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Digital distraction levels of university students in emergency remote teaching

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Abstract

The main objective of this study is to investigate the relationships between digital distraction, perceived learning, and general satisfaction in emergency remote teaching. Correlational design, one of the quantitative research methods, was used for the study. The study sample consists of 1532 university students in a Turkish university during Covid-19. The study results show a significant relationship between digital distraction, general satisfaction, and perceived learning. Digital distraction is negatively related to general satisfaction and perceived learning, and general satisfaction is positively related to perceived learning. When the independent demographic variables were analyzed, digital distraction scores were higher for females, those not working in any job, not participate orientation training, and not following the live class and watching it later. In addition, it was revealed that as the age of the students decreased, the digital distraction scores increased. It was found that digital distraction variables, the amount of digital distraction, sending instant messages, checking the time, boredom, sharing social media, and system usability were significant predictors of digital distraction.

Keywords Distance education · Online learning · Pedagogical issues · Teaching/learning strategies · Media in education · Gender studies

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1 Introduction

Covid-19 was declared a global epidemic by the World Health Organization on March 11, 2020 (WHO, 2020). The covid-19 pandemic changes human behavior in daily life. In many areas of life, closure measures have been taken in education against the measures taken within the framework of the pandemic. As in the whole world, in Turkey, with the closure of many educational institutions from preschool to higher education, schools had to switch from face-to-face education to emergency remote teaching (ERT) to ensure the continuity of educational activities and teaching has become completely technology based. The measures taken affected approximately 1.6 billion students worldwide and 25 million in Turkey at all academic levels. At the higher education level in Turkey, this number is approximately 7.2 million (Bozkurt, 2020).

Due to the Covid 19 pandemic, education processes worldwide have been transformed into ERT. ERT is a teaching method that refers to an urgent and temporary transition realized by transferring traditional teaching methods and resources to online environments in an unplanned and rapid manner using technology. In the literature, there are different evaluations of the distinction between online learning and ERT. The primary purpose of ERT is not to completely transfer traditional methods to e-learning but to provide temporary access through various available and reliable media or platforms in emergencies. Therefore, ERT can be understood as a temporary solution and should be separated from "online learning" (Cahyadi et al., 2021; Hodges et al., 2020).

ERT was implemented not as an option but as a necessity and was urgently made available to students during Covid 19 (Goksel, 2021).

In the ERT process efficiency of internet connections used by thousands of students simultaneously and the lack of access to technological devices can be stated as technological difficulties. The lack of course content, digital skills, and interaction/motivation in online environments of lecturers and students were stated as pedagogical difficulties (Ferri et al., 2020). Digital Distraction (DD) is one of ERT's most significant technological, pedagogical, and social challenges.

"Distraction" is defined as the shifting of an individual's attention from one object to another (Hanin, 2021). The concept of DD is based on distraction and individual differences. DD is the situation in which individuals turn away from their primary duties when they are busy with any work and turn to digital devices or applications that distract attention (Vermaat et al. (2017).

1.1 Literature review

DD, caused by the intensive use of digital technologies in the learning environment and the constant change in learning environments, is a significant concern for educators (Lai & Bower, 2019). DD is a technology-enabled user behavior that has recently attracted the attention of researchers due to potentially harmful consequences. (Chen et al., 2014; Nath et al., 2017). The

report, published by Growing Up Digital Australia, highlighted that digital technology and media increase distraction in students' learning and decrease students' focus on learning tasks (Graham & Sahlberg, 2020). These studies portray the effects of DD on learning outcomes.

Douglas et al. (2012) found that students who used a laptop experienced DD through Facebook or other things they could do during the course, 75% of the sample used mobile phones in the classroom during the lesson, and the rate of experiencing DD was three times on average per lesson. The study conducted by McCoy (2013) revealed that the rate of experiencing DD in unrelated activities in the classroom was 1–3 times. The same study found that students mostly used instant messaging, checking the time, sending e-mails, and sharing social media, respectively. Chen et al. (2014) conducted a study in 2012–2013 with 1150 students at six universities in Africa, China, and the US. They found that the intensity of DD was influenced by students' Internet addiction, gender, age, online time, classroom management, and teacher characteristics. Flanigan and Titsworth (2020) found that instructors regularly watched students experiencing high levels of DD in their classrooms and using digital devices for non-task-related purposes, social media, e-mail, and web browsing. Studies have shown that demographic variables and social media usage affect digital distraction.

Patil et al. found that students got lower scores in homework due to the time spent on phone and internet use, frequency of phone and internet use, and time spent on phone applications. Also, time to complete assignments increased as time was spent on phone apps or websites unrelated to assignments. The study concluded that students experience digital distractions.

As a result of the literature review, it is seen that the common points of the studies are the reasons for experiencing DD in the face to face learning, the rates of experiencing DD, and the factors affecting the intensity of DD. There are no studies in distance education and ERT related to DD, and it is seen that there is a need for research on the subject. In addition, there is no DD measurement tool in distance education.

In the ERT process, the reasons such as the unplanned and fast creation of the online learning contents, the long course durations, and the low interaction may cause DD. Besides, in ERT, DD may occur due to individual differences such as readiness, self-efficacy, self-control, and acceptance of distance education.

