# *Examining 21st Century Skill Levels of Students and the Relationship between Skills*

***Koçak, Ömer, Ataturk University, 0000-0001-7756-7169***
***Göksu, İdris, Mardin Artuklu University, 0000-0002-7120-6562***

**Abstract**

*In this study, it is aimed to determine the skill levels of 21st century learners and the relationship between these skills. The sample of this study, which is conducted with correlational research design, was determined by the convenient sampling method. The participants of the study consisted of 183 students in total studying at Atatürk University. Correlational and descriptive analysis techniques were used to analyze the data which was collected via Computational Thinking Scale, Digital Literacy Scale and Effective Communication Skills Scale. When the descriptive findings were examined, it was understood that the students generally had most of the skills but experienced ambivalence about the algorithmic thinking skills. As a result of the correlation analysis, it was found that critical thinking, problem solving, creativity, empathy and active-participative listening were significantly related to all variables. On the other hand, digital literacy skills were found to be significantly correlated with all variables examined in the scope of the study, except I-language. It was determined that the relationship between ego supportive language, active-participative listening, self-recognition/self-disclosure, and I-language skills and algorithmic thinking was not significant. The variables with the highest correlation coefficient were found to be creativity and critical thinking.*

**Keywords:** *21st century skills, learner skills, correlational research, algorithmic thinking, digital literacy*

İnönü University
Journal of the Faculty of Education
Vol 21, No 2, 2020
pp. 772-784
DOI: 10.17679/inuefd.656784

Article type:
Research article

Received : 08.12.2019
Accepted : 14.07.2020

**Suggested Citation**

Koçak, Ö. & Göksu, İ. (2020). Examining 21st century skill levels of students and the relationship between skills. *Inonu University Journal of the Faculty of Education*, *21*(2), 772-784. doi: 10.17679/inuefd.656784

## INTRODUCTION

The continuous development of technology, especially in today's world, has led to changes in the skills that individuals are expected to possess. It is unlikely that individuals who do not have these skills will be successful in both education and business life. In addition to having these skills, it is seen that it is more important to use information than to access information; because the newly grown individuals of today's society are not seen as passive consumers of knowledge, but especially as a new generation born with technology (Prensky, 2001), they are seen as producers of knowledge through technological tools (van Laar, van Deursen, van Dijk, and de Haan, 2019). In today's world where knowledge production plays a key role, it is important for individuals to have some basic skills to be present in the business world, to carry themselves safely into the future, or to "survive"; because individuals have to acquire skills and prepare themselves for various professions that arise or may emerge over time as a result of rapidly developing and changing conditions rather than existing conditions (van Laar et al., 2017); because it is foreseen that these professions that may arise will require the collation of information, and complex and high-level thinking skills in addition to basic thinking skills (Ekici, Abide, Canbolat, and Öztürk, 2017; Trilling and Fadel, 2009). This situation can be expressed as preparation for the occupations and problems that do not exist yet.

In a global world where information and communication technologies are developing rapidly, these technologies cause a continuous change and development from daily life to business life, from school culture to learning environments. For example, it is seen that the professions requiring physical labor and repetitive tasks have decreased considerably but the occupations requiring mental effort have increased compared to the past (Voogt and Roblin, 2012). Although this comprehensive knowledge, skills and features, which have an important role in individuals' building their future successfully, are defined in different ways (Marbach-Ad, Hunt, and Thompson, 2019), they are commonly referred to as 21st century skills (McGunagle and Zizka, 2020). Especially after the 2000s, the acquisition and providing of these skills has become very important. In order to become an effective citizen, student in the information society or an effective employee in the business world, it is necessary to have these skills (Siddiq, Gochyyev, and Wilson, 2017).

Today, a world of innovation and knowledge-based economy has created a structure where there is more intense competition, jobs become more complex, and collaboration and social networks are pioneers in relationships (Kay and Greenhill, 2011). In order to keep up with all these changes and transformations, educational institutions are making reforms to acquire 21st century skills (Dass, 2014). The necessity of acquiring 21st century skills is based on some basic reasons. The first of these is the fact that rapidly developing technology changes the nature of learning. 21st century skills create new student standards by integrating key topics and contemporary content. These skills can be developed with the learning environment and teacher competence (Ledward and Hirata, 2010). In this direction, various organizations, institutions and organizations conduct researches and analyses in order to reveal what kind of skills educational institutions should provide students. Most countries have tried to demonstrate the skills expected to be in their citizens in their own way. For example, the United States, through The Partnership for 21st Century Skills (P21), aims to prepare its students for today's world, which is thought to be highly competitive (Bell, 2016). In this direction, other organizations such as The Partnership for 21st Century Skills, International Society for Technology in Education (ISTE), Applied Educational Systems (AES), Queensland Curriculum and Assessment Authority (QCAA), and The Assessment and Teaching of 21st Century Skills (ATC21s) have tried to present the skills necessary for the 21st century from various perspectives (Siddiq et al., 2017; van Laar, van Deursen, van Dijk, and de Haan, 2020). Table 1 presents the 21st century skills demonstrated by various organizations (Binkley et al., 2014; Cogan-Drew, 2010; International Society, 2007; Partnership for 21st Century Learning, 2015; Thoughtful Learning, 2018).

**Table 1.** 21st Century Skills by Various Organizations

| | P21 | ATC21S | ISTE | AES | QCAA |
|---|---|---|---|---|---|
| Information literacy | ✓ | ✓ | ✓ | ✓ | |
| Computational Thinking | | | ✓ | | |
| Environmental literacy | ✓ | | | | |
| Digital citizenship | | | ✓ | | |
| Critical thinking | ✓ | ✓ | ✓ | ✓ | ✓ |
| Flexibility | ✓ | | | ✓ | |
| Financial and economic literacy | ✓ | | | | |
| Entrepreneurship | ✓ | | | ✓ | ✓ |
| Communication | ✓ | ✓ | ✓ | ✓ | ✓ |
| Collaboration | ✓ | ✓ | ✓ | ✓ | ✓ |
| Decision making | | ✓ | ✓ | | |

| | | | | | |
|---|---|---|---|---|---|
| Global awareness | ✓ | | | | |
| Global citizenship | | | | | ✓ |
| Leadership | ✓ | | | ✓ | |
| Media literacy | ✓ | | | ✓ | |
| Learning to learn (Metacognition) | ✓ | | | ✓ | |
| Problem solving | | ✓ | | | |
| Health literacy | ✓ | ✓ | ✓ | | |
| Responsibility | ✓ | | | | |
| Social skills | ✓ | ✓ | | | |
| Technology literacy | ✓ | | | ✓ | ✓ |
| Productivity | ✓ | ✓ | ✓ | ✓ | ✓ |
| Citizenship literacy | ✓ | | | ✓ | |
| Creativity | ✓ | | | | |
| Lifelong learning | | | | | |
| Innovation | ✓ | ✓ | ✓ | ✓ | ✓ |

