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Research Article

Investigation of 21st-Century Competencies and E-Learning Readiness of Higher Education Students on the Verge of Digital Transformation

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Abstract

This study aims to determine the 21st-century competencies of higher education students on the verge of digital transformation and their readiness for e-learning and to reveal the relationship between these two variables. Having been carried out by using single and relational screening models, this study was conducted with 2100 students attending higher education and participating in the research voluntarily. E-Learning Readiness Scale consisting of 33 items and 6 factors and 21st-Century Skills Scale consisting of 41 items and 5 factors were used as data collection tools. Kolmogorov-Smirnov, Mann-Whitney U, Games-Howell and Dunnett T3 tests were used for the analysis of data collected online. As a result of the research, it has been concluded that 21st-century competencies of higher education students are at a high level while their level of e-learning readiness is moderate. It has been determined that there are differences in the scores of the scale and its sub-dimensions according to age, gender and internet use status, and there is a statistically significant, positive and weak relationship between 21st-century competencies of students and their level of e-learning readiness.

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Introduction

It has been observed in recent years that the use of digital technologies in daily life has gradually increased followed by changes occurring in many areas. In particular, technological tools play crucial roles in the daily lives of individuals defined as "digital natives" by Prensky (2001). The learning and thinking styles of these individuals, who have been surrounded by technology in almost every aspect of their lives, also differ from previous generations (Gümüşoğlu, 2017), leading to differentiation in the demands and needs of individuals. In an era when learning information remains insufficient, the content of the information as well as how it is learned and put into practice in real life has gained

importance (Kotluk & Kocakaya, 2015). There are certain skills that an individual is supposed to acquire to achieve this. These skills are called 21st-century skills (Dede, 2010).

One may notice that there are different opinions in the literature about what 21st-century skills are. These skills were collected by the partnership for 21st-century skills (P21) under the main headings of a) learning and innovation skills, b) information, media and technology skills, c) life and career skills. The North Central Regional Educational Laboratory and Metiri Group (NCREL) identified these skills as digital literacy, creative thinking, effective communication and high productivity. The competencies determined by NRC (The American National Research Council) are cognitive skills, interpersonal skills and intrapersonal skills. In the classification made by The Organization for Economic Cooperation and Development (OECD, 2018), the characteristics that individuals should have are discussed under the main headings of alternative cognitive characteristics, change in cultural and social values, and expectations for teaching and learning. Apart from these, there are institutions and organizations that demonstrate different competencies.

When these approaches are taken together, it has become clear that the approaches by which the information is merely transferred are insufficient, but it is necessary to train individuals who know how to access information, who possess a critical approach and who can put this information into practice. One of the most important characteristics that should be possessed by individuals within the scope of 21st-century skills is to know how to access information. At this point, the role of digital technologies has gained importance. As a matter of fact, particularly the internet is one of the sources that learners and teachers have recently been using to access and share information (Arkorful & Abaidoo, 2015; Saraç & Özarslan, 2017). The inclusion of the internet in the process has brought about radical changes in all other education levels, especially in higher education (Rodrigues, Almeida, Figueiredo, & Lopes, 2019). According to Taşkıran (2017), the digitalization effort in education has made it necessary to carry out some structural reforms in education, especially in developed countries. The intensive use of technology has enabled learning activities to be carried out in virtual environments in educational environments.

Remarkable steps have been taken recently in the digital transformation in Turkey many related projects continuing. The Council of Higher Education (YÖK) launched the Learning and Teaching Project in Higher Education in the Digital Age in 2018 to realize digital transformation in universities. Within the scope of the project, the council ensured the

rapid progress of the process by providing training for both students and academicians. Besides, almost all of the universities in Turkey have begun to play a part in the online environment of the educational process by establishing Distance Education and Application Centres. In this way, individuals have been provided with access to education without time and space limitations. The use of information and communication technologies such as electronic media, educational technology, the internet, and computers in the teaching process is defined as e-learning (Arslan, Kutluca & Özpınar, 2011; Contreras & Hilles 2015). E-learning platforms not only increase learner engagement, but also provide the opportunity to develop an individual understanding of course content and to have access to a wider range of resources (Wang, Chen, & Khan, 2014). The introduction of teaching in online environments has brought some problems as well. One of these problems is to what extent students possess readiness for e-learning, which has a different characteristic than face-to-face learning. Mosadegh, Kharazi and Bazargan (2011) stated that readiness is an important factor in the successful implementation of e-learning. Similarly, Al-araibi, Naz'ri, Yusoff & Chuprat (2019) emphasized that one of the main reasons for the failure in the implementation of e-learning is the inadequacy of students' readiness.