In addition to all these, both the DD aspect of the home environment in learning and the absenteeism and direct narration-based approach could play a fundamental role in DD during ERT. With the onset of the COVID-19 pandemic, studies conducted in the first period focus primarily on students' perceptions of ERT and e-learning. Subsequently, studies were conducted on the effects of the transition to ERT and teachers' perceptions of online learning. Only 4.6% of the studies conducted in this process focus on student welfare. Studies directly related to students are grouped thematically into four subject groups: e-learning, classrooms, social, and data. It is noted that research in higher education, particularly undergraduate and medical students, focuses mainly on students' experiences during the pandemic (Bond et al., 2021).

While reviewing the literature, it was seen that there needed to be more studies on the concept of DD and its effects on students. Furthermore, there are few studies on which variables DD affects. In these studies, the focus is on perceived learning and satisfaction. It is seen that student content interaction in terms of satisfaction and students' online learning self-efficacy in terms of PL is the most critical factor (Alqurashi, 2019). Students experiencing DD are obstructed with their learning, affecting their PL (Flanigan & Titsworth, 2020). The study by Patil et al. (2019) showed that students experiencing DD performed worse on homework and took longer to complete. Since DD also affects interaction and self-efficacy, it is expected to affect PL and GS. Some studies also show a relationship between general satisfaction and perceived learning. (Alqurashi, 2019; Baloran & Hernan, 2021; Eom et al., 2006; Hong et al., 2003). Upon examining these studies, it can be said that DD affects perceived learning and satisfaction, while satisfaction affects perceived learning. This relationship presented in the Fig. 1 was decided to be analyzed as a model within the scope of the research.

The reviewed literature indicates that DD is affected by gender, age, work status, online time, and instructor/topic features (Chen et al., 2014; Lian et al., 2016; Selwyn, 2016; Throuvala et al., 2021; Wu & Cheng, 2019). In addition, the amount of DD and the tools used are also important in DD (Douglas et al., 2012). In this respect, whether gender, age, work status (working/non-working), online time, DD, and the tools used variables affect DD, which are found in a limited number of studies in the literature, are discussed in the research.

1.2 Aim of the study

The aim of the study is to explore the relationships among DD, perceived learning (PL), and general satisfaction (GS). The following research hypothesis provided the framework for the study:

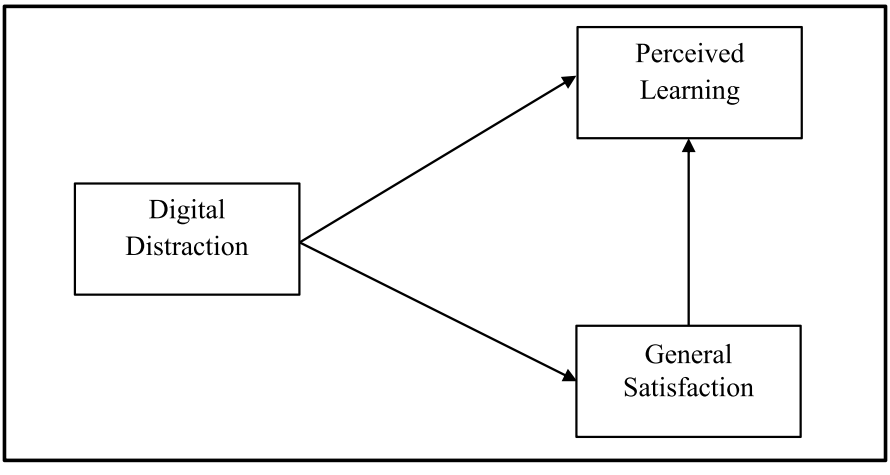

Fig. 1 Research model

1) DD, GS, and PL variables are intercorrelated.
   a) DD affects GS negatively.
   b) DD affects PL negatively.
   c) GS affects PL positively.
2) Demographic variables of age, gender, participation in orientation training, working at a job, and follow-up lessons are significant predictors of DD.
3) The number of DD, DD tools, and DD causes variables are significant predictors of DD.

2 Methodology

Correlational design, one of the quantitative research methods, was used in the research. In the correlational design, the variables are measured together at once to determine the relationship between two or more variables.

2.1 Participants

1532 students studying at a state university in Turkey participated in the research. These students are involved in ERT for at least two semesters during the Covid-19 period. 910 of these students (59.4%) were females, and 622 (40.6%) were males. When the age range of the participants was examined, it was seen that it ranged from 18 to 64, and the average age was 22.75 (±5.17) years. When we asked the participants whether they worked in a job other than being a student, 432 students (28.2%) stated that they were working, and 1100 students (71.8) were not working. The participants consisted of 48 preparatory class [students who take foreign language courses before starting university] (3.1%), 231 freshmen (15.1%), 424 sophomores (27.7%), 414 juniors (27%), and 415 senior students (27.1%). When we asked the students whether they participate the orientation training held at the beginning of the academic year, 373 students (24.3%) stated that they attended the training, and 1159 students (75.7%) did not. When the participants were asked how they generally followed the lessons, 921 students (60.1%) stated that they followed the lessons by participating in the live virtual classes. In contrast, 611 students (39.9%) stated that they followed the lessons mostly by watching them playback from the system.

2.2 Instruments

In the study demographic variable form, DD Scale, DD components, system usability (SU), GS and PL scales were used as date collection tools (see: all scales in Appendix-1 Table 6).

2.2.1 Demographic variable form

The demographic variable form is used to collect students' demographic information. In this form, data on participants' gender, age, grade, department, work

status (working/non-working), participate orientation training, and online lessons follow-up (live/playback) were collected.

