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The Universal Skill of 21st Century, Coding and Attitude of Secondary School Students towards Coding

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Abstract

Information society is a society, which consists of qualified individuals that meet the requirements of the era, that is to say, people that utilize the information in every field of life and produce them when necessary. From past to the present day, a wide variety of tools has been used to share and spread information. When people mention programming skill, the first thing to think about is to find a solution to a specific problem. Another important point here is to make the solution compatible with the computer environment. The main purpose of this study is to evaluate the attitude of the students towards learning to code (programming) regarding the computers, tablets and other devices that they use in school and classroom. From this point forth, a questionnaire study was conducted with the Near East College students, who take selective coding (programming) course in the school, which attaches importance on smart board and tablets. The findings show that the academic achievement scores of the students do not significantly create statistical difference on their attitudes towards learning to code (programming), yet their attitudes change according to the gender.

Keywords: *Attitude Scale towards Learning to Code, Coding Education, Secondary School Students*

Introduction

Today, as the societies get increasingly interested in the education, the number of the studies to make learning-teaching process more productive in school soars up. There is a need for contemporary education systems that can meet the need for future generations to be self-confident, productive, independent, critical, and able to solve the problems they encounter. As the computer technologies have become widespread, it has brought together the transformation at

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every aspect. Education is one of the most significant institutions to get its fair share from this transformation. Such changes in perceiving and interpreting the concepts of teaching and learning has paved the way for development of instructional technologies (Çelik, 1998).

There is a widespread agreement among researchers and teachers in the field of education that the use of Information and Communication technology makes better teaching and learning process (Soner, 2007). The use of Information and Communications Technologies (ICT) as a learning tool within meaningful contexts of learning has been identified and emphasized as a significant priority across the EU countries (European Commission, 2003). According to Miller (2008), the landscape of technology for classroom instruction continues to expand, along with creative uses for the technology in teaching and learning activities. According to Friedman (2005), it is inconceivable that the technology, specifically the information technologies (IT), cannot be kept out of educational systems especially in such an era in which the technological advances are everywhere (as cited in Ayas, Çakır, Ergun, Pamuk, & Yılmaz, 2013).

As the communication technologies develop so rapidly today, it is indispensable to utilize technological tools to use, develop and teach the information. Society has embraced computer technology and allowed it to reinvent the ways in which we create, find, exchange and even think about information (Pierson, 2001). Therefore, the relationship between education and technology has improved swiftly, thereby paving the way for emergence of the concept of educational technology. When we look at the education and learning systems, we observe that the majority of the problems originate from the traditional teaching and learning systems. Such problems can be categorized as instructional methods that emphasize knowledge transfer, excessive dependence on textbooks, absolute sovereignty of teacher, classroom environment that does not allow creative thinking or expression of personal opinions, teaching methods that allow understanding and interpreting the information that is presented. Furthermore, there are other problems the students face such as non-permanent learning, learning without a meaning, rote-learning-based education system, in which students forget what they learn after exams, and students' not being able to use the information and skills in their lives effectively (Sezgin; 2002). Technology is oftenly used in numerous areas, also including the field of education. Especially the tablet computers (TPC) play an important role in increasing the efficiency and effectiveness of the educational studies (Güngören et al, 2014).

Nowadays, many benefits, including social, economical and pedagogical are directly associated with information and communication technologies use in education (Soner, 2007). The studies in this area indicate that the mobile devices attract the attention of the students while also motivating them, facilitate a more flexible learning and better time management, therefore support the view that the students can use the mobile technologies in education environments (Corbeil & Valdes-Corbeil, 2007, Jacob & Isaac, 2008). After the changes on lesson curriculum of Information Technologies, there has been a requirement about bringing students in programming skills.

In today's information society, educated people refer to the ones that follow the developments regarding themselves, implement and question such developments in their lives and are open to

development by actively using information and communication technologies (Sayın and Seferoğlu, 2016).

21st Century Skills are another concept that is highly addressed. Such concept refers to the fact that which skills should children have for the future. These skills are critical thinking, problem solving, communication, collaboration, information and technology literacy, flexibility and adaptability, global competence and financial literacy (Sayın and Seferoğlu, 2016). We can simply say that coding (programming) is one of the 21st Century Skills and has great importance for future generations. In other words, coding is the process of application and development with various command sets for computer programming, problem solving, enabling individual-computer interaction and performing a specific task by computers (Business Dictionary 2015). That is to say, in order to give command to the smart phones and tablets and so on, the problems should clearly be defined and separated into parts which are called method (function). The computer program consists of the combination of these functions and each function contains the commands necessary to solve the problem. Based on the literature and expert opinions, it is obvious that computer programming can enhance problem solving capabilities of learners in all ages, which urges a need for the development of educational programming environment based multimedia activities, especially for young learners (Kalelioğlu and Gülbahar, 2014). According to Calao et al. (2015), the educational use of coding (programming) started with the use of Logo programming language in 1960s. Today, it has become more common with applications such as Alice, Kodu, code.org and Scratch.