Higher education institutions are supposed to adapt themselves to the needs of society (Gümüşoğlu, 2017). For, higher education institutions undertake the crucial role of raising qualified individuals needed in society and business life. In this context, individuals are expected to graduate from higher education institutions as individuals with 21st-century skills. The level of 21st-Century skills of individuals in Turkey has been determined in various studies. In the study conducted by Aygün et al. (2016), competence perceptions of prospective teachers regarding 21st-Century skills were determined. Gürültü, Aslan, and Alcı (2019) examined secondary school teachers' competencies of using 21st-century skills in their study. In the study conducted by Bozkurt and Çakır (2016), the 21st-century skill levels of secondary school students were examined in terms of various variables. Cemaloğlu et al. (2019) sought to determine the self-efficacy perceptions of the teachers working in vocational high schools regarding 21st-century skills. Özdemir-Özden et al. (2018) also tried to determine the competence perceptions of prospective teachers regarding 21st-century skills in their study. It has been observed that there are limited studies at the higher education level and these limited studies are mostly aimed at prospective teachers. However, higher education aims to raise qualified individuals not only for a specific field but for all fields. It is

important to determine the levels of 21st-century competencies in individuals who continue higher education as these competencies may be required by individuals in the future and to identify e-learning readiness, which has a key role for lifelong learning. The pandemic, which affected the world especially in early 2020 and was an obstacle to face-to-face education, once again revealed the importance of e-learning. It is also important to determine how ready individuals are for distance education processes, both in the normal process and in compulsory situations such as pandemics.

Research Objective

The aim of this study is to determine the 21st-century competencies of higher education students on the verge of digital transformation and their readiness for e-learning and to reveal the relationship between these two variables. Within the framework of this general purpose, the following questions were sought:

On what levels are 21st-century competencies of higher education students and their readiness for e-learning? Does the relevant level differentiate according to the variables given below:

- Gender
- Age
- Daily internet usage

Is there a statistically significant relationship between 21st-century competencies of higher education students and their readiness for e-learning?

Method

Research Design

In this study, single and relational scan models were used together. The single scan model aims to describe the occurrence of each variable as type or quantity. In this context, a single scan model was used to determine the 21st-century competencies of higher education students and their readiness for e-learning. The relational scan model aims to determine whether there is a change between more than one variable, and to find out the degree of this change if there is a change together (Fraenkel, Wallen, & Hyun, 2012). For this purpose, a relational scan model was used to determine the relationship between higher education students' 21st-century competencies and their e-learning readiness.

Population and Sample

The population of the study consists of 11078 students at a public university in Turkey. There are a total of 19 academic units in the relevant university, including 10 Faculties, 3 Colleges and 6 Vocational Schools. However, a total of 6 academic units, including 2 faculties, 1 College and 3 Vocational Schools, which do not have students yet or do not have enough students to meet the level of representation despite being within the university, were not included in the study. Proportional stratified sampling method, one of the probability-based sampling methods, was used in determining the participants in the higher education institution where the study was conducted. The proportional stratified sampling is the representation of subgroups in the population in proportion to their weight in the population (Shaughnessy, Zechmeister, & Zechmeister, 2016). In this context, taking into account the distribution of students in academic units, the population was divided into 13 strata, and a sample group close to the same percentage from each stratum was formed by considering the percentage shares of students in these strata in the population. Accordingly, 2100 students constitute the sample of the research. The sample of the research represents 20% of the population of the research. The distribution of the students who make up the population and sample of the research according to academic units is given in Table 1.

Table 1. The population of the research and the distribution of the students participating in the research according to academic units

Name of the Academic unit	**Population**		**Sample**	
	N	%	N	%
Faculty of Education	1957	18	371	17,7
Faculty of Theology	1150	10	212	10,1
Faculty of Economics and Administrative Sciences	705	6	134	6,4
Faculty of Arts and Sciences	1085	10	206	9,8
Faculty of Engineering	581	5	110	5,2
Faculty of Veterinary Science	241	2	46	2,2
Faculty of Agriculture	204	2	39	1,9
Faculty of Health Sciences	697	6	132	6,3
School of Physical Education and Sports	679	6	129	6,1
School of Foreign Languages	135	1	31	1,5
Vocational School of Social Sciences	1516	14	287	13,7

Vocational School of Technical Sciences	1045	9	198	9,4
Vocational School of Health Services	1083	10	205	9,8
Total	11078	100	2100	100

As can be understood from Table 1, of the 11078 participants that make up the research universe, 18% are students of Faculty of Education, 10% Faculty of Theology, 6% Faculty of Economics and Administrative Sciences, 10% Faculty of Arts and Sciences, 5% Faculty of Engineering, 2% Faculty of Veterinary, 2% Faculty of Agriculture and 6% Faculty of Health Sciences. Along with this, 6% of them are students of School of Physical Education and Sports, 1% School of Foreign Languages, 14% Vocational School of Social Sciences, 9% Vocational School of Technical Sciences and 10% Health Services Vocational School. A total of 2100 students constitute the sample of the study, with 20% of the students in the population being selected. The demographic characteristics of the participants participating in the study are given in Table 2.

Table 2. Information on demographic characteristics of participants

Variables		**N**	**%**
Gender	Male	1184	56,4
	Female	916	43,6
Age	18-21	1794	85,4
	22-25	184	8,8
	26-29	101	4,3
	30+	31	1,5
Daily internet usage	0-2 hours	1058	50,4
	3-5	856	40,8
	6+	186	8,9

Table 2 shows that 56% of the students selected for the sampling are male and 44% are female. 85% of the sample group is between the ages of 18-21, 9% between the ages of 22-25, 5% between the ages of 26-29, and 1% is between the ages of 30 and over. 50% of the participants use the internet on a daily basis for 0-2 hours, 41% for 3-5 hours, and 9% for 6 hours or more.