2.2.2 DD scale (DDS)

The DDS was used to measure the DD of the university students in live classes in ERT. The scale was developed by the researchers within the scope of the research. During the development of the scale, an item pool was created by first reviewing the literature. There were 8 items in the item pool. After then expert opinion was obtained from 3 education technologists for content and face validity. Some changes were made to the items in line with the experts' suggestions. Then, factorial validity studies were started. Exploratory (EFA) and confirmatory (CFA) factor analyses were performed for factorial validity. The scale was distributed to 400 university students. The scale development process was applied to the data collected from these students. The data were divided into two sets of 200 students and used for EFA and CFA.

EFA The KMO value was found to be 0.924, and the Sphericity test result as $\chi 2 = 1672.96$ (p. = 0.000). Since these results show that EFA will be done with the sample, the factor structure was examined by principal component analysis. As a result of EFA, the scale has a structure of 8 items in a single factor and explains 71.08% of the total variance (see: Appendix-2 Table 7). In line with these findings, the scale's factorial validity is acceptable (Field, 2013).

CFA The factorial structure obtained from EFA was tested with CFA. As a result of the first-factor analysis, it was decided to modify the three items. Three different modifications were made between items 1 to 2, items 6 to 7, and items 7 to 8. As a result of the second CFA, the t values of the items were found to vary between 13.52 and 20.54. Additionally, Standard solution values varied between 0.71 and 0.93 (see: Appendix-3 Fig. 3). The standard solution values are higher than 0.50 and t values higher than 2.56, which indicates that the items are important and significant for the factor (Jöreskog & Sörbom, 1996).

As a result of CFA, the fit indices of the model were found to be $\chi^2/df = 3.59$, RMSEA = 0.096, GFI = 0.95, AGFI = 0.89, SRMR = 0.024, CFI = 0.99, NFI = 0.98, and NNFI = 0.98. According to Schermelleh-Engel et al. (2003), GFI, AGFI, SRMR, NFI, CFI, and NNFI fit indexes were found acceptable (see: Appendix-4 Table 8). χ^2/df and RMSEA fit indexes were not acceptable. However, these indices are reported to be very close to the acceptable value.

Structure validity Convergence validity was examined due to the single-factor structure of the scale. The average variance extracted (AVE) value was found 0.697. This value is usually expected to be higher than 0.50. As a result, convergence and structure validity can be accepted.

Reliability The scale's coefficient of internal consistency was 0.94, and the reliability of the composite value was 0.95. Internal consistency and composite values were determined to be higher than 0.70. The reliability values of the scale are high, and the scale produces consistent data.

Use of the scale The scale consists of 8 items and a single factor. Since there is no reverse item in the scale, each item is scored directly. Then, the total score is obtained by summing the scores obtained from 8 items. A score between 8 and 40 is obtained from the scale. As the score obtained from the scale increases, the level of DD increases.

2.2.3 DD component questionnaire (DDCQ)

The DDCQ was used to determine the frequency of students' use of digital devices for non-learning purposes while participating in learning activities during online classes, their extracurricular digital device use purposes, and the reasons for using digital devices for extracurricular purposes.

While determining the scale, the researchers examined the literature in the field. DDCQ used in the study was developed from a questionnaire consisting of 20 questions used in the study of McCoy (2013). The original version of the questionnaire includes the use of digital devices for purposes unrelated to the classroom; frequency, purpose, causes, disadvantages, distraction rate, and the students' attitudes towards digital device use, their views on the policies of the teacher and the school. Within the scope of this study, three questions of the original questionnaire, including the frequency of use of digital devices for non-learning purposes (never, 1—4 times, 5—8 times, 9—12 times, 12 and above), the purposes of using digital devices outside of the classroom (e-mail, web browsing, time checking, gaming, social media posting, others), and the reasons for using digital devices for extracurricular purposes (entertainment, communicating with friends, boredom during virtual lessons, preparing for another lesson, communicating with family, and relatives) were translated into Turkish and used by the researchers. For the face validity, content validity, and linguistic validity of the measurement tool, the opinions of 3 experts on educational technology were taken.

DDCQ consists of three questions. Participants were asked to choose the frequency of use of digital devices for purposes other than learning and to rank the purposes and reasons for using digital devices in order of importance. All participants were given the option to complete the survey or not.

2.2.4 SU scale (SUS)

SUS has been used to determine university students' perception of SU in live class systems. The SUS was developed by Brooke (1996) and adapted to Turkish by the researcher's scope of this study. A preliminary translate-back translate method was used to determine the language equivalency. After translation, expert opinion was obtained from 4 education technologists for content and face validity. Some changes were made to the items per the experts' suggestions.

At the end of the expert opinion, factorial validity studies were started for the scale consisting of 10 items in a 5-point Likert type. For factorial validity, the process is performed the same as DDS.

EFA The KMO value was found to be 0.839, and the Sphericity test result as $\chi^2 = 1004.93$ (p. = 0.000). Since these results show that EFA will be done with the sample, the factor structure was examined by principal component analysis. As a result of EFA, the scale has a structure of 10 items in two factors and explains 59.88% of the total variance (see: Appendix-2 Table 7). In line with these findings, the scale's factorial validities are acceptable (Field, 2013).

CFA The factorial structure obtained from EFA was tested with CFA. As a result of the first-factor analysis, it was decided to modify the two items. Two modifications were made between items 3 to 9 and 6 to 8. As a result of the second CFA, the t values of the items were found to vary between 19.47 and 24.40. Additionally, standard solution values varied between 0.52 and 0.81 (see: Appendix-3 Fig. 3). The fact that the standard solution values are higher than 0.50 and t values higher than 2.56 indicates that the items are important and significant for the factor (Jöreskog & Sörbom, 1996).