Computer programming or coding education can also be used to improve cognitive thinking of students. According to Wing (2006), the computational thinking refers to the problem solving, system design and understanding the human behavior through use of basic computer sciences. Computational thinking skill is associated with problem analysis, data presentation and modeling, and is referred to as a basic skill for everyone. Coding (programming) at early age is of great importance for raising new individuals that are equipped with 21st century skills instead of the generations which have rote-learning based education without questioning and have critical thinking skills. Coding (programming) is not limited to computer units, but it represents a field that provides interaction between disciplines (www.kodlamadersi.com , 2017).

In an interview, Steve Jobs (2017) stated that "I think everyone in this country has to learn computer programming. Everyone should learn a computer language. Because it teaches people how to think. I see computer science as a social science. Everyone should learn it." and added that coding (programming) was one of the future skills http://www.kodlamadersi.com/kodlamanın-önemi.html. In the 21st century society, true learning requires being able to use new technologies, not simply to enhance the ability to memorize and repeat facts, but to gather, organize and evaluate information to solve problems and innovate practical ideas in real-world settings (Jimoyiannis, 2010).

Coding theory is used to examine the characteristics of information sentthrough communication channel which cover the source, the channel and the receiver. Also, it is used to optimize the transmission of the information and provide secure transmission (Arda, 2011).

Theoretically, the Dual-Coding theory is developed by Allan Paivio (1986). According to this theory, words and images activate the independent visual and oral codes. Dual coding theory has been applied to many cognitive states such as memory, problem solving, concept learning, language learning and multimedia learning (Sezgin, 2002). And also explains psychological phenomena by the collective action of nonverbal and verbal mental systems that are specialized for the processing of imagery and linguistic information, respectively (Clark and Paivio, 1991).

According to the Dual Coding Theory, there is a similarity, parallelism and continuity between perception and memory, behavioral skills and cognitive skills. Symbolic systems express the individual's perceptual, affective, and behavioral characteristics. The basic assumption of the theory is created by two symbolic systems, verbal and non-verbal, each independent yet related to each other, different from each other and formal and special, which develops in parallel with the individual experiences to symbolize and process the information regarding the cognitive, linguistic and non-verbal objects and events (Paivio, 1986). Paivio argues that concrete words have the advantage for learning over abstract words since concrete words has a chance to be dual coded into both imagery and verbal systems (Aldağ, 2005).

Coding (programming) does not merely mean writing a computer program and it is a phenomenon that requires top-tier thinking skills, systematic thinking, producing and establishing causal link and creative thinking (Yükseltürk and Altıok; 2015).

The complexity of the traditional programming language structures, reaching the target audience and education style create some challenges for coding (programming) education. Accordingly, coding (programming) platforms such as Alice, Microsoft Small Basic, Scratch, Stagecast Creator and Toontalk are developed to facilitate the learning for the individuals (Yükseltürk and Altıok, 2015:52).

Method

More than a thousand schools nationwide have committed themselves to some form of laptop computer initiative, and the number is increasing rapidly (Windschitl and Sahl, 2002). This study has been carried out to measure the attitudes of the secondary school students towards coding, who take computer and coding (programming) education in school. The sample of the study consisted of 6th, 7th and 8th grade students who studied at the Secondary School at Near East College in the 2017-2018 fall semester. We have selected Near East College as it extensively utilizes technology in education and provides selective coding lessons starting from primary school. The modules are enriched with the multimedia applications and students can attend the modules with their own tablets and they can reach the classroom materials whenever and wherever they want. Such facilities are thought to improve the level of learning and command of the students on the modules.

A total of 489 students participated in the study. We have added a scale to measure the attitudes of the students towards coding beside the questions to measure their success levels and demographic information to the questionnaire provided to the students. As shown in the Table,

49% of participants was female and 51% was male. 36% of the participants was 6th grader, 37% was 7th grader, 27% was 8th grader. The following table illustrates the gender distribution by grades.