Data Collection Tools

21st-Century Skills Scale: It was developed by Çevik and Şentürk in 2019. The scale consists of 41 items and 5 factors. The 17th, 18th, 19th, 20th, 21st and 35th items of the scale consist of reverse items. The items of the multi-dimensional 21st-century skills scale of higher education students were designed in a 5-point Likert type. Scale items range from "Strongly disagree (1)" to "Strongly agree (5)". The lowest score that can be obtained from the scale is 41, and the highest score is 205. A score that is close to 205 means that 21st-century competence is higher. Each of the reliability coefficients of the factors of the multidimensional 21st-century skills scale is over 0.70. The Cronbach Alpha reliability coefficient of the scale was calculated as 0.86. In this study, the Cronbach Alpha reliability coefficient of the scale was calculated as 0.91. The reliability coefficients of the scale factors vary between 0.81 and 0.90. The fact that each of these measurement results exceeded the critical value of 0.70 is used as proof of the reliability of the scale items (Nunnally & Bernstein, 1994). This situation indicates that the scale items serve to measure the desired properties.

E-Learning Readiness Scale: It was developed by Yurdugül and Demir in 2017. The scale consists of 33 items and 6 factors. There is no reverse item on the scale. Scale items were designed in a 7-point Likert type. The items of the scale range from "Not suitable for me (1)" to "Completely suitable for me (7)". The lowest score that can be obtained from the scale is 33 and the highest score is 231. If the score is close to 231, it means that there is more readiness for e-learning. The reliability coefficients of the factors of the e-learning readiness scale vary between 0.84 and 0.95. The construct reliability coefficient of the scale was 0.98 and the Cronbach Alpha reliability coefficient was calculated as 0.93. In this study, the Cronbach Alpha reliability coefficient of the scale was calculated as 0.94. The reliability coefficients of the scale factors vary between 0.83 and 0.92. Nunnally and Bernstein (1994) stated that the critical value should be 0.70 to ensure that the measurement results based on the measurement tool are reliable. In this respect, it was concluded that the e-learning readiness scale applied to higher education students produced reliable measurements.

Data Collection and Analysis

Due to the Covid-19 pandemic in the 2020-2021 academic year, when the study was conducted, the data were collected online, as the courses were conducted through distance education at the university in question. For this purpose, the necessary permissions and approvals for the decision of the Ethics Committee dated 18.06.2020 and numbered 49 were

obtained from the Ethics Committee of the university where the study was conducted, and then, within the framework of the permissions obtained from the Distance Education Research and Application Centre, the necessary link address for the scales to access the forms prepared in the electronic environment was sent to students' e-mail addresses. Necessary instructions were given in the link address on which the scale was filled in by the students.

Before analysing the data collected in the digital environment, the reliability of the data was checked. In this context, among the data collected from 2376 students, 276 data, which were not considered valid for reasons such as marking the same items, missing incorrect marking, were not included in the study. In this respect, the number of data, which was 2376 at the beginning, was determined as 2100 after the elimination process. Calculations were made after 6 negative items in the 21st-century competencies scale were reversed while no change was made in the calculations regarding the items included in the e-learning readiness scale with no negative items.

To interpret the scale and its sub-dimensions, an evaluation was made on average scores. For ease of interpretation, three evaluation intervals, which are low, medium and high, were taken as a basis. In the calculation of the score range, the formula (Highest Value - Lowest Value) / Evaluation Interval Number formula was used. The evaluation interval and criteria accepted in the study are presented in Table 3.

Table 3. Evaluation interval and criteria

Scales	Evaluation Interval	Criterion
21st-century competencies	1, 00 - 2,33	Low level
	2,33 - 3,66	Medium level
	3,66 - 5,00	High level
E-learning readiness scale	1, 00 – 3,00	Low level
	3,00- 5,00	Medium level
	5,00 - 7,00	High level

During the data analysis stage, the SPSS program was used in all statistical analyses. As a result of the Kolmogorov-Smirnov test ($p < .05$) applied to the scale and its sub-dimensions in order to control the assumption of normality of the data, it was observed that they did not show normal distribution. For this reason, the Mann-Whitney U test was used

for paired comparisons and the Kruskal Wallis-H test for comparisons more than two. In order to determine the difference between groups, Dunnett T3 for the sample size less than 50 and Games-Howell for the sample size larger than 50 from Post Hoc tests were used. Pearson Moments Multiplication Coefficient correlation value was examined to determine the relationship between 21st-century competencies and e-learning readiness. The data were analysed with the SPSS program and the significance level was accepted as 0.05.

Findings

The findings of higher education students' 21st-century competencies and their readiness for e-learning are presented below within the framework of research problems.

On what levels are 21st-century competencies and e-learning readiness of higher education students? Descriptive statistics values for the scale and its sub-factors within the scope of the sub-problem are given in Table 4. The arithmetic mean, standard deviation, skewness and kurtosis values are included in the descriptive statistics table.