As a result of CFA, the fit indices of the model were found to be $\chi 2/df = 1.78$, RMSEA = 0.053, GFI = 0.99, AGFI = 0.98, SRMR = 0.051, CFI = 0.94, NFI = 0.95, and NNFI = 0.91. According to Schermelleh-Engel et al. (2003), $\chi 2/df$, RMSEA, GFI, AGFI, SRMR, NFI, and CFI fit indexes were found at an acceptable level (see:Appendix-4 Table 8). NNFI fit indexes were not acceptable.

Structure validity The discriminant and convergent validity were examined for the construct validity of whether the SU scale measures the construct obtained with factorial validity. In convergent validity, AVE values of 2 factors were examined. AVE values were found to be 0.57 and 0.47, respectively. These values are expected to be greater than 0.50. However, since the second factor is very close to 0.50, it can be said that the scale has convergent validity. For discriminant validity, the square roots of the AVE values of the scale were found to be greater than both the correlation between constructs and 0.50, and it was stated that the scale had discriminant validity (Fornell & Larcker, 1981). The discriminant validity values are shown in Table 1.

Reliability results The scale's coefficient of internal consistency was 0.83, and the reliability of composite value of the factors were 0.87 and 0.81. Internal consistency

Table 1 Discriminant validity values

	F1	F2
F1	0,757	
F2	0,641	0,687

and composite values were determined to be higher than 0.70. The reliability values of the scale are high, and the scale produces consistent data.

Use of the scale The scale consists of 10 items and two factors. When using the scale, either two-factor or ten items are used in a single-factor structure. Since there is no reverse item in the scale, each item is scored directly in both uses. In a single factor structure, the total score is obtained by summing the scores obtained from 10 items. A score between 10 and 50 is obtained from the scale. As the score obtained from the scale increases, the level of SU increases.

2.2.5 GS scale (GSS)

To measure the GS with the system of university students in live classes, the GSS was used. To measure the GS with the system of university students in live classes, the GSS was used. The scale was developed by the researchers within the scope of the research. During the development of the scale, an item pool was created by first reviewing the literature. There were 8 items in the item pool. After the item pool was created, expert opinion was obtained from 4 education technologists for content and face validity. Some changes were made to the items per the experts' suggestions. Factorial validity studies were started for the scale consisting of 7 items in a 5-point Likert type. For factorial validity, the process is performed the same as DDS.

EFA The KMO value was found to be 0.929, and the Sphericity test result as $\chi^2 = 10419.12$ (p. = 0.000). Since these results show that EFA will be done with the sample, the factor structure was examined by principal component analysis. As a result of EFA, the scale has a structure of 7 items in a single factor and explains 77.62% of the total variance (see: Appendix -1 Table 6). In line with these findings, the scale's factorial validities are acceptable (Field, 2013).

CFA The factorial structure obtained from EFA was tested with CFA. As a result of the first-factor analysis, it was decided to modify the three items. Three different modifications were made between items 1 to 2, items 2 to 3, and items 6 to 7. As a result of the second CFA, the t values of the items were found to vary between 10.89 and 16.04. Additionally, Standard solution values varied between 0.62 and 0.82 (see: Appendix-3 Fig. 3). The fact that the standard solution values are higher than 0.50 and t values higher than 2.56 indicates that the items are important and significant for the factor (Jöreskog & Sörbom, 1996).

As a result of CFA, the fit indices of the model were found to be $\chi 2/df = 3.12$, RMSEA = 0.087, GFI = 0.97, AGFI = 0.91, SRMR = 0.030, CFI = 0.99, NFI = 0.98, and NNFI = 0.98. According to Schermelleh-Engel et al. (2003), GFI, AGFI, SRMR, NFI, CFI, and NNFI fit indexes were acceptable (see Appendix-4 Table 8). $\chi 2/df$

and RMSEA fit indexes were not acceptable. However, these indices are reported to be very close to the acceptable value.

Structure validity Convergence validity was examined due to the single-factor structure of the scale. The AVE value was found to be 0.532. This value is usually expected to be higher than 0.50. As a result, convergence and structure validity can be accepted.

Reliability The scale's coefficient of internal consistency was 0.88, and the reliability of the composite value was 0.89. Internal consistency and composite values were determined to be higher than 0.70. The reliability values of the scale are high, and the scale produces consistent data.

Use of the scale The scale consists of 7 items and a single factor. Since there is no reverse item in the scale, each item is scored directly. Then, the total score is obtained by summing the scores obtained from 7 items. A score between 7 and 35 is obtained from the scale. As the score obtained from the scale increases, the level of GS increases.

2.2.6 PL scale (PLS)

Students' PL was measured using the PLS, developed by Horzum et al. (2015). The scale contains 5 items on a 5-point Likert scale. The original scale was developed for distance learners. Since it is used for face-to-face students who receive ERT, the validity and reliability analysis of the data collected within the scope of the research was made using the data of 400 people. Findings related to EFA and CFA are presented in Appendix-2, 3, and 4.

While testing the obtained structure validity of PLS, only convergence validity was examined due to the single-factor structure of the scale. The AVE value was found to be 0.684. This value is normally expected to be higher than 0.50. As a result, convergence and structure validity can be accepted. The scale's coefficient of internal consistency was 0.92, and the reliability of the composite value was 0.91. Internal consistency and reliability of all of the composite values were determined to be higher than 0.70. The reliability values of the scale are high, and the scale produces consistent data.

