order to work more effectively on product creation, students need to understand the basic subjects very well, therefore it is appropriate to give the course in a spiral structure, from easy to difficult subjects, from a much earlier age." (Teacher-7)*

Percentage and frequency distribution of teachers' views on the fourth question of the teacher interview form, "It is noteworthy that the subjects included in the programs of developed countries are in accordance with the principles of progressivity and spirality. How do you evaluate the program implemented in Turkey from this point of view?" is presented in Table 21.

Table 21.
Percentage and Frequency Distribution of Teachers' Opinions Regarding the Suitability of the Program with the Principles of Progressivity and Spirality

Theme	Codes (Views)	f	%
Principles of Progressivity and Spirality	1. Since the course is compulsory at certain grade levels, it is not possible to deepen the subjects.	46	79.31
	2. Prerequisite learning is not considered in the program.	39	67.24
	3. The program content is in accordance with the principles of progressivity and spirality.	12	20.69

When Table 21 is examined, only 20.69% of the teachers stated that the program is in accordance with the principles of progressivity and spirality. 79.31% of the teachers stated that it is not possible to deepen the subjects every year because the information technologies and software course is compulsory at certain grade levels. In addition, 67.24% of the teachers stated that the prerequisite learning of the students was not considered. Some of teachers' views on the suitability of the program with the principles of progressivity and spirality are presented below.

> *"Although the secondary school program seems to have a spiral structure, unfortunately this spiral structure is not sufficient since the information technologies course is compulsory only at the 5th and 6th grade levels. If the student has not taken the elective course in the 7th and 8th grades, he/she passes to high school with great inadequacy..." (Teacher-55)*

"We can say that the program has a spiral structure for the fifth and sixth grades, but this very limited period of time within the entire school life is not enough. Computer science course in high school is effective in science high schools, but due to its structure in social science high schools, it causes young people who would focus on verbal sciences to become disinterested..." (Teacher-58)

"There is no graduality or spiraling because current topics are constantly repeated, ignoring the student's foreknowledge, interests and needs, and the requirements of the digital age..." (Teacher-54)

Percentage and frequency distribution of teachers' views on the fifth question of the teacher interview form, "By emphasizing the interdisciplinary approach in the program, it was stated that this course should be integrated with other courses. Does the program include behavioral objectives in this direction?" is presented in Table 22.

Table 22.
Percentage and Frequency Distribution of Teachers' Opinions on Interdisciplinary Approach

Theme	Codes (Views)	f	%
Interdisciplinary Approach	1. It is not implemented because it is very little expressed in the program.	32	55.17
	2. It has a completely independent structure from other courses.	26	44.82
	3. There is no explanation or guidance on how to implement it.	23	39.70

When Table 22 is examined, 55.17% of the teachers stated that the interdisciplinary approach was not applied in the curriculum because it was not adequately expressed. 44.82% of the teachers stated that the information technologies and software course have a completely independent structure from other courses and 39.70% stated that there is no explanation or guidance on how to implement it. Some of teachers' views about whether an interdisciplinary approach is applied in the program are presented below.

"There are a few statements about the interdisciplinary approach in the program, but they are not implemented because they are not emphasized much. Information technologies course should be more associated with other courses and this issue should be emphasized more" (Teacher-38)

"There are no explanations or behavioral objectives regarding the interdisciplinary approach in the program. I think it is independent from other courses. I don't think there is a need to specifically state it anyway, teachers should try to work interdisciplinary in their practices" (Teacher-6)

"I think the program should provide guidance so that we can make these applications by taking advantage of the flexible structure of the prepared programs. Teachers can implement it if explanations are given on how it should be implemented" (Teacher-48)

Percentage and frequency distribution of teachers' views on the sixth question of the teacher interview form, "In the teaching-learning process, do you associate the subjects in the program with daily life? How do you evaluate the contribution of this situation? Do you think that the implemented program covers the objectives for establishing a relationship with daily life?" is presented in Table 23.