When the skills presented in Table 1 are examined; skills such as collaboration, communication, digital literacy, citizenship, problem solving, critical thinking and creativity are seen in almost all organizations (Voogt and Roblin, 2012). These skills vary slightly across the target audiences. Especially the characteristics of the learners who came to the world in the 21st century and who should be prepared for the learning environment in accordance with the conditions of this age and the teachers who should plan the learning environment according to these learners are different from each other (Orhan Göksün and Aşkım Kurt, 2017). Some of the skills that are included in the scope of this study are presented below with different headings in line with the targeted skills of 21st century learners.

**Digital Literacy:** Individuals who have the necessary technical knowledge and skills to use information technologies, access, evaluate, produce digital information and use the internet network for communication, socialization and learning are defined as digital literacy (Ustundag, Gunes, and Bahcivan, 2017). Therefore, digital literacy should not be considered as just using technology. Digital literacy also requires social and cognitive skills (van Laar et al., 2017). As can be seen from this definition, it is very important to educate students who can use digital technologies in line with their needs in today's world.

**Effective Communication:** Communication can be defined as the process of message transfer and interacting effectively between individuals. Five basic skills can be mentioned in order to carry out this interaction process effectively. The first of these skills is *the ego supportive language*. This skill can be expressed as the ability of the individual to highlight his/her positive trait. The second skill, *active-participative listening*, is defined as the individual's participation in the communication process with sufficient motivation and attention. Another skill, *self-recognition/self-disclosure*, is the self-expression of an individual in a clear and transparent way. Another one of the important skills necessary for effective communication is *empathy*. *Empathy* is defined as the ability to try to understand the other person's feelings and thoughts. Finally, *I-language skill* can be expressed as explaining the unwanted effects of behaviors exhibited by others to those who exhibit behaviors (Buluş, Atan, and Sarıkaya, 2017).

**Creativity:** Creativity is often expressed as producing or developing new ideas. It is often stated that the ideas produced should be useful for that situation. In addition, it is seen as the first stage of creativity, especially when thinking differently from traditional thinking (Ramankulov, Dosymov, Mintassova, and Pattayev, 2019). Creativity is seen as a part of general intelligence and a field it is related to. Because mostly individuals with a high level of intelligence are more creative (McCrae and Ingraham, 1987).

**Algorithmic Thinking:** Algorithm can be defined as the sequence of logical steps created for the intended result (Katai, 2015). Algorithmic thinking can be thought as an individual's development of solution methods for the targeted result and putting the solution stages in order to achieve the goal (Korkmaz, Çakir & Özden, 2017). Algorithmic thinking does not require computer or mathematical skills. Therefore, it can also be considered as formulating abstract events into steps (Doleck, Bazelais, Lemay, Saxena, and Basnet, 2017). In this context, it can be said that algorithmic thinking is necessary not only for those who are interested in computer science, but for everyone (Kiss, 2013).

**Problem Solving:** Problem solving, which is one of the most important and necessary skills in daily life, can be considered as the ability to cope with the difficulties and problems faced by individuals. The past knowledge and experience of the individual also contributes significantly to the problem-solving skill, which is a cognitive process in general (Yurtseven and Doğan, 2019). Problem solving should not only be considered as solving mathematical problems just like algorithmic thinking (Gürbüz, Evlioğlu, Erol, Gülseçen, and Gülseçen, 2017), but it should also be considered as solving the algorithmic process developed for the problems faced by the individual in social sense.

**Critical Thinking:** In addition to being an art of thinking, critical thinking can be considered as better, more consistent, more accurate and clear thinking. Critical thinkers are defined as open-minded individuals who are generally curious and patient when confronted with complex events and who can postpone their decision when necessary and approach more positively to different views and perspectives (Profetto-McGrath, 2003). In today's world, it is very important that the new generation should get rid of ordinary thinking and has a critical way of thinking when it is considered that the problems that may be encountered in the future are not known or understood.

**Cooperativity:** In collaborative learning, a person is responsible for his or her own learning as well as the learning of other friends in the same group or working with. People who work with a commitment to a common goal motivate each other. Collaborative learning should not be perceived as acting only with the group and should not be considered as group activity alone. In cooperative learning, individuals in the group have positive interdependence with each other. They also take on individual responsibilities and evaluate the process of being a group by considering supportive face-to-face communication. One of the other benefits of collaborative learning is that it contributes to the acquisition of social skills (Turgut and Turgut, 2018).

In the literature, various researches have been made on 21st century skills and some studies focus on developing tools suitable for measuring these skills as a whole (Boyaci and Atalay, 2016; Ongardwanich, Kanjanawasee, and Tuipae, 2015), while some others aim to develop these skills (Nouri, Zhang, Mannila, and Norén, 2019; Piniuta, 2019). In addition to organizations aiming at identifying 21st century skills, research on this topic suggests that the skills examined in general are similar (Jia, Oh, Sibuma, LaBanca, and Lorentson, 2016).

van Laar et al. (2017) conducted a systematic review of research on digital and 21st century skills and concluded that 21st century skills are more comprehensive than digital skills and that 21st century skills do not need to be supported by digital technologies. Tican and Deniz (2019) found that university students have cognitive, independent, collaborative/flexibility and innovation skills as 21st century skills. It was also concluded that the learner skills are related to each other at medium and large levels. In the study of Orhan Göksün and Aşkım Kurt (2017), which examined the same skills as Tican and Deniz (2019), it was concluded that students mostly have 21st century skills. Van Laar et al. (2019) received the opinions of individuals in business life about the 21st century skills, and reached the result that knowledge management and knowledge evaluation skills are at a high level. Moreover, they found that the sub-dimension of self-expression was higher than other skills, especially in the communication dimension. It was concluded that the level of having some other communication sub-dimensions is less than the others.