The scale consists of 5 items and a single factor. Since there is no reverse item in the scale, each item is scored directly. Then, the total score is obtained by summing the scores obtained from 5 items. A score between 5 and 25 is obtained from the scale. As the score obtained from the scale increases, the level of PL increases.

2.3 Procedure

Student participation permission was obtained from Sakarya University. Data collection was conducted via an online questionnaire, ensuring the anonymity of the participants. In the research, it was first examined whether the

Table 2 Mean, standard deviation, and correlations among the variables

Variables	1	2	3
1. Distraction	–		
2. General Satisfaction	−0.549**	–	
3. Perceived Learning	−0.626**	0.799**	–
Mean	22.98	26.06	16.85
Standard deviation	11.14	8.74	6.52

**$p < 0.01$

Table 3 Descriptive analysis results of digital distraction scale items

Items	Mean	Standard deviation
Non-interactive	2.87	1.54
Lack of application	2.83	1.53
Monotony	3.04	1.56
Unattractiveness	2.92	1.58
Lack of motivation	2.90	1.68
Reluctance to attend	2.83	1.59
Inability to understand the topics	2.62	1.57
Long duration	2.97	1.55

assumptions of the variables for the relevant statistics were met. Subsequently, Pearson correlation, coefficient, and structural equation modeling were utilized to determine the relationships between DD, GS, and PL. Maximum likelihood estimations were used in structural equation modeling. Analyses were performed by LISREL 8.54. Also, for the statistical analyses, multiple linear regression analysis was utilized to evaluate how well variables (such as age, gender, working status (working/non-working), participate orientation training, unit of study, which method they follow more for online lessons, and SU) predicted DD. This analysis was performed via SPSS 21 and conducted at the 0.05 significance level.

3 Results

The results of means, standard deviations, and correlations of this study represent a significant correlation between DD, GS, and PL. DD was found to be negatively correlated with GS (r = -0.55) and PL (r = -0.63). GS has a positive correlation with PL (r = 0.80). These findings support Hypothesis 1 and are shown in Table 2.

In the study, mean and standard deviation scores were also calculated for eight items of the DDS. The obtained values are presented in Table 3.

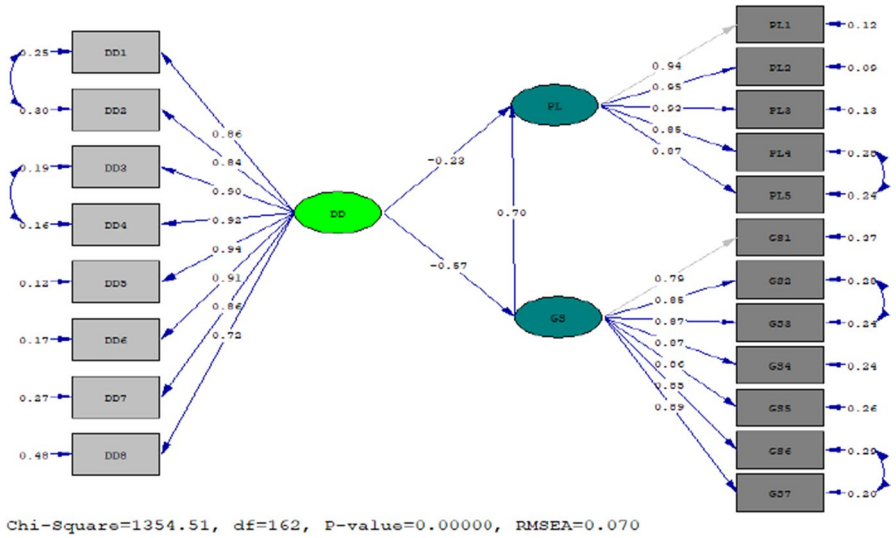

Fig. 2 Path Analysis between digital distraction, general satisfaction, and perceived learning

When Table 3 is examined, it is seen that the items with the highest DD are monotony, long duration, unattractiveness, and lack of motivation, respectively. These findings show that having an effective instructional design reduces DD.

3.1 Structural equation modeling

The results of the SEM analysis are presented in Fig. 2. The model exhibited a acceptable fit (χ^2 /df = 8.36, GFI = 0.92, SRMR = 0.47, AGFI = 0.89, CFI = 0.99, NFI = 0.99, IFI = 0.99, and RMSEA = 0.070). Furthermore, DD accounted for 32% of the GS and 39% of the PL variance, and GS accounted for 34% of the PL variance.

The standardized coefficients in Fig. 2 clearly showed that DD was predicted negatively by interaction (-0.23) and course structure (-0.57). Also, PL was explained positively by GS (0.70).

Table 4 Regression analysis with digital distraction as a dependent variable and gender, age, work status, program, orientation, and course follow-up as predictor variables

	B	S. E	Beta	T	p
Constant	28.454	1.933		14.718	< 0.001
Gender (0 = female)	−1.935	0.568	−0.085	−3.406	0.001
Age	−0.480	0.056	−0.223	−8.628	< 0.001
Work Status (0 = working, 1 = non-working)	1.427	0.661	0.058	2.159	0.031
Program (1 = graduate)	1.397	1.189	0.029	1.174	0.240
Orientation (0 = Yes)	3.625	0.635	0.140	5.713	< 0.001
Course Follow-up (0 = live virtual lesson)	2.872	0.566	0.126	5.077	< 0.001

3.2 DD and demographic variables

A multiple linear regression analysis was conducted to evaluate how well the demographic independent variables predicted DD scores. These findings are shown in Table 4 (total model: $F_{6, 1525} = 32.200$, $p < 0.001$, Adjusted $R^2 = 0.109$).