Table 23.
Percentage and Frequency Distribution of Teachers' Opinions Regarding the Association the Program with Daily Life

Theme	Codes (Views)	f	%
Associating with Daily Life	1. I explain the subjects by associating them with daily life.	50	86.20
	2. It attracts the attention of the students, the subjects are easier to understand.	48	82.80
	3. The program structure is aimed at associating the subjects with daily life.	46	79.31
	4. I think that the program should be made more comprehensive in terms of associating it with daily life.	12	20.69

When Table 23 is examined, 86.20% of the teachers stated that they explained the topics in the program by associating them with daily life, and 82.80% of them stated that the topics associated with daily life attracted more attention of the students and were easier to understand. In addition, 79.31% of the teachers stated that the curriculum structure was aimed at associating the subjects with daily life, and 20.69% of the teachers stated that the curriculum should be made more comprehensive in terms of associating it with daily life. Some of teachers' views on the association the program with daily life are presented below.

“I explain the topics by giving many examples from daily life since informatics is part of life. Students can relate the lesson to daily life and learn more easily” (Teacher-5)

“I relate the topics in the program to daily life. In this way, it attracts more attention of students and the topics are easier to understand. “I think it is important for teaching to be permanent” (Teacher-34)

“It is unthinkable to explain information technologies, which are a big part of daily life, without making connections with the topics covered. I think that the information technologies and software course program covers the behavioral objectives of establishing connections with daily life" (Teacher-10)

Percentage and frequency distribution of teachers' views on the seventh question of the teacher interview form, “How do you evaluate the information technologies and software course programs implemented in Turkey in terms of gaining the nature of knowledge?” is presented in Table 24.

Table 24.
Percentage and Frequency Distribution of Teachers' Opinions Regarding the Nature of Knowledge

Theme	Codes (Views)	f	%
Nature of Knowledge	1. Informatics laboratories are technologically inadequate in gaining the nature of knowledge.	44	75.90
	2. There is not enough explanation and guidance on this subject in the program.	40	69.00
	3. It is necessary to plan the teaching-learning processes in which the student will actively participate.	36	62.10
	4. The program is aimed at gaining the nature of knowledge.	10	17.24

When Table 24 is examined, only 17.24% of the teachers evaluated the information technologies and software course curriculum as aimed at gaining the nature of knowledge. 75.90% of the teachers stated that the informatics laboratories were inadequate in gaining the nature of knowledge due to problems such as technological equipment and infrastructure, and 69% of them stated that there was not enough explanation and guidance about the nature of knowledge in the program. In addition, 62.10% stated that teaching-learning processes should be planned in which students can actively perform applications. Some of teachers' views on the nature of knowledge are presented below.

“The nature of knowledge is research, action, application, making mistakes, evaluation. Equipped teaching environments are needed to learn the nature of knowledge by experiencing it in this way. Informatics laboratories need to be technologically updated. When we provide students with technically equipped environments, the student will not want to leave school" (Teacher-1)

"It may seem like it can be taught in theory, but in practice, the student cannot reach the nature of knowledge due to insufficient technological environments, there are very different applications from region to region, from school to school, there are schools that do not have information technologies laboratories or even teachers..." (Teacher-38)

“Explanations about what can be done to teach the nature of knowledge in the program are not sufficient. The program should be more descriptive on this issue” (Teacher-22)

Percentage and frequency distribution of teachers' views on the eighth question of the teacher interview form, “Computational thinking skill is emphasized in the programs implemented in developed countries. How do you evaluate the program implemented in Turkey in terms of gaining this thinking skill? Does the program include behavioral objectives in this direction?” is presented in Table 25.

Table 25.
Percentage and Frequency Distribution of Teachers' Opinions Regarding the Computational Thinking Skill

Theme	Codes (Views)	f	%
Computational Thinking Skill	1. In the program, computational thinking skill is not included in the behavioral objectives at a sufficient level, they are passed superficially.	51	87.93
	2. In order to gain computational thinking skills, the course should be given at all grade levels from an early age.	39	67.24
	3. Informatics laboratories should be enriched in order to gain computational thinking skill.	37	63.80
	4. Course hours are insufficient.	33	56.90

When Table 25 is examined, 87.93% of the teachers stated that the computational thinking skill is not adequately expressed in the behavioral objectives and that it was passed superficially. 67.24% of the teachers stated that the course should be given in all grades starting from early ages in order to gain computational thinking skill, 63.80% of them stated that in order to gain computational thinking skill, informatics laboratories should be enriched in a way to allow students to practice more. In addition, 56.90% of them stated that the course hours are not enough to gain this skill. Some of teachers' views on the computational thinking skill are presented below.

