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Analysis of the relation between computational thinking skills and various variables with the structural equation model

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ABSTRACT

The aim of this study is to determine how much various variables explain students' computational thinking (CT) skills. Furthermore, it was aimed to produce a model that explains and predicts the relations between computational thinking skills and various variables. Study group consists of 156 students who were studying in 5–12. Class in 2015–2016 academic year in different schools in Ankara. Relational screening model was used in this research. Two different data collection instruments were used in this research. The first one is "Personal Information Form". The second one is "Computational Thinking Skills Scale". Structural Equation Model was used in data analysis so as to produce a model that explains and predicts the relations between computational thinking skills and various variables. According to research results, it was found that computational thinking skill was highly predicted by variables, respectively; "thinking styles, academic success in mathematic class, attitude against mathematic class".

1. Introduction

Developments in computer science have brought about profound effects in economic and social life. Today, however, almost everyone, regardless of age, is expected to have some basic computing skills in parallel with the emerging developments in technology (Wing, 2014). Darling-Hammond (2008, pp. 1–9) emphasizes that we should prepare students for the future as individuals who have the competencies to use undiscovered technologies that we do not currently know in order to solve problems. In this context, it is natural that there are differences in competencies and anticipations expected from individuals. In addition to these stunning developments in technology, it is emphasized that people from all age groups should possess some computational skills at a basic level. (Kalelioğlu, Gülbahar & Kukul, 2016). At the bottom of this assumption the finding which states that individuals have to use digital technologies by critically thinking in order to acquire knowledge and skills and to solve the problems that they confront both in their educational and everyday lives lies (Wing, 2006); As Wing (2006) notes related to the skill of computational thinking, "Ubiquitous computing was yesterday's dream that became today's reality; computational thinking is tomorrow's reality. In this context, Wing (2014) considers that

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computational thinking skills are essential for every individual towards the mid-21st Century, such as reading, writing and basic mathematics skills.

Computational thinking is not a new concept; it is an important skill that has been emphasized in the context of computer science since the 1960s (Denning, 2009; Grover & Pea, 2013). Early on, CT had been seen as a proficiency to be acquired by computer scientists, which is considered important in the history of computer science yet this mentality has been changed especially by Wing's (2006) determination that CT is one of the basic competencies that everyone should acquire. The determination made by Wing has been responded within a very short period of time and has found a place in the literature broadly (Grover & Pea, 2013). At the same time, there are a number of institutions that develop international standards in the field of education (The International Society for Technology in Education [ISTE], Computer Science Teachers Association [CSTA], The National Research Council [NRC]), policy makers and large scale companies (Google, Microsoft etc.) have supported this idea and has made a great contribution to considering CT as a competency that should be acquired by everyone even at the basic level and as an important 21st century skill that is important in terms of the preparing individuals for the future world. In the 21st century, it is expected from the individuals to have a productive role by using technologies that exist instead of being the ones who consume technology (Kalelioğlu, 2015; Resnick et al., 2009). In this framework, it can be said that development of individuals' creativity and problem-solving skills should be improved. Kong (2016) stated that the development of computational thinking has become essential for young people in order to raise a future generation that acquires skills of creativity and problem-solving in conjunction with technology. In this context, ISTE (2011) emphasizes that young people should be prepared to become computational thinkers who understand how tomorrow's problems can be solved by using present-day technologies. Thus, it can be said that the CT related skills can improve the problem solving and critical thinking ability by benefitting from the power of information processing. In addition, CT has the potential to expand its capacity and ability to resolve individuals' problems unprecedentedly (ISTE, 2011). On the other hand, it can be said that CT competence has a remarkable impact on performing daily activities -that information technologies are used to perform-more effectively (Lee, Mauriello, Ahn, & Bederson, 2014). In this context, it can be said that the acquisition of CT skills during education and training process and the determination of the factors that are effective in the skill acquisition process have a great importance. When the literature has been examined, it has been seen that there are gaps related to this subject. From this point of view, the focus of this study is on the impact of various factors at the K5-12 level on the CT skill level.

1.1. What is CT? definition and scope

The concept of 'computational thinking' has become popular with the view that claimed by Wing (2006) which is "computational thinking represents applicable attitude and skill set for everyone, not just computer scientists". However, there is still no consensus on the definition of the concept of computational thinking, and discussions on this definition process are still in progress (Barr & Stephenson, 2011; Brennan & Resnick, 2012; Grover & Pea, 2013). Wing (2014) refers to the concept of computational thinking as an abbreviation for thinking like a computer scientist in the face of problems. In this context, Wing (2006) for the first time identified CT in 2006 as a thinking set that includes understanding problems with appropriate presentation styles, rationalizing these issues through abstraction and developing automated solutions for them.

Later on Wing (2014) have developed this definition and expressed CT as a thinking process that includes the formulation of problems as a computer can effectively perform and expression of the solutions/solutions. In another definition, Kalelioğlu (2015) defined the skill of computational thinking by using the mental abilities of; ability of individuals to generalize problem solving process in accordance with the information processing processes to other problems, automating the solution processes by thinking algorithmically, transforming the information by organizing and analyzing, abstracting information through computer applications, ability to use abstraction and modelling skills consecutively.

ISTE and CSTA (2011) defines computational thinking skill as a reflection of algorithmic thinking, creative, logical thinking and problem solving skills. NRC (2012) suggests mathematics and computational thinking as main practices within K-12 science education. Considering these definitions, the relation of computational thinking skill with numerous variables is communicable. A descriptive list of computational thinking characteristics determined by the ISTE together with CSTA is presented in Fig. 1 (ISTE & CSTA, 2011).

Although there are different efforts to define the term and there is no consensus on different definitions, there is a general acceptance that CT skills cover the concepts of "abstraction, algorithmic thinking, problem-solving, decomposition, generalization, and debugging" (Sarıtepeci & Durak, 2017). In support of this, Kalelioğlu, Gülbahar and Kukul (2016) have formed a word cloud in relation to the explanations about computational thinking in their work and have found that the data words that are most used in terms of defining the process of computation thinking in the literature are "abstraction, problem, solving, algorithmic and thinking.

1.2. The role of gender and educational level variables in CT skills

It can be said that gender and education level are two of the variables that should be taken into account in terms of acquiring and developing CT skills. It can be said that there is a conviction that the gender factor is effective in regards to the development of the CT skills, which is used as a concept related to general computer science. It can be argued that the most remarkable reason that constitutes this conviction is the influence of gender roles on attitudes towards technology (Stein & Nickerson, 2004). The concept of technology mentioned in this context generally corresponds to programming activities