Editorial policies

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Open Praxis welcomes contributions which demonstrate creative and innovative research, and which highlight challenges, lessons and achievements in the practice of distance and e-learning from all over the world.

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This second Open Praxis issue in 2020 includes nine research papers, authored by 32 researchers from nine different countries: Turkey, USA, Germany, United Kingdom, Canada, Japan, South Africa, Spain and China.

In the first paper (Development and validation of a scale to measure volition for learning), John M. Keller from the USA and Hasan Ucar and Alper Tolga Kumtepe from Turkey, present a new valid and reliable scale for measuring volition for learning, including two factors: volition planning and volition control, of online and face to face learners.

The next three papers, all of them from Turkey, present similar quantitative studies that have used different scales for data collection, and correlation, linear regression and/or structural equation modelling for data analysis. They examine different theoretical models to explain learners’ engagement, achievement or satisfaction in e-learning environments. The three studies include e-learning readiness, conceptualized in different ways, as an independent variable.

In the first paper (Exploring the Predictive Role of E-Learning Readiness and E-Learning Style on Student Engagement), Esin Ergün and Fatma Betül Kurnaz Adıbatmaz from Karabuk University, use multiple regression analysis to explore the relation between two variables and the students’ engagement during the learning process.

In the second paper (Online Distance Learning in Higher Education: E-learning Readiness as a Predictor of Academic Achievement), Emel Dikbas Torun from Pamukkale University, focuses on the relation between e-readiness and achievement, understood as the average of the midterm and final grades of an English as a Foreign Learning course.

In the third paper (Examining e-Learners’ Preferences and Readiness Satisfaction: A Holistic Modelling Approach), Hale Ilgaz and Yasemin Gülbahtar from Ankara University, test the validity of a theoretical model that relates learning preferences, e-readiness and satisfaction at the end of the semester in an e-learning environment.

Following these quantitative research studies, Isa Bingol, Engin Kursun and Halil Kayaduman (Factors for Success and Course Completion in Massive Open Online Courses through the Lens of Participant Types), from Turkey, use a qualitative approach to explore the factors that lead to completing (finishing) a MOOC and to succeeding (completing a MOOC successfully). Through interviews with learners with different level of involvement in MOOCs, they explore personal, technical, instructional, course design and affordability related dimensions that affect course completion and success in MOOCs.

The next four papers relate, specifically, to resources that can be used in open and distance education; the first three papers refer to open educational resources (OER), going from an international comparative perspective to a specific course case study.

A large international team led by Victoria I. Marín and linked to the Center for Open Education Research (COER) at the Carl von Ossietzky University of Oldenburg (Germany), presents A Comparative Study of National Infrastructures for Digital (Open) Educational Resources in Higher Education. The paper reports about the situation in 10 countries, providing a comparative overview...
and covering topics such as national policies for OER and quality assurance of open educational resources in higher education.

In the next paper (*Effective Pedagogical Strategies for STEM Education from Instructors’ Perspective: OER for Educators*), Meina Zhu, from the USA, uses 15 MIT OCW Courses from the Department of Electrical Engineering and Computer Science as inputs to explore and identify the pedagogical strategies, the assessment methods and the challenges the instructors of the courses present in the documents available at the MIT OCW site (‘instructor insights’). The findings compile a set of strategies from a pioneer institution in relation to OER that provide insight to researches and practitioners.

Caitlin Finlayson (*Opening World Regional Geography: A Case Study*), from the USA, undertakes a survey-based case study that shows the positive benefits of the shift from a traditional textbook to an open one in a specific course. She highlights students’ perceptions and explains how this textbook change facilitated the whole course redesign, having a clear impact on the teaching practices.

Finally (*The usability of augmented reality in open and distance learning systems: A qualitative Delphi study*), Hakan Altınpulluk, Mehmet Kesim and Gulsun Kurubacak, from Turkey, present a qualitative study based on universal design principles to examine the usability of augmented reality in open and distance learning environments. The Delphi study leads to the identification of 92 themes to consider in the use of augmented reality in education, that are presented in a complete table in the paper.