When Table 4 is examined, it has been found that gender, age, work status, participate or not in the orientation training, and the follow-up the lessons are significant predictors of DD. This finding partially supports hypothesis 2. Among the students participating in the research, it was found that the DD scores of the females, those who did not work in any job other than being a student, those who did not participate in the orientation training, and the students who followed their lessons more by playback were higher. It was also revealed that as the age of the students decreased, the DD scores increased. In addition to all these, the program in which the students studied was not found to be a significant predictor of DD.

3.3 DD and DD variables

A second multiple linear regression analysis was conducted to evaluate how well the DD variables predicted DD scores. These findings are shown in Table 5 (total model: $F_{14, 1517} = 182.983$, $p < 0.001$, Adjusted $R^2 = 0.625$).

When Table 5 is examined, it was found that DD amount, sending instant messages, controlling the clock, boredom, social media posting, and SU scores are significant predictors of DD. This finding supports hypothesis 3. Among the students participating in the research, the DD scores of those who think

Table 5 Regression analysis with digital distraction as a dependent variable and digital distraction amount, digital distraction tool, digital distraction reason, and system usability score as predictor variables

	B	S. E	Beta	T	p
Constant	25.945	1.254		20.687	< 0.001
DD amount	1.477	0.200	0.151	7.388	< 0.001
Instant Messaging	0.456	0.172	0.062	2.651	0.008
E-mail	-0.199	0.158	-0.023	-1.255	0.210
Web surfing	-0.050	0.185	-0.006	-0.270	0.787
Checking clock	0.801	0.133	0.108	6.004	< 0.001
Game play	0.105	0.229	0.011	0.457	0.648
Sharing Social Media	-0.449	0.219	-0.049	-2.054	0.040
For Fun	-0.227	0.180	-0.029	-1.259	0.208
Connecting friends	0.154	0.185	0.020	0.833	0.405
Connecting Family	-0.113	0.153	-0.015	-0.739	0.460
Boredom	2.655	0.170	0.370	15.628	< 0.001
Preparing for another lesson	0.097	0.145	0.012	0.669	0.504
System Usability	-0.431	0.022	-0.372	-19.840	< 0.001

that the usability of the system is low, who are bored, who check the time, who send instant messages, and who have a high amount of DD, were also found to be high. Besides, it was determined that other variables were not significant predictors of DD.

4 Discussion

The main objective of this study is to investigate the relationships among DD, PL, SU, and GS in ERT. The main findings of the research are that a scale was created to measure DD and that the results obtained with this scale are captured with variables that influence and are influenced by DD. The conclusion and discussion part of the study are presented, considering each research question.

Hypothesis 1: DD, GS, and PL variables are interrelated

The research findings support the expectation that DD was a significant predictor of GS and PL and that increases in DD had a negative effect on GS and PL. This situation suggests that DD is one of the most important factors affecting GS and PL in ERT (Hypothesis 1.a and 1.b). In ERT, the unplanned transfer of traditional teaching methods and resources to online environments and the implementation of the educational process based entirely on live classes are considered important factors in terms of the study findings. These factors have a negative impact on the basic structure and functioning of distance education. It is seen that student content interaction in terms of satisfaction and students' online learning self-efficacy in terms of PL is the most important factor (Alqurashi, 2019). Students experiencing DD are impeded in their learning and this affects their PL (Flanigan & Titsworth, 2020). As students who experience DD leave the learning activity and engage in another activity or are distracted by focusing on another item. In contrast, the learning process continues, and adverse learning activity outcomes occur as the continuity of the learning activity is removed.

The study by Patil et al. (2019) pointed that students who faced DD performed worse on homework and took longer to complete. Since DD also affects interaction and self-efficacy, it is expected to affect PL and GS. Therefore, to increase satisfaction and PL, technology-based applications in educational processes delivered through distance learning methods should be designed to prevent or minimize students' DD. Depending on the PL and GS factors, components such as learning outcomes, course design, measurement, and evaluation should be developed according to the remote teaching model.

In addition, PL was explained positively by GS (Hypothesis 1.c). This is an expected finding and some studies also show a relationship between general satisfaction and perceived learning (Alqurashi, 2019; Baloran & Hernan, 2021; Eom et al., 2006; Hong et al., 2003).

Hypothesis 2: Demographic variables of age, gender, participation in orientation training, working at a job, and follow-up lessons are significant predictors of DD

In the study, gender, age, working and non-working, participation in orientation courses, and follow-up to classes were important predictors of DD. DD scores were higher among students who were females, who were of low age, who were not employed, who had not participated in orientation training related to distance learning, and who were not following the live class and watching it later. Similarly, Chen et al. (2014) found that the intensity of DD is influenced by a student's gender, age, online time, and instructor subject characteristics of a student. In addition, the age of the students is negatively related to DD and the tendency of DD decreases as the age of the students' increases. These findings support the result of the research. On the contrary, in a study by Wu and Cheng (2019), it was concluded that women experience less DD than men. The reason for this different finding may be the measurement method, the medium, or the culture of DD.