Table 4. Descriptive statistics on 21st-century competencies and e-learning readiness of higher education students

Scales and Sub-dimensions	Male (N=1184)		Female (N=916)		General(N=2100)	
	⚜	Ss	⚜	Ss	⚜	Ss
21st-century competencies	3,61	0,56	3,85	0,62	3,71	0,60
Information and Technology Literacy	3,89	0,68	4,09	0,64	3,98	0,67
Critical Thinking and Problem-solving	2,20	1,01	2,65	1,25	2,40	1,15
Entrepreneurship and Innovation	3,53	0,68	3,79	0,65	3,64	0,68
Social Responsibility and Leadership	3,36	0,78	3,65	0,78	3,49	0,79
Career Awareness	4,35	0,80	4,28	0,81	4,31	0,80
E-Learning Readiness	4,85	1,10	4,94	1,16	4,89	1,12
Computer Self-efficacy	4,01	1,53	4,27	1,44	4,12	1,50
Internet Self-efficacy	5,39	1,58	5,58	1,50	5,47	1,55
Online Communication Self-efficacy	4,73	1,60	4,95	1,51	4,82	1,57
Self-learning	5,29	1,28	5,21	1,31	5,26	1,29
Learner control	5,28	1,61	5,09	1,55	5,20	1,58
Motivation for e-learning	4,45	1,57	4,64	1,64	4,53	1,61

It is understood from Table 4 that higher education students find themselves competent at a high level (◎= 3.71) in terms of 21st-century competencies and at a medium level (◎= 4.89) in terms of being ready for e-learning. Considering 21st-century competencies in terms of sub-dimensions, it is seen that the sub-dimensions of "information and technology literacy" (◎= 3.98) and "career awareness"(◎ = 4.88) are at an advanced level,"

critical thinking and problem-solving "(◎= 2,39), "entrepreneurship and innovation" (◎= 3.64) and "social responsibility and leadership" (◎= 3.49) sub-dimensions are found to be at a moderate level.

When examined in terms of e-learning readiness sub-dimensions, "computer self-efficacy" (◎= 4.12), "online communication self-efficacy" (◎= 4.82) and "motivation for e-learning" (◎= 4, 53) sub-dimensions were found to be moderate. "Internet self-efficacy" (◎= 5.47), "self-learning" (◎= 5.26) and "learner control" (◎= 5.20) sub-dimensions are observed to be at a high level.

Do higher education students' 21st-century competencies and their e-learning readiness differentiate according to the gender variable? Mann-Whitney U test analysis was conducted within the scope of the sub-problem. Whitney U analysis results are given in Table 5.

Table 5. Mann-Whitney U analysis results regarding the gender variable

Scales and Sub-dimensions	Group (Gender)	N	Mean Rank	Rank S	U	p
21st-century competencies	Male	1184	935,96	1108174,00	406654,00	,000*
	Female	916	1198,55	1097876,00		
Information and Technology Literacy	Male	1184	961,51	1138430,50	436910,50	,000*
	Female	916	1165,52	1067619,50		
Critical Thinking and Problem-solving	Male	1184	961,79	1138758,50	437238,50	,000*
	Female	916	1165,17	1067291,50		
Entrepreneurship and Innovation	Male	1184	944,65	1118469,00	416949,00	,000*
	Female	916	1187,32	1087581,00		
Social Responsibility and Leadership	Male	1184	935,07	1107124,50	405604,50	,000*
	Female	916	1199,70	1098925,50		
Career Awareness	Male	1184	1083,26	1282575,00	503489,00	,004*
	Female	916	1008,16	923475,00		
E-Learning Readiness	Male	1184	1017,66	1204906,00	503386,00	,005*
	Female	916	1092,95	1001144,00		
Computer Self-efficacy	Male	1184	1004,18	1188946,50	487426,50	,000*
	Female	916	1110,38	1017103,50		
Internet Self-efficacy	Male	1184	1018,19	1205542,50	504022,50	,005*
	Female	916	1092,26	1000507,50		
Online Communication Self-efficacy	Male	1184	1018,49	1205898,00	504378,00	,006*
	Female	916	1091,87	1000152,00		
Self-learning	Male	1184	1064,99	1260947,50	525116,50	,213
	Female	916	1031,77	945102,50		
Learner control	Male	1184	1096,16	1297856,50	488207,50	,000*
	Female	916	991,48	908193,50		
Motivation for e-learning	Male	1184	1015,51	1202365,50	500845,50	,003*
	Female	916	1095,73	1003684,50		

*p<.05

As seen in Table 5, the level of 21st-century competence of higher education students differs by gender [U = 406654,00 p <0.05]. Considering the mean rank, it is seen that the differentiation is in favour of female students. The level of the 21st-century competence of female students is higher than male students. When examined in terms of sub-dimensions, gender is a significant factor in all sub-dimensions of 21st-century competencies. In "Information and technology literacy" [U = 436 910.50 p <0.05], "critical thinking and problem-solving" [U = 437238.50 p <0.05], "entrepreneurship and innovation" [U = 416949.00 p <0.05], "social responsibility and leadership" [U = 405604.50 p <0.05] sub-dimensions, gender is in favour of women while "career awareness" [U = 503489.00 p <0.05] is seen to differ in favour of males.