> *"Behavioral objectives on thinking skills are almost non-existent, and existing behavioral objectives are not emphasized. Since the class hours are limited, there are no practices aimed at higher level thinking" (Teacher-42)*

> *"Behavioral objectives on thinking skills in the program are very superficial, behavioral objectives are not sufficient to provide computational thinking skill, and course hours need to be increased" (Teacher-57)*

> *"It is desired to implement a program suitable for computational thinking skill, but the students' readiness level for this situation is very low and class hours are not enough to gain these skills" (Teacher-34)*

4. RESULTS, DISCUSSION AND RECOMMENDATIONS

4.1. Results and Discussion

In the first and second sub-problems of the research, it was aimed to determine the level of attainment of the 8th and 12th grade students in Turkey with the common features that are aimed to be gained by the students in the information technologies and software courses until the end of the 8th and 12th grades in developed countries. In the third and fourth sub-problems of the research, it was aimed to determine whether the level of reaching the common features of the 8th and 12th grade students shows a significant difference according to the gender, the total number of years the information technology and software course was taken at school, and their participation in out-of-school learning processes related to information technologies. In the fifth sub-problem, the opinions of the teachers were examined in terms of the factors affecting the acquisition of common features regarding the structure of the information technologies and software course curriculum. In this direction, these sub-problems were interpreted and reported together to deal with the interpretations of the findings in a more holistic way.

In the research, in line with the common features that are aimed to be gained by students in information technologies and software courses in developed countries, 29 critical behavioral objectives at the 8th grade level and 28 critical behavioral objectives at the 12th grade level were determined for the themes of Problem Solving, Algorithms and Programming, Computer Systems, Network Systems, Ethics and Security. In some cases, new learning is based on previous learning and is the basis for subsequent learning. Prior learning needed to learn new information is defined as prerequisite learning. If the prerequisite learning of the behaviors that are critical in learning a learning unit has not been achieved, it is very difficult to learn them. If it is achid, it makes it easier to learn new information (Senemoğlu, 2018). Since the behavioral objectives are supportive of each other in the subject areas where the prerequisite relations are strong, an absolute criterion should be used in the courses that include learning that is built on each other and the learning level in these courses should not be reduced below the specified criteria. In general, the criterion for these courses is between 75-85%. Considering the prerequisite relationships within the scope of this research, the level of reaching the determined behaviors was interpreted as 0.75 (Özçelik, 1989).

When the level of reaching all the determined common critical behavioral objectives of 8th grade students in Turkey is examined, it is seen that the students can reach these behavioral objectives at the level of 0.37. According to the themes of each behavioral objective determined within the scope of common objectives of information technologies and software courses of developed countries, it has been observed that students can reach all of the behavioral objectives in the Problem Solving, Algorithms and Programming theme at the 0.40 level, all the behavioral objectives in the Computer Systems theme at the 0.32

level, all the behavioral objectives in the Computer Networks theme at the 0.33 level, and all the behavioral objectives in the Ethics and Security theme at the 0.39 level. Similarly, when the level of reaching all the critical behavioral objectives determined as common in developed countries of the 12th grade students in Turkey is examined, it is seen that the students can reach these behavioral objectives at the level of 0.36. According to the themes of each behavioral objective determined within the scope of common objectives of information technologies and software courses of developed countries, it has been observed that students can reach all of the behavioral objectives in the Problem Solving, Algorithms and Programming theme at the 0.38 level, all the behavioral objectives in the Computer Systems theme at the 0.34 level, all the behavioral objectives in the Computer Networks theme at the 0.34 level, and all the behavioral objectives in the Ethics and Security theme at the 0.69 level.

It is thought that the failure of the students in Turkey to reach the common features that are aimed to be gained in the information technologies and software courses of developed countries at the target criterion level (0.75) is due to the fact that the spiral structure cannot be fully provided in the program implemented in Turkey. It can be said that the lack of progressive and spiral structure in the program causes the students to forget the topics taught in a short time and to be unable to organize the information they have acquired in a meaningful way. It can be said that 8th and 12th grade students did not reach the behavioral objectives at the expected level because they did not participate in any teaching-learning process for the continuation of the course throughout their school life after taking the information technologies and software/computer science course for a certain period as a compulsory course, and the subjects that cannot be repeated are forgotten over time.