When the researches in the literature are examined, it is seen that it is mostly tried to determine 21st century skills (van Laar et al., 2017) that the scales to measure 21st century skills are developed (van Laar et al., 2019) or that modeling studies with 21st century skills have been done (Orhan Göksün and Aşkım Kurt, 2017). Therefore, it can be said that the studies conducted to reveal the relationship between 21st century skills are limited and more studies are needed on this subject. In this study, it is considered to be important to reveal the level of relationship between 21st century skills. Correlational research is important in terms of making predictions, determining prevalence and directing experimental studies based on the relationships between variables. (Curtis, Comiskey, and Dempsey, 2016). In this study, it is aimed to reveal how these skills change each other by examining the level of relationship between 21st-century skills, which are thought to deeply affect students' future work lives (Hewett, Zeng, and Pletcher, 2020). Thus, by determining which skills are strong or weak, holistic approaches can be developed to develop these skills that are strong and weakly related. Though it is often mentioned in the literature that these skills are necessary for the 21st century, it is seen that the studies dealing with the interrelation of these skills as a whole are limited. Accordingly, our study has two main objectives. The first aim is to determine the level of 21st century skills of the students. The second objective is to determine the level of relationship between 21st century skills.

## METHOD

### Research Design

In this study, the correlational research design was preferred among non-experimental designs, one of the quantitative research methods (Price, Jhangiani, Chiang, Leighton, and Cuttler, 2017). In the correlational research design, the participants are not intervened and this research design is preferred to examine the possibility of the relationship between the two variables (Fraenkel, Wallen, and Hyun, 2011). In this study, correlational research design was preferred because it was aimed to reveal whether there is a relationship between 21st century skills and the size and direction of the relationship. In this study, it was investigated whether there is a relationship between the variables obtained through the scales.

### Participants

The participants of the study were determined by using convenient sampling method. The primary purpose of the convenient sampling method is to reveal the relationship between the variables in a more understandable way, not generalizability. In addition, this sampling method was preferred because it provides time and cost advantage in terms of being accessible and suitable for researchers (Mcmillan and Schumacher, 2013). In this context, 183 undergraduate students studying at various disciplines of social sciences at Atatürk University constitute the participants of this research. 61 of the participants are male and 122 are female with 19-24 age range. Distribution of the participants regarding gender, grade, and age are given in Table 2.

**Table 2.** Demographic Characteristics of the Participants

| | n | % |
|---|---|---|
| **Gender** | | |
| Male | 61 | 33.3 |
| Female | 122 | 66.7 |
| **Grade** | | |
| 2. Grade | 88 | 48.1 |
| 3. Grade | 18 | 9.8 |
| 4. Grade | 77 | 42.1 |
| **Age** | | |
| 19-21 | 81 | 44.3 |
| 22-24 | 102 | 55.7 |
| **Total** | 183 | 100 |

**Data Collection Tools**

In this study, three different data collection tools that are valid and reliable have been used. *Dijital Literacy Scale*, which was developed by Ng (2012), was preferred to determine the level of digital literacy. This scale is one-dimensional (α=0.86) and it is adapted to Turkish by Ustundag et al. (2017). *The Computational Thinking Scale (CTS)*, which was developed by Korkmaz, Çakir and Özden (2017), was used to determine the level of creativity, collaboration, problem solving, critical thinking and algorithmic thinking of the students. Since the *CTS*, which was developed in Turkish and whose validity and reliability (α=0.82) was developed in accordance with university students, no analysis of the scale's adaptation has been made. The dimensions of creativity, collaboration, problem solving, critical thinking and algorithmic thinking are the sub-dimensions of *the CTS*. Due to the fact that these dimensions had original scales in the literature but that many skill levels need to be measured and that the possibility of the number of questions was high in this study, *CTS* was preferred. In order to measure communication skills, *Effective Communication Skills Scale*, which was developed in Turkish by Buluş, Atan and Sarıkaya (2017), was used. Since this data collection tool was developed for university students, no adaptation process was performed. As the scale consists of five sub-dimensions (α=0.73-0.85), the relationship between the dimensions and other skills was considered separately. The dimensions and reliability coefficients of the scales are presented in Table 3. The reliability coefficients obtained in both this study and the original study are given in Table 3. It is seen that the reliability coefficients obtained in our study are close to the reliability coefficients in the original study. In addition, it was found that all dimensions except for using the I-language were over 0.75. In the literature, it is stated that the reliability coefficient above 0.75 is generally accepted well and that the reliability coefficient between 0.5 and 0.75 is moderately reliable (Brownlow, Hinton, and McMurray, 2014).

**Table 3.** Number of items and reliability coefficients (Cronbach's alpha) of dimensions

| | | **Number of Items** | **Original Study** | **This Study** |
|---|---|---|---|---|
| 1 | Digital literacy | 10 | 0.86 | 0.82 |
| 2 | Ego supportive language | 6 | 0.72 | 0.80 |
| 3 | Active-participative listening | 8 | 0.84 | 0.89 |
| 4 | Self-recognition/Self-disclosure | 5 | 0.76 | 0.75 |
| 5 | Empathy | 8 | 0.85 | 0.88 |
| 6 | I-Language | 7 | 0.83 | 0.50 |
| 7 | Creativity | 8 | 0.84 | 0.86 |
| 8 | Algorithmic thinking | 6 | 0.87 | 0.91 |
| 9 | Collaboration | 4 | 0.87 | 0.89 |
| 10 | Critical thinking | 5 | 0.78 | 0.80 |
| 11 | Problem solving | 6 | 0.83 | 0.78 |

**Data analysis**

The data obtained in this study were analyzed using descriptive and inferential statistical analysis methods. Findings obtained during descriptive analysis the values were evaluated as follows: 1.00 – 1.79 value range "strongly disagree", 1.80 – 2.59 value range "disagree", 2.60 – 3.39 value range "neutral", 3.40 – 4.19 value range "agree", 4.20 – 5.00 value range "strongly agree". Before determining the level of the relationship between the variables, it was checked whether the data were distributed normally or not, and the data was determined not to show normal distribution. Missing and inaccurate data are not included in the analysis and non-parametric analysis method was preferred for the analysis of data which is not normally distributed. Spearman rho correlation analysis technique, which is one of the statistical analysis techniques, was used because the data were not distributed normally (Kalaycı et al., 2014). If the correlation coefficient is between 0.1 and 0.3, it is interpreted as low; if it is between 0.3 and 0.5 it is interpreted as medium; and if it is over 0.5, it is interpreted as a high-level relationship.