Considering the e-learning readiness levels of higher education students, it is revealed that there is a significant difference according to gender. [U = 503386.00 p <0.05]. Considering the mean rank, it is seen that the differentiation is in favour of female students. It is observed that the level of e-learning readiness of female students is higher than that of male students. When examined in terms of sub-dimensions, "computer self-efficacy" [U = 487426.50 p <0.05], "internet self-efficacy" [U = 504022.50 p <0.05], "online communication self-efficacy" [U = 504378.00 p <0.05], "motivation for e-learning" [U = 500845.50 p <0.05] sub-dimensions are important factors in favour of women while "learning control" [U = 488207.50 p < 0.05] is an important factor in favour of men. However, the sub-dimension of "self-learning" [U = 525116.50 p> 0.05] does not differ according to gender.

Do higher education students' 21st-century competencies and their e-learning readiness differ according to the age variable? Kruskal Wallis-H test analysis was performed within the scope of the sub-problem. Kruskal Wallis test analysis results are given in Table 6.

Table 6. Kruskal Wallis-H test analysis results for the age variable

Scales and Sub-dimensions	Group (Age)	N	Mean Rank	Sd.	X^2	p	Significant Difference (Games-Howell)
21st-century competencies	A (18-21)	1794	1056,39	3	5,64	,131	-
	B (22-25)	184	1068,18				
	C (26-29)	91	970,20				
	D (30+)	31	840,68				
Information and Technology Literacy	A (18-21)	1794	1054,46	3	3,41	,333	-
	B (22-25)	184	1069,06				
	C (26-29)	91	990,90				
	D (30+)	31	886,29				
Critical Thinking and Problem-solving	A (18-21)	1794	1059,02	3	8,33	,040*	A-D
	B (22-25)	184	1054,63				
	C (26-29)	91	966,58				

	D (30+)	31	779,44				
Entrepreneurship and Innovation	A (18-21)	1794	1056,08	3	3,14	,370	
	B (22-25)	184	1056,38				
	C (26-29)	91	974,64				
	D (30+)	31	915,29				
Social Responsibility and Leadership	A (18-21)	1794	1042,01	3	16,00	,001*	C-D
	B (22-25)	184	1168,87				
	C (26-29)	91	909,10				
	D (30+)	31	1254,34				
Career Awareness	A (18-21)	1794	1050,50	3	21,38	,000*	D
	B (22-25)	184	1107,88				
	C (26-29)	91	1094,94				
	D (30+)	31	579,48				
E-Learning Readiness	A (18-21)	1794	1058,83	3	21,06	,000*	D
	B (22-25)	184	1021,36				
	C (26-29)	91	1108,88				
	D (30+)	31	570,21				
Computer Self-efficacy	A (18-21)	1794	1064,59	3	24,82	,000*	D
	B (22-25)	184	994,00				
	C (26-29)	91	1061,60				
	D (30+)	31	537,74				
Internet Self-efficacy	A (18-21)	1794	1060,72	3	23,54	,000*	D
	B (22-25)	184	1020,17				
	C (26-29)	91	1083,99				
	D (30+)	31	540,52				
Online Communication Self-efficacy	A (18-21)	1794	1047,85	3	13,26	,004*	D
	B (22-25)	184	1125,74				
	C (26-29)	91	1069,42				
	D (30+)	31	701,53				
Self-learning	A (18-21)	1794	1056,13	3	12,74	,005*	D
	B (22-25)	184	1046,28				
	C (26-29)	91	1078,47				
	D (30+)	31	667,71				
Learner Control	A (18-21)	1794	1052,17	3	3,61	,307	-
	B (22-25)	184	1036,45				
	C (26-29)	91	1106,75				
	D (30+)	31	872,16				
Motivation for e-learning	A (18-21)	1794	1054,91	3	7,47	,058	-
	B (22-25)	184	1010,41				
	C (26-29)	91	1128,14				
	D (30+)	31	805,35				

*p<.05

As seen in Table 5, the age variable does not cause a significant difference in 21st-century competence levels of higher education students (X^2 (sd = 3, n = 2100) = 5.64, p> .05), yet it causes a significant difference in "critical thinking and problem-solving" (X^2 (sd = 3, n = 2100) = 8.33, p <.05), "social responsibility and leadership" (X^2 (sd = 3, n = 2100) = 16.00, p < .05) and "career awareness" (X^2 (sd = 3, n = 2100) = 21.38, p <.05) sub-dimensions. The Games-Howell test, which is one of the Post-Hoc tests conducted to determine the difference, shows

that the difference in the sub-dimension of "critical thinking and problem-solving" is between the ages of 18-21 and 30+, the difference in the sub-dimension of "social responsibility and leadership" is between the ages of 26-29 and 30+, and the difference in the "career awareness" sub-dimension is in the 30+ age range. In line with these data, the critical thinking and problem-solving competencies of the students between the ages of 18-21 and the social responsibility and leadership competencies of the higher education students between the ages of 26-29 are higher than the students between the age range of 30+. However, career awareness competencies of higher education students in the age range of 30+ are lower than those of other age groups.