Table 1
Gender Distributions by Student Grades

	6th Grade	7th Grade	8th Grade	Total
Female	85	89	66	240
Male	87	94	67	248
Total	172	183	133	488

A majority of the students (96.9%) has different digital tools in addition to the tablets they use in the school. When they are asked how much time they spend with such tools on a daily basis, the group, who spends 1-2 hour per day (29.7%) has the highest rate, which is followed up by a group spending 2-3 hours per day (22.9%) on computers and tablets. The lowest rate is 12.5%, which refers to the group spending more than 4 hours a day. Taking the success averages of the students into account, it is observed that the majority of the students (27%-132 students) have grade point average between 80-89. The lowest rate is the students which have 49 and lower grades with 4.3%.

Data Collection Tools

Questionnaire method, which is one of the quantitative research methods, was applied to the participants. We have included socio-demographic questions to learn the demographic information and module success averages of the participants in the question form. Following the socio-demographic questions, "Attitude Scale for Code Learning" is included. The scale was prepared by Keçeci et al. (2016), and validity and reliability of the scale were carried out by themselves. We have implemented the scale considering the desire to learn code, interest towards the use of computer games in an instructional way, the concerns towards anti-socialization caused by computers scales. Cronbach Alpha reliability coefficient of the scale is 833.

Findings

We initially ask students about their purpose of using computers and internet. Accordingly, the following table illustrates the responses of the participants and their rates.

Table 2
The purposes of the students for using computers and internet

	People	%
Playing games	168	34.4
Social networking sites	152	31.1
Watching movies and TV shows	83	17.0
Research and homework	84	17.2
Unanswered	10	2.0

As we can understand from the Table, the students spend their time on computers or tables to play games the most.

Table 3
Genders of the students and findings on the desire to learn coding sub-dimension

	N	Mean	Std. Deviation	Std. Error
Female	240	36.41	9.692	.626
Male	248	31.74	9.151	.581
Total	488	34.04	9.697	.439

As we can see in the Table, the desire to learn coding by female students is higher than that of males. Therefore, it appears that female students are more willing to learn coding.

Table 4
Gender of the students and variance analysis results for desire to learn coding sub-dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2658.228	1	2658.228	29.950	.000
Within Groups	43134.941	486	88.755		
Total	45793.169	487			

As can be seen in Table 4, we can say that there is a statistically significant difference between the genders of the students and their desire to learn coding at the level of $p< 0.05$.

Table 5
Gender of the students and findings on the interest to use during the classroom sub-dimension

	N	Mean	Std. Deviation	Std. Error
Female	240	34.70	6.163	.398
Male	248	31.20	6.470	.411
Total	488	34.04	6.551	.297

Similarly, the ability of female students to use the computer and programming skills during the classroom is higher than that of the male students. Even though there is a slight difference, we can say that female students have more interest in using the technology.

Table 6
Gender of students and variance analysis results for interest to use during the classroom sub-dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1486.498	1	1486.498	37.210	.000
Within Groups	19415.411	486	39.949		
Total	20901.909	487			

As we can observe in the Table 6, we can say that there is a statistically significant difference between the genders of the students and desire to learn coding at the level of $p< 0.05$.

Table 7
Gender of the students and findings for concern for anti-socialization sub-dimension

	N	Mean	Std. Deviation	Std. Error
Female	240	15.67	4.794	.309
Male	248	13.67	4.295	.273
Total	488	14.65	4.650	.211

Despite the findings above, even though the female students have higher scores for desire to learn coding and desire to use it in classroom, they have more anti-socialization concerns than the male students have. In other words, while they individually want to engage with technology, they think that they may get anti-social as they are alone. You can find the variance analysis results between the gender and concern for anti-socialization.

Table 8
Gender of students and variance analysis results for concern for anti-socialization sub-dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	483.539	1	483.539	29.950	.000
Within Groups	10048.306	486	20.676		
Total	10531.845	487			

Taking the variance analysis results, we can say that there is a statistically significant difference between the genders of the students and the concern for anti-socialization at the level of $p< 0.05$.

Table 9
Grade averages of students and their attitudes towards coding

Desire to learn coding	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	518,123	5	103,625	1,103	,358
Within Groups	44345,881	472	93,953		
Total	44864,004	477			
Interest to use in classroom	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	122.823	5	24.565	.569	.724
Within Groups	20384.049	472	43.187		
Total	20506.872	477			
Concern for anti-socialization	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	199.388	5	39.878	1.854	.101
Within Groups	10154.840	472	21.514		
Total	10354.228	477			

As we can see in the Table 9, there is no statistically significant difference between the desire to learn coding, interest to use in classroom, concern for anti-socialization sub-dimension and success averages of the students in classroom at the level of $p<.05$. In other words, the academic achievement of students does not affect their attitudes towards coding (programming) education.