It has been seen that some of the behavioral objectives included in the program implemented in Turkey are aimed to be acquired by students at smaller grades in developed countries. It has been determined that the themes in the curriculum of England, Australia and the United States are the same at different grades, the behavioral objectives determined within the scope of these themes differ according to the grade levels, and higher order behavioral objectives are given more place as the grade levels progress. It has been seen that the subject headings in the curriculum in Turkey are the same, but the behavioral objectives in the curriculum do not change much according to the grade level, and as the grade level progresses, it has been seen that basic level behavioral objectives are still tried to be gained to the students, unlike the higher order behavioral objectives. Since the information technologies and software course in Turkey is not compulsory from the primary school, students must learn the lower-level behavioral objectives when they reach the secondary school. For this reason, it is not possible for students to reach higher order gains according to the progress rates of developed countries. The lack of continuity of the course is thought to be the reason for this situation. In the interviews with the teachers, there are clues about the deficiencies in the progressiveness and spirality principles of the program.

Only 20.69% of the teachers who were consulted for their opinions on the evaluation of the program stated that the program was in accordance with the principle of progressivity and spirality, and 79.31% stated that it was not possible to deepen the behavioral objectives due to the fact that the information technologies and software course was compulsory only at certain grade levels. These results also support the interpretation that the program is not structured in accordance with the principles of progressivity and spirality. Parallel to this, it is thought that the level of students' reaching behavioral objectives lower than the determined criterion (0.75) may be due to the deficiencies in their prerequisite learning. The findings of the interviews conducted to determine the opinions of the teachers about the general structure of the information technologies and software course curriculum in terms of the factors affecting reaching the common features give clues that the students cannot reach the behavioral objectives at a sufficient level. The fact that 79.31% of the teachers stated that it is not possible to deepen the subjects every year because the information technologies and software course is compulsory only at certain grade levels, 60.34% of them stated that the behavioral objectives were not suitable for the students' readiness levels and 67.24% of them stated that the prerequisite learning of the students was not considered support this view. Only 27.60% of the teachers stated that the course subjects are suitable for the current grade levels. 72.41% of the teachers recommended the development of compulsory information technologies and software curriculum for all grade levels. They also stated that the subjects should be arranged in a spiral structure starting from primary school (62.10%).

In the study conducted by Karakuş, Çoşgun, and Lal (2015), according to the findings obtained from the opinions of information technology teachers regarding the behavioral objectives in the information technologies and software curriculum, the fact that some of the behavioral objectives in the program are divided into levels provides convenience to the teachers who are the implementers of the program during the implementation of the program, but It was stated that some of the behavioral objectives are not suitable for readiness levels of students. It was also stated that it is difficult for students to understand the behavioral objectives that include abstract concepts in the program, especially due to the deficiencies arising from prerequisite learning. Similarly, in studies on the elective information technology course curriculum, it was determined that there are some problems regarding the compatibility of the behavioral objectives with the developmental levels of the students (Kabakçı, Kurt, & Yıldırım, 2008) and the behavioral objectives are not suitable for the students' readiness levels (Kural Er & Güven, 2008; Fırat Durdukoca & Arıbaş, 2011). As a result, it is seen that the current levels and needs of the students are ignored while preparing the information technologies and software course curricula. Although the BTY course was planned as a compulsory course in the 5th and 6th grades and as an elective course in the 7th and 8th grades, it was determined that the course was not chosen in the 7th and 8th grades. According to the elective course legislation, it is not possible for all students to choose BTY course. In the study conducted by Burhanlı (2017), it was observed that this course was not offered due to reasons such as the insufficient number of teachers and IT laboratories, or that not all students who wanted to choose it could choose this course and the course was not conducted according to the elective course legislation. Accordingly, the non-compulsory BTY course is suspended for a long time in the 7th and 8th grades. In this case, it prevents the continuity of the course. If the students can continue, they can take the course again at the high school level, but it can be said that they can forget a lot of information in the passing time.

It is thought that the development of information technologies and software course programs in accordance with the spiral structure, considering the interests and readiness of students, and updating them to gain higher order behavioral objectives within the scope of knowledge and skills required by the today's world, will play an important role in raising individuals who will produce new technologies by transferring knowledge to technology. In addition, it is thought that it is a necessity to design effective teaching-learning environments equipped with rich technological tools and equipment for gaining these behavioral objectives. The fact that the level of students' reaching the behavioral objectives is lower than the determined criteria may be due to the insufficient teaching-learning environment and equipment or the fact that the behavioral objectives in the program were not prepared according to the today's requirements. In this direction, the findings regarding the teacher's views on the quality of the behavioral objectives included in the information technologies and software course curriculum give clues that the students cannot reach the behavioral objectives at a sufficient level.