The age variable causes a significant difference at higher education students' levels of "readiness for e-learning" (X^2 (sd = 3, n = 2100) = 21.06, p <.05), and at levels of sub-dimensions including "computer self-efficacy" (sd = 3, n = 2100) = 24.82, p <.05), "internet self-efficacy" (sd = 3, n = 2100) = 23.54, p <.05), "online communication self-efficacy" (sd = 3, n = 2100) = 13.26, p < .05) and "self-learning" (sd = 3, n = 2100) = 12.74, p <.05). As a result of the Games-Howell test, students aged 30+ had lower levels of e-learning readiness and computer self-efficacy, internet self-efficacy, online self-efficacy and self-learning sub-dimensions than students in other age ranges.

Do higher education students' 21st-century competencies and their e-learning readiness differentiate according to the daily internet usage variable? Kruskal Wallis-H test analysis was performed within the scope of the sub-problem. Kruskal Wallis-H test analysis results are given in Table 6.

Table 6. Kruskal Wallis-H test analysis results for the daily internet usage variable

Scales and Sub-dimensions	Group (Hours)	N	Mean Rank	Sd.	X^2	p	Significant Difference (Dunnett T3)
21st-Century Competencies	A (0-2)	1058	1009,60	2	9,73	,008	A-B
	B (3-5)	856	1093,24				
	C (6+)	186	1086,49				
Information and Technology Literacy	A (0-2)	1058	1018,28	2	6,17	,046	A-B
	B (3-5)	856	1086,42				
	C (6+)	186	1068,48				
Critical Thinking and Problem-solving	A (0-2)	1058	1024,06	2	8,22	,016	A-B
	B (3-5)	856	1095,16				
	C (6+)	186	995,37				
Entrepreneurship and Innovation	A (0-2)	1058	1015,43	2	7,23	,027	A-B
	B (3-5)	856	1083,63				
	C (6+)	186	1097,52				
Social Responsibility and Leadership	A (0-2)	1058	1036,54	2	1,20	,548	-
	B (3-5)	856	1066,82				

	C (6+)	186	1054,78				
Career Awareness	A (0-2)	1058	1006,37	2	12,28	,002	A-B
	B (3-5)	856	1102,52				
	C (6+)	186	1062,11				
E-Learning Readiness	A (0-2)	1058	1032,47	2	2,05	,359	-
	B (3-5)	856	1065,26				
	C (6+)	186	1085,15				
Computer Self-efficacy	A (0-2)	1058	1056,05	2	0,80	,671	-
	B (3-5)	856	1051,74				
	C (6+)	186	1013,21				
Internet Self-efficacy	A (0-2)	1058	1005,84	2	12,38	,002	A-B
	B (3-5)	856	1102,76				
	C (6+)	186	1063,99				
Online Communication Self-efficacy	A (0-2)	1058	1039,50	2	4,13	,127	-
	B (3-5)	856	1045,47				
	C (6+)	186	1136,19				
Self-learning	A (0-2)	1058	1026,33	2	3,40	,182	-
	B (3-5)	856	1074,11				
	C (6+)	186	1079,30				
Learner control	A (0-2)	1058	1018,97	2	5,95	,051	-
	B (3-5)	856	1085,73				
	C (6+)	186	1067,73				
Motivation for e-learning	A (0-2)	1058	1053,86	2	3,68	,159	-
	B (3-5)	856	1030,45				
	C (6+)	186	1123,69				

*p<.05

As seen in Table 6, the variable of daily internet usage causes a significant difference in 21st-century competence levels of higher education students (X^2 (sd = 3, n = 2100) = 9.73, p <.05). It also causes a significant difference in all sub-dimensions except for the "social responsibility and leadership" sub-dimension. As a result of the Dunnett T3 test, one of the Post-Hoc tests performed to determine the difference, it is seen that the difference is caused by the daily internet usage range of 0-2 to 3-5 hours. In line with these data, students who use the internet for an average of 0-2 hours a day, their 21st-century competencies, critical thinking and problem-solving, entrepreneurship and innovation, career awareness competencies are lower than students who use the internet for 3-5 hours a day.

Daily internet usage variable does not cause a significant difference in the e-learning readiness levels of higher education students (X^2 (sd = 3, n = 2100) = 2.05, p> .05). However, the internet self-efficacy (X^2 (sd = 3, n = 2100) = 12.38, p <.05) of the students who use the internet for an average of 0-2 hours per day is lower than the students who use the internet for 3-5 hours daily.

Is there a statistically significant relationship between higher education students' 21st-century competencies and their e-learning readiness? Pearson Correlation analysis was

performed within the scope of the sub-problem. Pearson Correlation analysis results are given in Table 7.