## RESULTS

Descriptive data obtained from students regarding their level of having the 21st century skills are presented in Table 4. When Table 4 is examined, it is found that all the skills of the participants are "agree" except the algorithmic thinking skills and active-participative listening skills. That is, the students stated that they had the skills of digital literacy ($\bar{X}$=3.55, *SD*=0.53), ego supportive language ($\bar{X}$=3.99, *SD*=0.56), self-knowledge / self-disclosure ($\bar{X}$=3.62, *SD*=0.75), empathy ($\bar{X}$=3.95, *SD*=0.53), I-language ($\bar{X}$=3.66, *SD*=0.50), creativity ($\bar{X}$=4.10, *SD*=0.59), collaboration ($\bar{X}$=3.69, *SD*=0.86), critical thinking ($\bar{X}$=3.61, *SD*=0.72) and problem-solving skills ($\bar{X}$=3,45, *SD*=0.70). The students stated that they certainly had active-participative listening ($\bar{X}$=4.25, *SD*=0.55) skill. However, it was found that they were undecided about whether they had algorithmic thinking ($\bar{X}$=3.07, *SD*=0.95) skill.

**Table 4.** Descriptive Data on Dimensions

| **Dimension** | $\bar{X}$ | **SD** |
|---|---|---|
| Active-participative listening | 4.25 | 0.55 |
| Creativity | 4.10 | 0.59 |
| Ego supportive language | 3.99 | 0.56 |
| Empathy | 3.95 | 0.53 |
| Collaboration | 3.69 | 0.86 |
| I-language | 3.66 | 0.50 |
| Self- recognition / Self- disclosure | 3.62 | 0.75 |
| Critical thinking | 3.61 | 0.72 |
| Digital literacy | 3.55 | 0.53 |
| Problem solving | 3.45 | 0.70 |
| Algorithmic thinking | 3.07 | 0.95 |

The relationship between the dimensions was examined in line with the data obtained from the students and the findings were presented in Table 5.

**Table 5.** Correlations between Dimensions

| | | Digital Literacy | Ego Supportive Language | Active-Participative Listening | Self-recognition /Self-disclosure | Empathy | I-Language | Creativity | Algorithmic Thinking | Collaboration | Critical Thinking | Problem-Solving |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Digital Literacy** | r | 1.00 | | | | | | | | | | |
| | p | . | | | | | | | | | | |
| **Ego Supportive Language** | r | 0.19** | 1.00 | | | | | | | | | |
| | p | 0.00 | . | | | | | | | | | |
| **Active-Participative Listening** | r | 0.19* | 0.43** | 1.00 | | | | | | | | |
| | p | 0.01 | 0.00 | . | | | | | | | | |
| **Self-recognition /Self-disclosure** | r | 0.14* | 0.22** | **0.51**** | 1.00 | | | | | | | |
| | p | 0.04 | 0.00 | 0.00 | . | | | | | | | |
| **Empathy** | r | 0.34** | **0.52**** | **0.55**** | 0.39** | 1.00 | | | | | | |
| | p | 0.00 | 0.00 | 0.00 | 0.00 | . | | | | | | |
| **I-Language** | r | 0.07 | **0.50**** | 0.38** | 0.38** | 0.44** | 1.00 | | | | | |
| | p | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | . | | | | | |
| **Creativity** | r | 0.30** | 0.39** | **0.51**** | 0.45** | **0.53**** | 0.40** | 1.00 | | | | |
| | p | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | . | | | | |
| **Algorithmic Thinking** | r | 0.15* | 0.00 | 0.04 | 0.06 | 0.20** | 0.05 | 0.31** | 1.00 | | | |
| | p | 0.03 | 0.95 | 0.55 | 0.37 | 0.00 | 0.46 | 0.00 | . | | | |
| **Collaboration** | r | 0.20** | 0.25** | 0.28** | 0.25** | 0.35** | 0.21** | 0.31** | 0.28** | 1.00 | | |
| | p | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | . | | |
| **Critical Thinking** | r | 0.32** | 0.26** | 0.37** | 0.32** | 0.48** | 0.25** | **0.64**** | 0.49** | 0.35** | 1.00 | |
| | p | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | . | |
| **Problem-Solving** | r | 0.25** | 0.19** | 0.34** | 0.35** | 0.44** | 0.32** | 0.33** | 0.27** | 0.39** | 0.41** | 1.00 |
| | p | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | . |

* Significant at 0.05 level ** Significant at 0.01 level

When the relationship between the variables is examined, it is seen that the relationships are significant and there is a low, medium and high level of relationship. The relationship between some variables is seen not to be significant. It was observed that there was a significant relationship between digital literacy, ego supportive language, active-participative listening, self-recognition/self-disclosure, algorithmic thinking, collaboration and problem-solving, but that the relationship was low ($r$<0.3). The relationship between creativity, empathy, critical thinking and digital literacy was found to be moderate and significant ($0.3 \leq r < 0.5$).

The ego supportive language was found to have a moderate relationship with active-participative listening ($r$=0.43) and creativity ($r$=0.39). It was found that there was no significant relationship between ego supportive language ($r$=0.00), active-participative listening ($r$=0.04), self-recognition/self-disclosure ($r$=0.06), and I-language ($r$=0.05) and algorithmic thinking. Empathy has a significant relationship ($r$=0.20), albeit at a low level, with algorithmic thinking. It was found that the sub-dimensions of the effective communication skills scale were significantly related to each other, but that the relationship between self-recognition/self-disclosure and ego supportive language was low ($r$=0.22).