Only 29.31% of teachers' opinions show that the behavioral objectives are sufficient in terms of quality. The main opinions expressed by the teachers about the behavioral objectives are that the behavioral objectives aimed to be acquired are not at an accessible level due to the lack of technical infrastructure in most schools (72.41%), that behavioral objectives should be updated in order to focus on software development (63.80%), that behavioral objectives at the applying level should be given more place (60.34%), that the number of behavioral objectives are higher than the weekly course hours (58.62%) and that behavioral objectives were behind the times (56.90%). In addition, 86.20% of the teachers stated that the information technology and software course curriculum is not sufficient to provide students with informatics literacy and higher order thinking skills, and that the informatics laboratory should be enriched in terms of software and hardware to gain these skills (82.76%). 79.31% of the teachers suggested that the program should be updated within the scope of informatics literacy and high-level thinking skills starting from primary school, and they stated that these skills were included in a limited level in the behavioral objective expressions in the current program (70.69%). Teachers' suggestions for students to conduct workshops on coding and robotics to support teaching-learning processes in gaining informatics literacy and higher order thinking skills (58.62%) also support these views. As a result of the opinions obtained from the teachers about whether the computational thinking skill, which is thought to be one of the main competencies of the 21st century, can be gained with the information technologies and software course curriculum, it has been concluded that this skill is superficially included in the program explanations (87.93%). In addition, it was stated that this course should be given at all levels and grades from an early age (67.24%) to gain computational thinking skills. It has been stated that teaching-learning environments need to be enriched in terms of digital tools and equipment (63.80%) and the weekly course hours (56.90%) should be increased. The findings obtained within the scope of the research support the research findings examined in the literature (Aslan, 2014; Berkant & Çolak, 2021; Bulut, 2018; Domaç, 2016; Gülcü, Aydın & Aydın, 2013; Karakuş, Çoşgün & Lal, 2015; Karal, Reisoğlu, & Günaydın, 2010; Şişman Eren & Şahin İzmirli, 2012; Yılmaz Tanataş, 2010).

It has been determined that the behavioral objectives and practices aimed at improving coding and programming skills are mainly included in the information technologies and software curriculum of developed countries. Coding and programming skills are shown as one of the skills that individuals who learn in the 21st century should have (Sayın & Seferoğlu, 2016). In the study conducted by Sarıkoz and Bangir Alpan (2019), it was determined that students were more familiar with basic features such as expressing themselves and communicating using basic information and communication technologies, sharing digital information, accessing information using research technologies and collaborative work, but problem solving, programming and original product development. levels were found to be very low. Similarly, in the study conducted by Solmaz (2015), it was seen that the learning levels of 6th grade students in creating flow diagrams in algorithm development were lower than in other subjects. It is stated that the main reason for the difficulties encountered in the curriculum applied in Turkey, especially in problem solving and programming teaching, is that the students have different levels of interest, motivation and similar issues, the technical inadequacies of the schools, the lack of continuity of the course and the deficiencies in the prerequisite learning of the students (Yecan, Özçınar & Tanyeri, 2017).

As seen in the results of the research examined in the literature, it has been determined that the readiness levels of the students are not considered, the course hours and the technical facilities of the schools are insufficient, and the behavioral objectives do not fully cover the knowledge and skills required by the today's world. In this direction, it is thought that it will not be possible to reach the common features of developed countries with the informatics programs implemented in Turkey. In support of this finding, Fırat Durdukoca and Arıbaş (2011) also state that the behavioral objectives specified in IT programs are not at a level that can be reached with the current conditions of the schools (laboratory, internet, books, etc.). It has been stated that most of the IT laboratories do not have technological tools and equipment, and that these tools are insufficient in terms of both quantity and quality (Şahna, 2012; Kır, 2012). It can be said that the existing infrastructures and opportunities of regions and schools were not considered in the development of the curriculum. Karakuş, Çoşğun, and Lal (2015) also state that some content in the program cannot be implemented in IT laboratories due to internet restrictions, and differences according to regions and schools are ignored during the preparation of behavioral objectives. In a study by Seferoğlu (2007), which included the opinions of teachers, it was stated that the infrastructure in the IT laboratories was old, and the tools and equipment were insufficient. It has been observed that no progress has been made over the years in the studies on this subject. Similarly, although there have been many changes in the ICT course curriculum over the years, it has been seen in the studies that the weekly course hours are not sufficient and there is no regulation in this regard (Henkoğlu and Yıldırım, 2012; Kabakçı, Kurt, & Yıldırım, 2008; Karal, Reisoğlu, & Günaydın, 2010; Yılmaz Tanataş, 2010).