Table 7. Pearson correlation analysis results

		E-learning Readiness	Computer Self-efficacy	Internet Self-efficacy	Online Communication Self-efficacy	Self-learning	Learner control	Motivation for e-learning
21st-century Competencies	Pearson Correlation	0,370**	0,276**	0,220**	0,396**	0,380**	0,317**	0,118**
	P	,000	,000	,000	,000	,000	,000	,000
	N	2100	2100	2100	2100	2100	2100	2100
		21st-century Competencies	**Information and technology literacy.**	**Critical thinking and problem-solving**	**Entrepreneurship and innovation**	**Social responsibility and leadership**	**Career awareness**	
E-learning readiness	Pearson Correlation	0,370**	0,427**	-0,137**	0,364**	0,209**	0,406**	
	P	,000	,000	,000	,000	,000	,000	
	N	2100	2100	2100	2100	2100	2100	

**p<.001

As can be seen in Table 7, there is a statistically significant, positive, weak relationship (r = .370; p <.05) between higher education students' 21st-century competencies and their level of e-learning readiness. When examined in terms of sub-dimensions, while there is a positive and low (.220 ≤r≤.396; p <.05), there is a very low and positive correlation (r = .118; p <.05) between the motivation for e-learning sub-dimension among the sub-dimensions of "computer self-efficacy", "internet self-efficacy", "online communication self-efficacy", self-learning", and "learner control". .

There is a moderate positive correlation (.406 ≤r≤.427; p <.05) between "information and technology literacy" and "career awareness" and a weak positive correlation between "entrepreneurship and innovation" and "social responsibility and leadership" (.209 ≤r≤ .370; p<.05). On the other hand, it was found that there is a very weak negative correlation (r = -.137; p <.05) between the "critical thinking and problem-solving" sub-dimension.

Discussion, Conclusion and Recommendations

The results of this study, which examines 21st-century competencies and e-learning readiness of higher education students on the verge of digital transformation, are presented under the headings within the framework of the research sub-problems.

Results Regarding Higher Education Students' 21st-Century Competencies and Readiness for E-Learning

According to the results of the research, it was concluded that 21st-century competencies of higher education students are at a high level. This situation means that higher education students consider themselves highly competent in terms of 21st-century competencies. It is thought that this situation may be related to the learning experiences of the students in the higher education process. However, students find themselves highly competent in terms of information and technology literacy and career awareness. Individuals consider themselves moderately sufficient in terms of critical thinking and problem solving, entrepreneurship and innovation, social responsibility and leadership, which are among the other sub-dimensions of the scale. When the literature is examined, it is possible to find research results that support this research result. As a matter of fact, Erdogan and Eker (2020), in their studies on prospective teachers, reached the conclusion that prospective teachers' levels of 21st-century competencies are high. Similarly, in the study conducted by Kozikoğlu and Altınova (2018) on prospective teachers, it was determined that prospective teachers' perceptions of 21st-century efficacy were at a high level. In general studies, it is seen that 21st-century competence levels of higher education students in are high (Cemaloğlu etc., 2019; Erdoğan & Eker, 2020; Sinan & Doğan, 2019).

It was determined that higher education students' readiness for e-learning is medium. Students feel ready at a medium level of e-learning. Students feel highly prepared for internet self-efficacy, self-learning and learner control. They find themselves moderately ready in terms of computer self-efficacy, online communication self-efficacy and motivation for e-learning. It is thought that the diversification of ways of access to information due to the rapid developments in internet technology, today's abundance of information and the internet access speed of mobile technologies may have influenced students' e-learning readiness and sub-dimensions. It was also revealed in many studies that computer technologies and factors such as the internet affect students' readiness (Eom, 2014; Wu, Tennyson & Hsia, 2010). Likewise, similar results were obtained in the study conducted by Yılmaz, Sezer, and Yurdugül (2019) with 5021 university students.

Results Regarding the Variables of Gender, Age and Daily Internet Usage of Higher Education Students' 21st-Century Competencies and Readiness for E-Learning

According to the results of the research, it was determined that 21st-century competence level of the female students is higher than the male students. It was concluded that female students were more competent than male students in terms of information and technology literacy, critical thinking and problem solving, entrepreneurship and innovation, social responsibility and leadership. However, in the career awareness sub-dimension, it has been seen that there is a significant difference in favour of male participants. When the literature is examined, unlike the present study, it is seen that the level of 21st-century competencies does not differ according to the gender variable (Cemaloğlu etc., 2019; Kozikoğlu & Altunova, 2018). In the present study, the fact that 21st-century competencies of female students are higher than those of men may be because women are more open to learning in terms of information and technology literacy, critical thinking and problem solving, entrepreneurship and innovation, social responsibility and leadership and continue their learning habits outside the university. In addition, it is thought that these results may have occurred because there are more departments related to social sciences in the higher education institution where the study is conducted and that these departments are preferred more by female students. Therefore, considering this difference, it is recommended to determine the sample characteristics well and to reconsider the gender variable. Thus, it can be said that the results obtained in terms of 21st-century competencies can be better discussed in terms of gender variable.