Conclusion

Since the use of computers in all areas of our age, the age of science, communication era, as well as stunning developments and improvements in the information age has been raised (Arıcan, 2014). In the 21st century, schools are expected to prepare individuals to be proactive members of the knowledge economy (Soner, 2007). A decade ago, Prensky (2001) noted that the students of the day were not those for which the educational system was designed. With the increasing pace of technological development, that statement is even more true today (Manuguerra and Petocz, 2011). The use of multimedia technologies in instruction is increased in time. In many research studies, researchers conclude that these applications or software have significant effect on recall of information and on academic success (Aldağ, H. And Sezgin M.E., 2002)**.** Coding is perceived as an important competence for the development of problem solving skills in addition to logical reasoning (Kalelioğlu and Gulbahar, 2014).

It is indispensable to develop an additional curriculum based on programming and design in addition to the computer courses and current general-purpose education. In this way, students can constantly use these tools in the school to improve their digital literacy, increase their motivation for school and courses. Furthermore, problem solving and analytical thinking skills and learning by doing and learning by teaching computer habits and culture can be developed (Akpınar and Altun, 2014).

As mentioned in the study, it is expected that having coding skills will become a highly significant ability for the employees in all industries in the 21st century. What is more, taking the research results into consideration, even though the use of technology is usually attributed to the males or considered as an area that primarily interests them, females having higher interests in learning to code (programming) and willing to use it indicates that there may be substantial steps to take in providing the equality of opportunity for females to take part in education and work life in the future.

"Attitude Scale on Learning Coding" was applied to secondary school students in the study. Concern levels of 488 students who participated in the research were measured regarding the desire for learning coding, the interest in the usage of computer games for educational purposes in lessons and anti-socialization ability of computers.

Firstly, when the findings are reviewed, the majority of the students (96.9%) stated that they had their own computers outside the school. Thus, their ability use computers do not pose an obstacle for the usage of information-communication technologies within education or difficulty in terms of teaching the lesson. In addition, the fact that contents of the courses were uploaded on the tablet computers given to students by the school in the Secondary School of Yakın Doğu Koleji, where the research was conducted, helps students to reach the resources and also makes it

easy to repeat the contents at home, study the subject in case of absenteeism or contact the course teacher.

When the success levels of the participating students are seen and the coding-assisted and multimedia-oriented education they receive is taken into account, it can be said that the grade point average of the majority (27%) ranges between 80-89 and the group with the least average (49 and below) is a very small one with 4.3%. Considering that coding education mainly aims at teaching software programming by playing games, it can be accepted as an advantage that a great part of the participants (34.4%) in the research used the internet and computers mostly for playing games, because coding education present the aim of understanding the game softwares and hence creating their own game, that is, their own software or program to the students as per the age groups and bring the users close to the "computer language".

As seen in the Findings section, the attitudes of the students towards learning coding were measured separately depending on the gender factor. Moreover, the proportions of the female and male students, which were quite close to each other, (49% female students, 51% male students) enabled significant assessment of the results.

Also, a statistically significant difference was found at the level of $p< .05$between the students' genders and desires to learn coding in the analyses. Accordingly, the scores of the students' desires to learn coding were generally high, and the scores of the female students were found higher than those of male students. In fact, both in terms of education and making use of leisure time, it is a widely accepted idea in the society that men are more interested in using computers and technology. However, according to the results of the research, the high calculation of the desire and ability levels of the female students in terms of using computers and technology, as opposed to what was anticipated, should be considered as a both hopeful and gratifying situation for both today and future, because the participation of women in employment is accepted as a policy supported in the whole world and every area in today's societies, and education appears as the main condition for ensuring it. Thus, it is of great importance to ensure equal opportunities and to guide tendencies in this direction from an early age.

As mentioned above, coding education aims to improve software or, in other words, programming competence with various tools (game, math, etc.). In this context, it can also be adapted to course contents or applied to a part of the course. When considered in terms of students, it is important whether they want to use coding within the course. Regarding the findings, a statistically significant difference ($p< .05$) was found between the students' genders and interests in using coding within the course. Similarly to the results above, the interest of the female students in using computers and the ability to programming within the course is higher than male students. This result is not surprising considering that the scores of the desire to learn coding is higher for female students. However, since the difference is not very high, it is seen that all students have high scores of the interest in using computers and coding within the course. This finding suggests that students also want to see technology within the education system.

In addition to the widespread opinion that men use technology and computers more effectively, the idea that the intensive use of computers and technology will lead to anti-

socialization is another topic that is frequently discussed. Another sub-dimension of the "the attitude scale on coding" used in the research is the concern of anti-socialization.