It was found that creativity had a significant relationship with all variables and that the relationship size was moderate or large ($r \geq 0.3$). Algorithmic thinking has a moderate ($r$=0.49) significant relationship with critical thinking. The relationship between creativity and active-participative listening ($r$=0.51) and empathy ($r$=0.53) was seen to be high. Creativity was also found to have a significant and high relationship ($r$=0.64) with another skill, critical thinking.

The collaboration was found to have a significant relationship with all dimensions, but it was found to have a moderate relationship with problem-solving ($r$=0.39), critical thinking ($r$=0.35), creativity ($r$=0.31) and empathy ($r$=0.35), and a low relationship with other dimensions. The relationship between collaboration and algorithmic thinking was found to be significant at a low level ($r$=0.28).

Critical thinking was found to be significantly related to all dimensions, but it was found to be moderately and highly related to all dimensions except the dimensions of ego-developing language and I-Language. In addition, critical thinking had a medium level of relationship with digital literacy ($r$=0.32), active-participative listening ($r$=0.37), self-recognition/self-disclosure ($r$=0.32), empathy ($r$=0.48), algorithmic thinking ($r$=0.49), collaboration ($r$=0.35) and problem solving ($r$=0.41), and a high level of relationship with creativity ($r$=0.64).

It is seen in Table 5 that the problem-solving dimension is also significantly related to all dimensions. It was found that there was a significant but low level of relationship between problem-solving and digital literacy ($r$=0.25), ego supportive language ($r$=0.19) and algorithmic thinking ($r$=0.27). It was determined that there was a moderate relationship between all other dimensions and problem-solving. The relationships between 21st century skills are presented in Figure 1 by visualizing the correlogram.

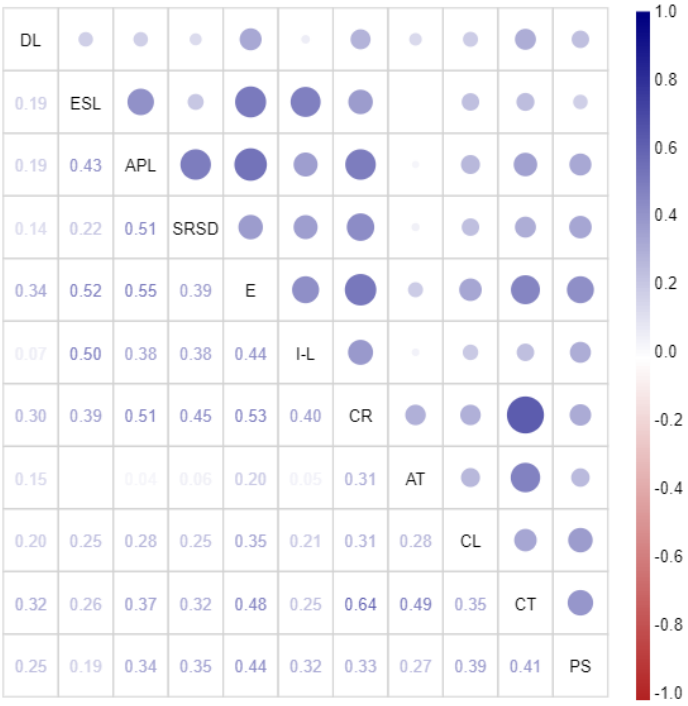

**Figure 1.** Correlogram of relations between dimensions. DL: Digital literacy, ESL: Ego supportive language, APL: Active-participative listening, SRSD: Self-recognition/self-disclosure, E: Empathy, I-L: I-language, CR: Creativity, AT: Algorithmic thinking, CL: Collaboration, CT: Critical thinking, PS: Problem-solving

## DISCUSSION

In this study, the level of the students' having 21st century skills and the relationship between these skills were examined. The descriptive findings show that students generally have 21st century skills. These findings are partly consistent with the findings of van Laar et al. (2019) on the level of having digital skills in the 21st century. The difference is thought to be due to the differences in the skills studied. van Laar et al. (2019) examined the dimensions of communication, knowledge, problem solving, critical thinking, collaboration and creativity. In our study, on the other hand, algorithmic thinking and digital literacy were discussed. However, when we look at the levels of having common skills, it is observed that students have a higher level of communication and creativity skills in our study. This is an indication that students have effective communication skills (Carey and Naudin, 2006), which are stated to be a basic ability for today. However, the reason for this difference may be since the participants in the study of van Laar et al. (2019) consisted of individuals working in the business world. Because the age range of individuals in business life is likely to be higher than the participants of our study.

It is noteworthy that digital literacy skill is significantly related to all skills except I-language skill. This finding reveals that digital literacy, which is one of the most fundamental requirements of our digital age, is related to all fields. Kim (2019) also revealed that digital literacy is correlated with many variables such as critical thinking, problem-solving, and creativity. Therefore, it may prove that it is a necessity for the technological competitive environment of the 21st century. Also, these findings can be thought to be proof that digital skills are not only technological skills but they also require cognitive and social skills, which is expressed by van Laar et al. (2017); because digital literacy is also moderately related to empathy, a social skill, and critical thinking, a high-level cognitive skill. van Laar et al. (2020), emphasize that perspectives on digital skills are not sufficiently involved in research on 21st century skills. In this regard, it can be said that this finding obtained in our study will contribute significantly to the literature.

One of the important skills that students should have in the 21st century is communication. Communication skills also play an important role in the emergence of other skills. Even communication skills can be considered as one of the most basic life skills. In the research conducted by LinkedIn Company on recruitment managers, it was found that communication and teamwork skills were the most important skills (Berger, 2016). In this respect, effective communication skills can be considered as an expected result to be significantly related to other 21st century skills. It is also expected that the sub-dimensions of the Effective Communication Skills Scale are significantly related to each other; because the scale dimensions are expected to be related to each other. The fact that all sub-dimensions of effective communication skills except empathy are not significantly related to algorithmic thinking skills may be because algorithmic thinking is an abstract skill and communication skills are mostly evaluated as social skills except empathy. On the other hand, in a recent study, communication skills have been correlated with many variables such as creativity, digital literacy and problem-solving (Kim, 2019). These results indicate that more research is needed to determine the relationships between 21st century skills.