Higher education students' levels of readiness for e-learning differ in favour of female students. E-learning readiness of female students is higher than male students. While there is a significant difference in favour of women in the sub-dimensions of computer self-efficacy, internet self-efficacy, online communication self-efficacy, motivation for e-learning, there is a significant difference in favour of male participants in the learning control sub-factor. In the self-learning sub-dimension of the scale, there is no significant difference according to gender. This result obtained from the research differs at this point with the results of similar studies in the literature. In similar studies, it has been concluded that there is no overall gender differentiation (Jackson et al., 2008; Yılmaz, Sezer, & Yurdugül, 2019). This situation is thought to be due to the characteristics of the sample group. In future studies, it is suggested that the data obtained from the sample should be analysed together with different variables (such as technological access, technological infrastructure, use of technology, technical support). As a matter of fact, it is stated that problems such as lack of technological

support can negatively affect students' e-learning readiness (Naresh & Reddy, 2015). This result reveals the necessity of various studies to increase students' readiness for e-learning. In this context, institutional measures can be taken by organizing technology-supported elective courses, additional sessions or courses for students.

The age factor does not cause a significant difference in 21st-century competence levels of higher education students. However, critical thinking and problem solving competencies of students aged 18-21, and social responsibility and leadership competencies of higher education students aged 26-29 are higher than students aged 30+. However, career awareness competence of higher education students in the age range of 30+ is lower than students in the other age range. Although there is no direct study in the literature regarding this result, it can be said that higher education students under the age of 30 have higher levels of critical thinking and problem solving, social responsibility and leadership, career awareness. However, it is recommended to future researcher(s) in order to interpret the results obtained from the information about the students' previous learning experiences more properly.

The age factor differs in favour of students under the age of 30 in the level of e-learning readiness of higher education students. Computer self-efficacy, internet self-efficacy, online self-efficacy and self-learning sub-dimension levels of higher education students were also higher than students aged 30 and over. When the literature is examined, there is no study directly related to the age variable regarding the state of being ready for e-learning. However, it is possible to come across studies on the grade level variable (Çetin, 2008; Hung et al., 2010; Yurdugül & Demir, 2017). Yurdugül and Demir (20107) concluded in their study that students in the 4th-grade of higher education are more ready for e-learning in terms of all components of e-learning readiness compared to the 1st-grade students. Similarly, in the study conducted by Çetin (2008), the level of computer self-efficacy of upper-class university students was found to be higher than those of lower classes. This situation in the studies may be related to the learning experiences of the students during their time in higher education. However, it is thought that this result, which emerged within the scope of this study, may be more related to the learning experience in higher education. Therefore, it is recommended that the data to be obtained regarding the age variable in future studies should be presented by considering them together with different parameters.

The variable of daily internet usage causes a significant difference in 21st- century competence levels of higher education students. Students who use the internet for an average of 3-5 hours a day have higher 21st-century competencies and information and technology literacy, critical thinking and problem solving, entrepreneurship and innovation, career awareness competencies than students who use the internet daily for 0-2 hours. Considering this situation, it is recommended that institutions should take into account the daily internet usage periods and take measures for this in developing the 21st-century competence levels of students. In this context, in line with the suggestion of Orban, Teeling-Smith, Smith, and Porter (2018), online courses and face-to-face lessons can be taught in a way as blended learning. However, the variable of daily internet usage does not cause a significant difference in the level of e-learning readiness of higher education students. The internet self-efficacy of students who use the internet for an average of 0-2 hours per day is lower than the students who use the internet for an average of 3-5 hours per day. In general, it is known that there is a positive relationship between internet usage time and internet self-efficacy (Yenilmez et al., 2011). Therefore, it can be said that this situation is an expected result. However, for what purposes students use the internet and the effect of this on the variables rather than how long they spend on the internet can be revealed by the studies.

There is a statistically significant, positive and weak relationship between higher education students' 21st-century competencies and their level of e-learning readiness. While a weak and positive relationship is found between the 21st-century competencies and the dimensions of computer self-efficacy, internet self-efficacy, online communication self-efficacy, self-learning and learner control, there is a positive and weak relationship between the 21st-century competencies and the motivation for e-learning sub-dimension. There is a positive, moderate-level relationship between students' e-learning readiness and information and technology literacy, career awareness and a low and positive relationship between entrepreneurship and innovation, social responsibility and leadership.

In the 21st century, higher education institutions are one of the most effective institutions in changing the skills expected from individuals and gaining these skills. In this context, it is important to determine to what extent individuals studying at higher education institutions possess these skills. The pandemic process, which emerged at the end of 2019 and affected the world and was an obstacle for face-to-face education, once again revealed the importance of e-learning. It is also important to determine how ready individuals are for

distance education processes, both in the normal process and in compulsory situations such as pandemics. Within the scope of this research, 21st-century skills of individuals and their level of e-learning readiness were determined and the relationship between these variables was revealed. Future studies may investigate how to ensure individuals acquire 21st-century skills and how to increase the e-learning readiness of individuals. It is thought that it would be beneficial to carry out similar studies in primary, secondary and high schools to reveal the situation and discuss the measures that can be taken for that.

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Author Contribution Statement

Mithat ELÇİÇEK: *Conceptualization, methodology, measurement tool, implementation, data analysis, review-writing and editing.*

Hüsamettin ERDEMCİ: *Conceptualization, methodology, implementation, consultancy and control preliminary draft writing and editing.*

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