The aim of education in the information society is to raise productive, hardworking, and creative individuals who will adapt to the 21st century. The realization of this aim is possible by raising individuals who have the necessary knowledge and skills regarding information technologies, who produce knowledge and transfer it to technology. However, as Phelps et al. (2005) stated, information technologies are developing rapidly and knowledge and skills in this field may become out of date after a certain period (Akbıyık & Seferoğlu, 2012). For this reason, it was stated that the content in the fields related to information technologies should be updated frequently to reach the objectives.

Teachers are required to process the behaviors aimed to be acquired by students by connecting them with daily life and to actively involve the student in the teaching process. In the findings of the study, it is thought that the low level of students' attainment of behavioral objectives may be due to the inability of the students to transfer the knowledge and skills they have learned to the situations they encounter in their daily lives and the insufficient teaching-learning environments that will develop their higher order thinking skills. In the research, 86.20% of the teachers stated that they tried to explain the topics in the curriculum by associating them with daily life, 82.80% of them stated that the topics associated with daily life attracted more attention of the students and were easier to understand. In addition, 79.31% of the teachers stated that the curriculum structure was aimed at associating the subjects with daily life, and 20.69% of the teachers stated that the curriculum should be made more comprehensive in terms of associating it with daily life. In addition, 55.17% of the teachers stated that the interdisciplinary approach was not applied in the program because it was not adequately expressed. 44.82% of the teachers stated that the information technologies and software course have a completely independent structure from other courses and 39.70% stated that there is no explanation or guidance on how to apply the interdisciplinary approach in the learning outcomes.

In the teaching-learning process of information technologies and software courses, transferring the subjects in connection with daily life and in accordance with the interdisciplinary teaching approach facilitates the learning process of the students. In practice, it is considered important to determine whether the information that students learn at school relates to daily life, to ensure the permanence of the subjects and to structure the learned information meaningfully (Cohen, Manion, & Morrison, 2007). According to Duman and Aybek (2003) although the interdisciplinary teaching approach has been widely and successfully applied in many countries, there are very few resources in our country regarding the content, importance of this approach and how it can be applied. In terms of cohesion, it has been observed that there are no explanatory statements about how the information technologies and software program can be associated with the curricula of other courses. Especially with the recent updates made in the information technologies and software curriculum, there are some explanations in the introductory parts of the programs, although the connections with daily life are not as clear as in the previous programs. Arslan and Özpınar (2008) emphasize the necessity of teaching the subjects based on the interdisciplinary teaching approach and making associations with daily life. As much as possible, it should be tried to establish a relationship with the experiences outside of school (Fidan, 1985). Teaching the subjects in connection with daily life increases the permanence and level of learning.

Only 17.24% of the teachers stated that the information technologies and software course curriculum is aimed at gaining the nature of knowledge. 75.90% of the teachers stated that the informatics laboratories were inadequate in providing the nature of knowledge due to problems such as technological equipment and infrastructure, and 69% of them stated that there was not enough explanation and guidance about the nature of knowledge in the program. In addition, 62.10% stated that teaching-learning processes should be planned in which students can actively perform applications. A student who acquires the nature of knowledge understands how technological information is obtained, whether its source is reliable, and how to use the learned information in daily life. In this context, it is very important to develop the information technologies and software curriculum in a way that will help students to construct knowledge in a meaningful way, to associate what has been learned with daily life, and to understand the nature of knowledge. Driver, Leach, Millar, and Scott (1996) state that students who acquire the nature of scientific knowledge will learn knowledge and skills related to science more successfully and will use the learned knowledge and skills in daily life. It is thought that the curricula of developed countries provide rich clues for raising individuals who comprehend the nature of knowledge, equipped with scientific process skills, and have ethical values, based on the use of the learned information in daily life.