It is noteworthy that the algorithmic thinking skill, which is thought to be important for students in the 21st century, is low in this study. This finding partially supports the results obtained by van Laar et al. (2017). Although it is stated that the ability of algorithmic thinking does not have a direct connection with mathematics or technology (Doleck et al., 2017), one reason for its being at a low level in our study may be that the participants consisted of students studying in social disciplines. The overall low level of the relationship between algorithmic thinking and other 21st century skills supports the conclusion expressed by van Laar et al. (2017) that the 21st century skills are more comprehensive than digital skills and are not a prerequisite for digital ones. On the other hand, it seems interesting that algorithmic thinking, which seems to be integrated with digital skills, has a significant but small relationship with digital literacy. This finding partially supports the finding that digital literacy, as proposed by Yadav, Good, Voogt, and Fisser (2017), is an important part of computational thinking. Also, this finding supports the conclusion that there is a

significant positive relationship between computational thinking and new media literacy obtained by Ata and Yıldırım (2020). This may be because digital literacy requires computational knowledge and algorithmic thinking is associated with high-order cognitive skills. Besides, algorithmic thinking is considered as a dimension of computational thinking. In this study, the result that algorithmic thinking has a medium level relationship with creativity and critical thinking, which are high-level thinking skills, partially supports this conclusion.

Algorithmic thinking is expected to be significantly related to problem-solving skills; because, when the definition of algorithmic thinking is examined, it is seen that it is expressed as understanding the problem and offering solutions which are the pre-stages of problem-solving (Doleck et al., 2017; Korkmaz et al., 2017). Considering this context, algorithmic thinking is seen as a necessary skill for problem-solving skills. The relationship between these two skills is expected to be higher; because the two variables are also very close to each other by definition. Algorithmic thinking is considered as a sub-element of problem-solving (Gürbüz et al., 2017). The relationship we identified in this study is based on the data we collected from undergraduate students. This relationship may differ at lower education levels. Kiss and Arki (2017) emphasize that the algorithmic thinking skills of university students do not have a background and therefore the educators should focus on such skills in high school and before educational levels.

Creativity is one of the most frequently expressed basic skills for the 21st century (Kereluik, Mishra, Fahnoe, and Terry, 2013). It is expected that the relationship between creativity and critical thinking is significant and that the relationship level is high (Eggers, Lovelace, and Kraft, 2017); because these two skills, which are called high-level thinking skills, sometimes are used interchangeably in the literature, which is not correct though, and it is seen that they have common points in their definitions. In some studies, it is stated that critical thinking is a basic skill for creativity (Eggers et al., 2017); because critical thinking requires important skills, especially analysis, evaluation and creativity (Piniuta, 2019). In this respect, the relationship between these skills, which contain similar expressions, is expected to be high. On the other hand, it is remarkable that the relationship between critical thinking and problem-solving (Boyacı and Atalay, 2016), which are accepted as the basic skills of human development and life, has emerged at a moderate level. The finding that the relationship between creativity and active-participative listening and empathy is high is also important. Although empathy appears to be a sub-dimension of effective communication in our study, it should also be remembered that it is a cognitive process (López-Fernández, Arias-Castro, González Restrepo, and García Santana, 2018). López-Fernández et al. (2018) found a significant and positive relationship between cognitive empathy and creativity as a result of their study, which is consistent with the results of our study.

It is noteworthy that the level of the relationship between the dimensions of collaboration and effective communication remained low except for the empathy dimension. The relationship between communication and collaboration (Kereluik et al., 2013), which is generally evaluated together as 21st century skills and having similar dimensions, would be expected to be higher; because communication has an important place in teamwork to create a collaborative environment that requires team spirit. Also, the fact that the dimensions of effective communication were found to be related to other areas, albeit at a small level, supports the interpretation that communication is a key feature in uncovering other skills, as stated by Korkmaz et al. (2017). Collaboration may depend on effective communication. The need for cooperation increases as the problem starts to get complicated (Doleck et al., 2017). Therefore, evaluation of cooperation, communication and problem-solving skills as a whole seems important.

## CONCLUSION AND RECOMMENDATIONS

Some of the skills that individuals should have in today's society are called as 21st century skills. These skills have been identified by various organizations. In our study, digital literacy, effective communication, creativity, collaboration, critical thinking, algorithmic thinking and problem-solving skills, which are of the 21st skills, were examined. The level of students' having these skills and the relationships between these skills were investigated. As a result of our study, it was determined that students generally have the 21st century skills. It was found that the students were undecided about whether they had an algorithmic thinking skill which is an abstract and cognitive skill. Also, most of the 21st century skills were found to be

significantly correlated with each other. It was seen that there was a moderate and high significant relationship between critical thinking, creativity, empathy, algorithmic thinking and problem-solving which require high level cognitive skills. However, it was also observed that some variables had no significant relationships with each other. It was determined that algorithmic thinking was not significantly related to the sub-dimensions of communication skills. Some variables were seen to be significantly related to each other, but the relationship was low. It is considered important to make some suggestions in line with the findings obtained in this study; because it was revealed that students mostly possessed 21st century skills but that their algorithmic thinking skills were low. For this reason, it is important to increase teaching processes to support algorithmic thinking skills. What is more, it can be said that the investigation of the extent to which the existing education and training systems or curricula are suitable for the acquisition of 21st century skills can make a significant contribution to the process. In this study, findings regarding the direction and size of the relationship between skills are presented. In line with these findings, experimental researches for developing 21st-century skills or modeling researches on the effect of 21st-century skills on academic achievement can be conducted. Also, the reasons behind the low algorithmic thinking skills of undergraduate students can be investigated.

## REFERENCES


Ata, R. & Yıldırım, K. (2020). Analysis of the relation between computational thinking and new media literacy skills of first-year engineering students. *Journal of Educational Multimedia and Hypermedia, 29*(1), 5-20.