In the light of the previous findings, both the high sub-dimension scores of the interest in using them within the course and the high sub-dimension score of the desire to learn coding creates an expectation towards the calculation of lower scores in terms of anti-socialization concern. However, when the findings are analyzed, it is seen that the scores are at similar levels with the other sub-dimension scores. In other words, students think that they might be anti-socialized because they are lonely although dealing with technology is desirable on the individual basis.

When the results are evaluated according to the gender factor, a statistically significant difference is similarly observed at the level of $p < .05$. Again, the female students' scores of the sub-dimension of anti-socialization concern are calculated higher compared to male students. In other words, female students are more worried about anti-socialization than male students.

This finding suggests that students are not sufficiently informed in terms of the use of coding education and information-communication technologies in education, or that students are not sufficiently informed about the reasons and consequences of this matter in this institution where tablet computers are actively used in education.

In the first chapters of the study, it is stated that the coding supports many traits such as creativity, fast decision-making, effective use of time, problem solving skills. Because the Secondary School of Yakın Doğu Koleji, where the field study was conducted, is a school that uses technology in education quite intensively and include learning coding in their curricula from the pre-school period onward, this support is very important. However, the findings of this study indicate that information is provided insufficiently regarding the aims of the coding education such as the reason behind this education, its significance and where it will be used. In this sense, providing necessary information is thought to increase the desires, expectations and contributions of the students.

Coding, which is one of the qualifications of the future working life to be sought, is considered as a necessary and important element as learning a foreign language even today. Nowadays, technology has increased its influence over time with the integration of information and communication technologies into every area of life and the necessity of learning coding is becoming a more and more interesting topic. In order to produce something in the 21st century, which is also called the technological era, starting to learn coding at an early age will provide various advantages in terms of both job opportunities and contributions to economy in the future and it appears as a qualification which could help the individual move ahead of the others at the beginning of his working life. Furthermore, coding also makes significant contributions to understanding what is going on around us in the process of the digitalization of our period. Coding can be described as an instrument which helps making right decisions during the decision-making phase, enables acquiring high living standards, improve the problem-solving skill and enhances creativity. This instrument is also necessary to use the technology consciously and produce useful products. Learning coding will be an immense investment in

preparations for the future regardless of the age. In this way, the foundation of a society, which not only uses information and communication practices but also adapt them to necessary fields and produce information, will be laid. Beside having coding knowledge and skills and developing necessary skills about how a present or possible problem can be solved in the shortest way in terms of the adaptation of the information, their integration into education is of great significance for gaining skills in many fields such as mathematics, physics, health, production etc. It is thought that coding education, which has become an important part of education in many developed countries, should start at a very early age. Yakın Doğu Koleji and some other private schools are noticing the importance of the topic day by day and take great steps to improve it. Children must be provided with the coding logic at an early age and the necessity and achievements of this education must be explained to them clearly so that we can talk about the success of the local softwares in the future and also become a part of the technological era.

Visual programming languages, which are very easy, understandable and entertaining for students who start coding at an early age, are of great importance since they are expected to make the lessons more enjoyable and amusing thanks to the games and increase the interest and attitudes of the students towards the lesson. Therefore, coding learning has started to be included in curricula in Turkey and the Turkish Republic of Northern Cyprus as in many countries in the world.

To summarize in the light of all these data, these technologies have begun to be used more and more extensively within the educational system together with the rapid change in information technologies. Consequently, the integration of these technologies into our lives necessitated the production of new softwares in this field. In order to meet this need, bring up a productive and creative generation, it requires giving individuals coding education from an early age on. Thanks to coding education, a productive generation will grow up and the need for staff trained in the field of programming will be eliminated. Furthermore, it is thought that the coding skill will also encourage young learners to develop positive attitudes towards school and lessons and to do research. As mentioned above, the problem solving, numerical thinking, spatial and analytical thinking skills of students who learn coding are also developing.

Finally, the scale used in the research was adapted to Turkish in 2016. Therefore, it is seen as a new research area in terms of subject. In the literature review performed within the scope of this study, it was seen that there are few academic studies on coding education. In this respect, it is thought that following studies must measure the attitudes towards the above-mentioned informing process, the purpose behind its inclusion in the education and its necessity for the educators and they will also make contribution to the field. In addition, it will be possible to obtain the expected benefits from the coding education when information and communication technologies are integrated into education, coding education is approached as a policy, contents of the information technologies and programming course are provided at an equal level in all the schools, the necessary technological environments are provided for the lesson, teachers are informed about the developing technologies, they are encouraged to participate in the relevant courses and parents are informed about the importance of coding as well.

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