Another study showed that students who work in any job experience less DD than those who do not work, and seniors experience less DD than lower classes (Selwyn, 2016). These findings support the result of this study. In the studies, women multitask more than men and use the phone more than men, so they experience more DD (Lian et al., 2016; Throuvala et al., 2021). According to the BTK Digital Gaming Report published in Turkey in 2020, on average, 79% of adults play mobile games, with 81.7% of this rate consisting of women and 76.5% of men (Bilgi Teknolojileri ve İletişim Kurumu (BTK), Turkiye, 2020). The social media usage study conducted by Perrin (2015) in 2005–2015 also states that 68% of women and 62% of men use social media. Women use social media and mobile devices more than men, so they can be expected to be exposed to DD. Students who are not employed may be more digitally distracted because they have more free time than employed students. In addition, students who did not attend the ERT orientation training may have experienced DD due to adaptation to the system and cognitive overload. It can be assumed that the students who follow their lessons via playback can pause the online replays of the lessons whenever they want and return to the lesson whenever they want, thus postponing the situation they need to focus on to the second schedule, and the rate of DD is higher than the students who follow their lessons live.

In light of these findings, applications can be developed to guide individuals with the help of learning analytics in learning management systems where access to live lessons and replays is provided. Thus, the course contents should be designed in a way that interacts and attracts the attention of the students.

Hypothesis 3: The number of DD, DD tools, and DD causes variables are significant predictors of DD

In this study, findings showed that the amount of DD, sending instant messages, checking the time, boredom, sharing social media, and rating the ease of use of the system are significant predictors of DD. Students who thought that

SU was low were bored, frequently checked the time, sent instant messages, and had a high amount of DD were found to have high DD scores. In addition, the study's findings show that the items with the highest DD are monotony, long courses, unattractiveness, and lack of motivation, respectively. This finding indicates that DD occurs when the system is not useful and the content is not designed effectively. When instructors create an engaging learning environment in the classroom, students show more interest, participate actively, and suffer less from inattention in class (Voelkl, 1995). On the other hand, if an instructor cannot provide an engaging environment, students are more likely to suffer from attention deficits in the classroom (Taneja et al., 2015). It has been revealed that this situation is similar in distance education.

Furthermore, Douglas et al. (2012) stated that experience rates with digital and DD averaged 3 times per lesson, but observational data could be much higher. These results indicate that effective instructional design reduces DD. The findings showed that distance education systems and the system's content must be designed effectively.

5 Conclusion

The conclusion is that age, gender, participation in orientation courses, working or non-working, the following lesson (live/playback), boredom, and the system's usability lead to DD. On the contrary, it was found that there were no significant variables in DD for program, e-mail, web surfing, game play, for fun, connecting friends/family and preparing for another lesson. DD has been shown to impact GS and PL negatively. In addition, it was revealed that PL was a significant predictor of positively in GS.

6 Limitations

As with previous studies, this study has some limitations that should be considered when evaluating the results. One of these limitations is that the data were collected using a questionnaire based on personal statements. For future studies, it is recommended that data be collected using real-time participant data (digital footprints in the system) or real-time behavioral data (eye-tracking, keyboard/mouse prints, tracking data, etc.). In addition, the results may not be generalizable to a broader student population because the survey used in the study was conducted only among students at the national level. Because of this limitation, a larger student population at randomly selected international universities may be surveyed in future studies.

The study discussed PL and GS as learning outcomes. It is recommended that the impact of DD on learning outcomes, such as readiness, interest, motivation, attitude, success, etc., should be studied. In addition, it is recommended that future studies examine the effects of factors such as student chronotype, learning style, and teacher teaching style on DD.

Appendix 1

Table 6 Scales

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Digital Distraction					
Live virtual classes being non-interactive led to digital distraction.	( )	( )	( )	( )	( )
Lack of application in Live virtual classes led to digital distraction	( )	( )	( )	( )	( )
The monotony of Live virtual classes led to digital distraction	( )	( )	( )	( )	( )
The unattractiveness of Live virtual classes led to digital distraction.	( )	( )	( )	( )	( )
My lack of motivation while watching Live virtual classes led to digital distraction	( )	( )	( )	( )	( )
Reluctance to attend virtual classes led to digital distraction	( )	( )	( )	( )	( )
My inability to understand the topics covered in virtual lessons led to digital distraction.	( )	( )	( )	( )	( )
The long duration of virtual lessons led to digital distraction.	( )	( )	( )	( )	( )
System Usability					
I think that I would like to use virtual lesson system frequently.	( )	( )	( )	( )	( )
I found the virtual lesson system unnecessarily complex.	( )	( )	( )	( )	( )
I thought the virtual lesson system was easy to use.	( )	( )	( )	( )	( )
I think that I would need the support of a technical person to be able to use virtual lesson system.	( )	( )	( )	( )	( )
I found the various functions in virtual lesson system were well integrated.	( )	( )	( )	( )	( )
I thought there was too much inconsistency in virtual lesson system.	( )	( )	( )	( )	( )
I would imagine that most people would learn to use virtual lesson system very quickly.	( )	( )	( )	( )	( )
I found the virtual lesson system very cumbersome to use.	( )	( )	( )	( )	( )
I felt very confident using the virtual lesson system.	( )	( )	( )	( )	( )
I needed to learn a lot of things before I could get going with virtual lesson system.	( )	( )	( )	( )	( )
General Satisfaction					
I did not have any difficulties while using the live virtual class lesson system.	( )	( )	( )	( )	( )
I love using the live virtual class lesson system.	( )	( )	( )	( )	( )