Bell, D. V. J. (2016). Twenty-first century education: Transformative education for sustainability and responsible citizenship. *Journal of Teacher Education for Sustainability*, *18*(1), 48–56. https://doi.org/10.1515/jtes-2016-0004

Berger, G. (2016). Data Reveals The Most In-Demand Soft Skills Among Candidates | LinkedIn Talent Blog. Retrieved October 20, 2019, from https://business.linkedin.com/talent-solutions/blog/trends-and-research/2016/most-indemand-soft-skills

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2014). Defining twenty-first century skills. In *Assessment and teaching of 21st century skills* (pp. 17–66). https://doi.org/10.1007/978-94-007-2324-5_2

Boyacı, Ş. D. B., & Atalay, N. (2016). A scale development for 21st century skills of primary school students: A validity and reliability study. *International Journal of Instruction*, *9*(1), 133–148. https://doi.org/10.12973/iji.2016.9111a

Brownlow, C., Hinton, P., & McMurray, I. (2014). *SPSS explained 2nd Edition*. In *Routledge*. https://doi.org/10.4324/9781315797298

Buluş, M., Atan, A., & Sarıkaya, H. E. (2017). Effective communication skills: A new conceptual framework and scale development study. *International Online Journal of Educational Sciences*, *9*(2), 575–590. https://doi.org/10.15345/iojes.2017.02.020

Carey, C., & Naudin, A. (2006). Enterprise curriculum for creative industries students: An exploration of current attitudes and issues. *Education and Training*, *48*(7), 518–531. https://doi.org/10.1108/00400910610705908

Cogan-Drew, D. (2010). 21st century skills: Making student achievement public in the digital age. *eLearn, 2010*(2), 1-6. https://doi.org/10.1145/1719292.1730970

Curtis, E., Comiskey, C., & Dempsey, O. (2016). Importance and use of correlational research. *Nurse Researcher, 23*(6), 20–25. https://doi.org/10.7748/nr.2016.e1382

Dass, R. (2014). Literature and the 21st century learner. *Procedia - Social and Behavioral Sciences*, *123*, 289–298. https://doi.org/10.1016/j.sbspro.2014.01.1426

Doleck, T., Bazelais, P., Lemay, D. J., Saxena, A., & Basnet, R. B. (2017). Algorithmic thinking, cooperativity, creativity, critical thinking, and problem solving: exploring the relationship between computational thinking skills and academic performance. *Journal of Computers in Education*, *4*(4), 355–369. https://doi.org/10.1007/s40692-017-0090-9

Eggers, F., Lovelace, K. J., & Kraft, F. (2017). Fostering creativity through critical thinking: The case of business start-up simulations. *Creativity and Innovation Management*, *26*(3), 266–276. https://doi.org/10.1111/caim.12225

Ekici, G., Abide, Ö. F., Canbolat, Y., & Öztürk, A. (2017). 21. Yüzyıl becerilene ait veri kaynaklarının analizi. *Eğitim ve Öğretim Araştırmaları Dergisi*, *6*(1), 124–134.

Fraenkel, J., Wallen, N., & Hyun, H. (2011). *How to design and evaluate research in education*. Retrieved from http://tailieuso.udn.vn/bitstream/TTHL_125/9056/1/HowToDesignAndEvaluateResearchInEducation.TT.pdf

Gürbüz, H., Evlioğlu, B., Erol, Ç. S., Gülseçen, H., & Gülseçen, S. (2017). "What's the Weather Like Today?": A computer game to develop algorithmic thinking and problem solving skills of primary school pupils. *Education and Information Technologies*, *22*(3), 1133–1147. https://doi.org/10.1007/s10639-016-9478-9

Hewett, K. J. E., Zeng, G., & Pletcher, B. C. (2020). The acquisition of 21st-century skills through video games: Minecraft design process models and their web of class roles. *Simulation & Gaming,* 1-29. https://doi.org/10.1177/1046878120904976

International Society. (2007). ISTE standards for students. Retrieved October 19, 2019, from International Society for Technology in Education (ISTE) website: http://www.iste.org/docs/pdfs/20-14_ISTE_Standards-S_PDF.pdf

Jia, Y., Oh, Y. J., Sibuma, B., LaBanca, F., & Lorentson, M. (2016). Measuring twenty-first century skills: development and validation of a scale for in-service and pre-service teachers. *Teacher Development*, *20*(2), 229–252. https://doi.org/10.1080/13664530.2016.1143870

Kalaycı, Ş., Albayrak, A. S., Eroğlu, A., Küçüksille, E., Ak, B., Karaltı, M., ... & Antalyalı, Ö. L. (2014). SPSS uygulamalı çok değişkenli istatistik teknikleri, Ankara: Asil Yayın Dağıtım.

Katai, Z. (2015). The challenge of promoting algorithmic thinking of both sciences- and humanities-oriented learners. *Journal of Computer Assisted Learning*, *31*(4), 287–299. https://doi.org/10.1111/jcal.12070

Kay, K., & Greenhill, V. (2011). Twenty-First Century Students Need 21st Century Skills. In *Bringing Schools into the 21st Century* (pp. 41–65). https://doi.org/10.1007/978-94-007-0268-4_3

Kereluik, K., Mishra, P., Fahnoe, C., & Terry, L. (2013). What Knowledge Is of Most Worth: Teacher Knowledge for 21 st Century Learning. *Journal of Digital Learning in Teacher Education*, *29*(4), 127–140. https://doi.org/10.1080/21532974.2013.10784716

Kim, K. T. (2019). The Structural Relationship among Digital Literacy, Learning Strategies, and Core Competencies among South Korean College Students. *Educational Sciences: Theory and Practice*, *19*(2), 3-21. https://doi.org/10.12738/estp.2019.2.001

Kiss, G. (2013). Teaching programming in the higher education not for engineering students. *Procedia - Social and Behavioral Sciences*, *103*, 922–927. https://doi.org/10.1016/j.sbspro.2013.10.414

Kiss, G., & Arki, Z. (2017). The influence of game-based programming education on the algorithmic thinking. *Procedia - Social and Behavioral Sciences*, *237*(21), 613–617. https://doi.org/10.1016/j.sbspro.2017.02.020

Korkmaz, Ö., Çakir, R., & Özden, M. Y. (2017). A validity and reliability study of the computational thinking scales (CTS). *Computers in Human Behavior*, *72*, 558–569. https://doi.org/10.1016/j.chb.2017.01.005

Ledward, B. C., & Hirata, D. (2010). *An overview of 21 st century skills*. Honolulu.