The results reached based on the findings of the study are summarized below:

Results for the first and second sub-problems

- It was determined that 8th and 12th grade students could not reach all the critical behavioral objectives determined for information technologies and software courses in developed countries at the level of 75%.
- It has been determined that 8th and 12th grade students cannot reach all the behavioral objectives in the themes of Problem Solving, Algorithms and Programming, Computer Systems, Computer Networks, Ethics and Security at the level of 75% within the scope of the common goals of information technologies and software courses of developed countries.

Results for the third and fourth sub-problems

- Level of attainment of 8th grade students' common behavioral objectives in information technologies and software courses of developed countries;
  - It is seen that there is no significant difference according to gender.
  - It shows a significant difference in favor of students who have taken information technologies and software course longer at school.
  - It shows a significant difference in favor of students who participate in out-of-school learning processes (courses, private lessons, etc.) related to information technologies and software. In addition, it was observed that there was a significant difference in favor of the students who participated in the out-of-school learning processes for a longer period.

- Levels of 12th grade students reaching common behavioral objectives in information technologies and software courses of developed countries;
  - It is seen that there is no significant difference according to gender.
  - It shows a significant difference in favor of students who have taken information technologies and software course longer at school.
  - It shows a significant difference in favor of students who participate in out-of-school learning processes (courses, private lessons, etc.) related to information technologies and software. In addition, it was observed that there was a significant difference in favor of the students who participated in the out-of-school learning processes for a longer period.

Results for the fifth sub-problem

- According to the teachers' views on the behavioral objectives in the program, it was stated that the behavioral objectives were not at a sufficient level in terms of quality. It has been determined that most of the behaviors aimed to be gained are not accessible due to the lack of technical infrastructure in the school, the behavioral objectives should be updated to focus on software development, the behavioral objectives are not suitable for the readiness levels of the students and the behavioral objectives at the application level should be given more space. In addition, teachers' opinions were determined that the number of behavioral objectives is higher than the weekly lesson hours and that the behavioral objectives are behind the times.
- It was stated that the applications aimed at providing students with information literacy and high-level thinking skills in the information technologies and software course curriculum are not sufficient, there are limited amount of learning outcomes in this direction, and the information laboratory should be enriched in terms of software and hardware in order to gain these skills. In addition, opinions were determined that the program should be updated for the acquisition of information literacy and high-level thinking skills starting from primary school, and that students should be provided with workshops on coding and robotics to support the teaching-learning processes in acquiring information literacy and high-level thinking skills.
- Teachers stated that the course subjects are not suitable for the current grade levels, the program is not designed in accordance with the principle of progressivity and spirality, the prerequisite learning of the students is not considered, and the subjects should be arranged in a spiral structure starting from primary school.
- It was determined that the teachers expressed their opinions about the fact that the interdisciplinary approach was not applied because it was not adequately expressed in the program, that the course had a completely independent structure from other courses, and that there was no explanation or guidance on how to apply the interdisciplinary approach in the learning outcomes.
- The teachers stated that they explained the subjects in the program by associating them with daily life, that the subjects related to daily life attracted more attention of the students and were easier to understand, and that the program structure was suitable for associating the subjects with daily life. It was observed that some of the teachers stated that the program should be made more comprehensive in terms of associating it with daily life.
- Teachers stated that the ICT course curriculum is not aimed at gaining the nature of knowledge and that the informatics laboratories are insufficient in providing the nature of knowledge due to problems such as technological equipment and infrastructure. In addition, it has been determined that there is not enough explanation and guidance about the nature of knowledge in the program and that they express opinions that teaching-learning processes should be planned in which the student can actively perform applications.
- In the program, higher order thinking skills are not adequately expressed in the behavioral objectives, and they are superficial in objectives. In order to gain computational thinking skill, the course should be given in all classes from early ages, and information laboratories should be enriched in a way to allow students to practice more in order to gain computational thinking skill. In addition, it was determined in line with the opinions of the teachers that the course hours were not sufficient for gaining this skill.