Table 6 (continued)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I learned about my lessons using the live virtual class system.	( )	( )	( )	( )	( )
I was able to easily follow my lessons (live lessons and replays) on the system.	( )	( )	( )	( )	( )
I was able to easily participate in my exams on the system.	( )	( )	( )	( )	( )
I was able to easily follow the course announcements on the system.	( )	( )	( )	( )	( )
I was able to easily follow the course materials on the system.	( )	( )	( )	( )	( )
Perceived Learning					
I was able to learn the relationships on important topics in the course materials	( )	( )	( )	( )	( )
I was able to understand of the basic concepts in the materials.	( )	( )	( )	( )	( )
I learned to identify the central topics of the lessons.	( )	( )	( )	( )	( )
I improved my ability to communicate openly about topics.	( )	( )	( )	( )	( )
I improved my ability to generalize and integrate events in course materials.	( )	( )	( )	( )	( )

Appendix 2

Table 7 EFA results of the scales

Scale	Item	Factor loadings	Component matrix	
Digital Distraction	1	0.700	0.836	
	2	0.683	0.827	
	3	0.802	0.896	
	4	0.757	0.870	
	5	0.812	0.901	
	6	0.705	0.840	
	7	0.706	0.840	
	8	0.522	0.723	
	Eigen Values = 5.69, % of Variance = 71.08			
General Satisfaction	1	0.693	0.832	
	2	0.764	0.874	
	3	0.798	0.893	
	4	0.790	0.889	
	5	0.780	0.883	
	6	0.774	0.880	
	7	0.834	0.913	
	Eigen Values = 5.43, % of Variance = 77.62			
Perceived Learning	1	0.797	0.836	
	2	0.784	0.827	
	3	0.780	0.896	
	4	0.700	0.870	
	5	0.755	0.901	
	Eigen Value = 3.82, % of Variance = 76.31			
			F1	F2
System Usability	1	0.481	0.690	
	2	0.616		0.701
	3	0.689	0.797	
	4	0.579		0.753
	5	0.663	0.812	
	6	0.571		0.730
	7	0.588	0.735	
	8	0.528		0.726
	9	0.703	0.813	
	10	0.572		0.743
	Eigen Values (Tot. = 5.99)		4.21	1.78
	% of Variance (Tot. = 59.88)		42.08	17.80

Appendix 3

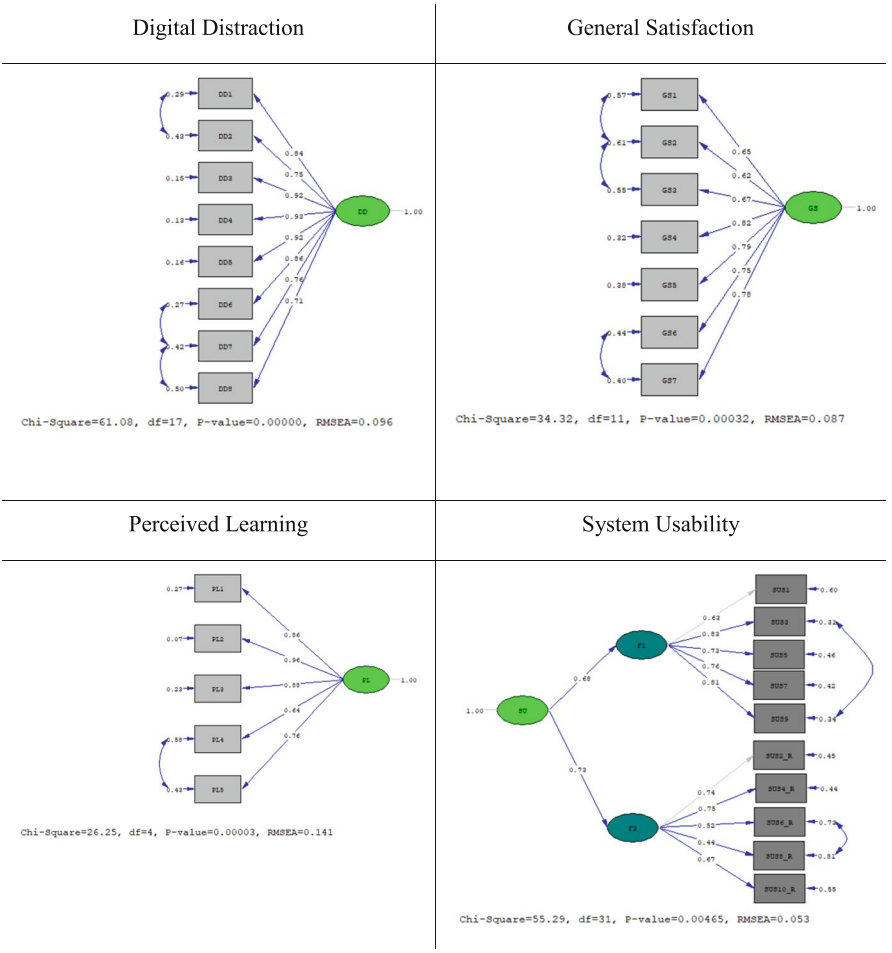

Fig. 3 Standard solutions of the scales

Appendix 4

Table 8 Model indexes

Acceptable values	DDS	GSS	PLS	SUS
$2 < \chi^2/df \leq 3$	3.59	3.12	6.56	1.78
$0.05 < RMSEA \leq 0.08$	0.096	0.087	0.141	0.053
$0.95 \leq CFI < 0.97$	0.99	0.99	0.98	0.95
$0.90 \leq NFI < 0.95$	0.98	0.98	0.98	0.92
$0.95 \leq NNFI < 0.97$	0.98	0.98	0.96	0.91
$0.90 \leq GFI < 0.95$	0.95	0.97	0.96	0.99
$0.85 \leq AGFI < 0.90$	0.89	0.91	0.86	0.898

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Declarations

Declaration of conflicting interests The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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