López-Fernández, V., Arias-Castro, C., González Restrepo, K., & García Santana, K. (2018). A study of the relationship between empathy and creativity in colombian students and their educational implications. *Revista Complutense de Educación*, *29*(4). https://doi.org/10.5209/RCED.54881

Marbach-Ad, G., Hunt, C., & Thompson, K. V. (2019). Exploring the values undergraduate students attribute to cross-disciplinary skills needed for the workplace: An analysis of five STEM disciplines. *Journal of Science Education and Technology, 28*(5), 452–469. https://doi.org/10.1007/s10956-019-09778-8

McCrae, R. R., & Ingraham, L. J. (1987). Creativity, divergent thinking, and openness to experience. *Journal of Personality and Social Psychology*, *52*(6), 1258–1265. https://doi.org/10.1037/0022-3514.52.6.1258

McGunagle, D., & Zizka, L. (2020). Employability skills for 21st-century STEM students: The employers' perspective. *Higher Education, Skills and Work-Based Learning, 10*(3), 591–606. https://doi.org/10.1108/HESWBL-10-2019-0148

Mcmillan, J., & Schumacher, S. (2013). *Research in education: Evidence-based inquiry* (7th ed.). Pearson Education.

Ng, W. (2012). Can we teach digital natives digital literacy? *Computers and Education, 59*(3), 1065–1078. https://doi.org/10.1016/j.compedu.2012.04.016

Nouri, J., Zhang, L., Mannila, L., & Norén, E. (2019). Development of computational thinking, digital competence and 21st century skills when learning programming in K-9. *Education Inquiry*, 1–17. https://doi.org/10.1080/20004508.2019.1627844

Ongardwanich, N., Kanjanawasee, S., & Tuipae, C. (2015). Development of 21st century skill scales as perceived by students. *Procedia - Social and Behavioral Sciences*, *191*, 737–741. https://doi.org/10.1016/j.sbspro.2015.04.716

Orhan Göksün, D., & Aşkım Kurt, A. (2017). The relationship between pre-service teachers' use of 21st century learner skills and 21st century teacher skills. *Education and Science*, *42*(190), 107–130. https://doi.org/10.15390/EB.2017.7089

Partnership for 21st Century Learning. (2015). P21 Partnership for 21st Century Learning. *Partnership for 21st Century Learning*, 9. Retrieved from http://www.p21.org/documents/P21_Framework_Definitions.pdf

Piniuta, I. (2019). Technology based activities to develop 21st century skills in the foreign language classroom. *Proceedings of the 2019 8th International Conference on Educational and Information Technology - ICEIT 2019*, 79–85. https://doi.org/10.1145/3318396.3318404

Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon*, *9*(5), 1–6. https://doi.org/10.1108/10748120110424816

Price, P. C., Jhangiani, R. S., Chiang, I.-C. A., Leighton, D. C., & Cuttler, C. (2017). *Research methods in psychology* (3rd ed.). https://opentext.wsu.edu/carriecuttler/

Profetto-McGrath, J. (2003). The relationship of critical thinking skills and critical thinking dispositions of baccalaureate nursing students. *Journal of Advanced Nursing*, *43*(6), 569–577. https://doi.org/10.1046/j.1365-2648.2003.02755.x

Ramankulov, S. Z., Dosymov, E., Mintassova, A. S., & Pattayev, A. M. (2019). Assessment of student creativity in teaching physics in a foreign language. *European Journal of Contemporary Education*, *8*(3), 587–599. https://doi.org/10.13187/ejced.2019.3.587

Siddiq, F., Gochyyev, P., & Wilson, M. (2017). Learning in digital networks – ICT literacy: A novel assessment of students' 21st century skills. *Computers & Education*, *109*, 11–37. https://doi.org/10.1016/J.COMPEDU.2017.01.014

Thoughtful Learning. (2018). What are 21st century skills? Retrieved October 19, 2019, from Thoughtful Learning website: https://k12.thoughtfullearning.com/FAQ/what-are-21st-century-skills

Tican, C., & Deniz, S. (2019). Pre-Service teachers'o pinions about the use of 21st century learner and 21st century teacher skills. *European Journal of Educational Research*, *8*(1), 181–197.

Trilling, B., & Fadel, C. (2009). What is 21st Century Learning? In *21st century skills: Learning for life in our times* (pp. 1–19). San Francisco: Wiley & Sons.

Turgut, S., & Turgut, İ. G. (2018). The effects of cooperative learning on mathematics achievement in Turkey: A meta-analysis study. *International Journal of Instruction*, *11*(3), 663–680. https://doi.org/10.12973/iji.2018.11345a

Ustundag, M. T., Gunes, E., & Bahcivan, E. (2017). Turkish adaptation of digital literacy scale and investigating pre-service science teachers' digital literacy. *Journal of Education and Future*, (12), 19–29.

van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in Human Behavior*, *72*, 577–588. https://doi.org/10.1016/j.chb.2017.03.010

van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2019). Determinants of 21st-century digital skills: A large-scale survey among working professionals. *Computers in Human Behavior*, *100*, 93–104. https://doi.org/10.1016/j.chb.2019.06.017

van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2020). Determinants of 21st-century skills and 21st-century digital skills for workers: A systematic literature review. *SAGE Open, 10*(1–14). https://doi.org/10.1177/2158244019900176

Voogt, J., & Roblin, N. P. (2012). A comparative analysis of international frameworks for 21 st century competences: Implications for national curriculum policies. *Journal of Curriculum Studies*, *44*(3), 299–321. https://doi.org/10.1080/00220272.2012.668938

Yadav, A., Good, J., Voogt, J., & Fisser, P. (2017). Computational thinking as an emerging competence domain. In *Technical and Vocational Education and Training* (Vol. 23, pp. 1051–1067). https://doi.org/10.1007/978-3-319-41713-4_49

Yurtseven, N., & Doğan, S. (2019). Structural relationships among academic procrastination, academic motivation, and problem solving skill in prep class college students. *Pegem Eğitim ve Öğretim Dergisi*. https://doi.org/10.14527/pegegog.2019.027

**Correspondence**

Dr. Ömer KOÇAK, kocakomer@atauni.edu.tr