4.2. Recommendations

Recommendations for the development of practices:

- It was determined that the principles of progressivity and spirality were not considered sufficiently in the development of the program. For this reason, it is recommended that the behavioral objectives in the program be restructured according to horizontal and vertical cohesion, considering the readiness and prerequisite learning of the students.
- It has been determined that the explanations in the information technologies and software program do not provide sufficient guidance to the teachers to gain the behavioral objectives. Accordingly, it was determined that the behavioral objectives were not completely understood and could not be gained at the targeted level. In this context, the behavioral objective statements in the program should be rearranged in a way to provide students with the nature of knowledge, and teaching-learning methods and assessment-evaluation practices should be included in an explanatory and guiding way for teachers.
- It has been determined that informatics literacy and higher order thinking skills are not sufficiently included in the program. It is recommended to reorganize the program in a way that will contribute to the formation of behaviors that will enable students to develop higher order thinking skills to develop solutions for individual and daily life problems and to use these skills in a way that will contribute to technological developments.
- It has been determined that the concepts of acquiring the nature of knowledge, computational thinking skill, associating subjects with daily life are very limited in the explanations section of the programs and are not reflected in the objectives. It is thought that the curriculum should be rearranged in this direction and more examples and explanations should be included in the curriculum to guide teachers on how to gain these acquisitions.
- It has been determined that the interdisciplinary approach is not adequately applied in the curriculum and there are not sufficient explanations for teachers in the curriculum on how to apply this approach. It is recommended to restructure the program according to an interdisciplinary approach and to include examples and explanations on how to apply this approach. Collaborative work can be done when teachers come together with other teachers in a way that will enable them to benefit from other disciplines in the teaching-learning processes.
- It was stated that the duration of the course determined in order to gain the targeted features in the program was not sufficient, the performance of the students in the elective course type was not evaluated with grades and the students did not take the course into consideration because there was no report card grade. It is thought that the course hours should be increased, the student performance should be evaluated with grades, the student grade should be reflected on the report card, and the assessment-evaluation processes should be arranged in a way to determine the learning levels and learning deficiencies of the students, and the process should be arranged in a way that would improve the students' higher order thinking skills. It is suggested that comprehensive explanations should be included in the curriculum so that teachers can carry out these processes as intended.
- It has been determined that it is not possible to reach the behavioral objectives determined in the program and to acquire the nature of knowledge by the students due to the inadequacies of the existing informatics laboratories such as technological equipment and infrastructure. It is recommended that schools be equipped with technological tools and equipment and well-maintained informatics laboratories should be prepared to provide students with the knowledge and skills required by the today's world within the scope of the information technologies and software program.
- It was stated that the reason why the students could not reach the common features of the developed countries' information technologies and software courses at the determined criterion level was that they started to take this course at the 5th and 6th grades. It is thought that information technologies and software course should be taught as a compulsory course at every grade level, starting from primary school, by applying qualified programs in order to enable our students to produce knowledge and transfer it to technology and to compete with the world.

Recommendations for new research:

- Studies can be conducted to determine the common and different features between the curriculum of other courses and the programs of developed countries, apart from the information technologies and software course.
- In this research, it is aimed to determine at what level the students in Turkey gain the common features that are aimed to be gained in the information technologies and software courses curriculum of developed countries at the end of the 8th and 12th grades. Research can be conducted to determine the level of attainment of undergraduate and graduate students or teachers to these common features.
- By developing curricula that include common themes and common behavioral objectives in the information technologies and software curriculum examined within the scope of this research, the level of attaining behavioral objectives of students at different levels can be tested with experimental research.
- Interdisciplinary practices can be developed for the solution of daily life problems that require the use of computational thinking skills, and the effect of these practices on students' higher order thinking skill can be tested with experimental research.

Research and Publication Ethics Statement

Hacettepe University Ethics Committee stated that the research was ethically appropriate and necessary permission was given to conduct the research. The research data were obtained from the 8th and 12th grade students at the schools affiliated to the Ministry of National Education in the central districts of Kayseri province and from the information technologies and software teachers in the same schools on a voluntary basis. Before the data collection process, it was clearly stated to the participants that they had the right to choose whether to participate in the study, that they were free to give up at any time after the study started, that this would not impose any responsibility on them, and that all information requested from the participants within the scope of the study would be kept confidential by the researchers. All the information in the article was obtained within the framework of academic rules, and the principles of publication ethics were followed during the article writing process.

Contribution Rates of Authors to the Article

This study is a part of the doctoral thesis titled "The levels of attainment of the 8th and 12th grade students in Turkey considering the objectives of information technologies and software courses in the developed countries", completed by first author under the supervision of second author. Both authors contributed equally to the process of transforming the thesis into an article.

Statement of Interest

There is no conflict of interest between the authors.

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