Special thanks from *Open Praxis* to the authors and reviewers who have contributed to this issue. We wish the different contributions, that provide useful resources, models and recommendations, will foster reflection, discussion and good practice in open and distance education.
Development and validation of a scale to measure volition for learning

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Abstract
Volition explains the transition from desire, or motivation, to action especially when faced with competing goals. In learning environments, the concept refers to acting with the aim of achieving learning objectives. Despite the importance of volition in learning environments, research has rarely addressed the volition construct. Thus, the purpose of this study was to explore and develop a valid and reliable scale to measure the volition construct in online and face to face learning environments. The data for this research were collected from 594 undergraduate online learners who also took some courses face to face at a state university in Turkey. After analyzing the validity and reliability of the scale, a two-factor, 13-item volition for learning scale was developed. The scale was comprised of two factors: action planning and action control. Confirmatory factor analysis results confirm the factor structure of the scale. Results indicated that the volition for learning scale is a valid and reliable instrument that can be utilized to measure learners’ volition in learning environments.

Keywords: Motivation, volition, scale development, measurement, online learning

Introduction
In learning environments, some learners have clear objectives and motivations, as well as their own strategies and methods for success. These learners, however, may sometimes feel worn out and confused if they are distracted, and in this case, may need volitional competence, which is different from motivation, to achieve their objectives (Dewitte & Lens, 1999; Kim & Keller, 2008). Motivation refers to having an objective and developing plans to achieve this objective, while volition (taking action) refers to acting with the aim of achieving these objectives (Achtziger & Gollwitzer, 2018; Brophy, 2010). In a broader sense, volition means more than just self-regulatory skills, referring rather to the regulation of cognitive, motivational and effective processes to achieve the necessary tasks on the way to completing challenging undertakings (Bartels, Magun-Jackson, & Kemp, 2009; Corno & Kanfer, 1993; Dewitte & Lens, 1999; Kuhl, 1987). The volition factor that has been added to the ARCS-V (attention, relevance, confidence, satisfaction, and volition) model of motivational design relates to situations in which a learner acts after becoming motivated to achieve an objective (Deimann & Bastiaens, 2010; Keller, 2010; Kim & Keller, 2010). When learners are not motivated enough, they tend to procrastinate (Grund & Fries, 2018). Therefore, using effective motivational and volitional strategies reduce procrastination behaviors of the individuals (Shanahan & Pychyl, 2007). In this sense, volitional competence could be considered as a complementary part of learner motivation (Angelo, 2017).
The volition factor is mainly based on Kuhl’s theory of “volitional control” (1987), Zimmerman’s theory of “self-regulatory learning” (1989) and Gollwitzer’s theory of “implementation intentions” (Gollwitzer, 1993; Deimann & Bastiaens, 2010; Keller, 2010). Learners take action to achieve their goals once they are motivated in the learning process; in other words, as explained in ARCS-V model, after the attention, relevance and confidence steps are completed. At this stage, the instructor employs various tactics and strategies in motivational design to encourage learners to take action, and as a result put effort into achieving their goals. The volition factor promotes the attention, relevance and confidence drivers in ARCS-V model. So, it is a crucial element for learners to maintain their motivation and feel satisfied. In this context, the volition factor plays a key role and serves as a bridge between all aspects of the model. Keller (2008a, 2008b, 2010) emphasizes that learners will be motivated to learn and will feel satisfied after the first three factors (attention, relevance, and confidence) are successfully applied in the learning process. However, the volition factor, which was added later to the model, plays a unique and necessary role linking the first three factors with satisfaction (Keller & Deimann, 2012).

Motivation in learning environments expresses the expectations and desires of the learners. In learning environments, learners need to have sufficient motivation to achieve their goals. However, within this context, although motivation is necessary, sometimes it is not a sufficient condition. Motivated learners should also have the necessary volition competency to reach their goals (Keller, 2010; Kim & Keller, 2010). Motivation refers to having a specific goal and developing plans for that goal. On the other hand, volition means taking action to achieve these goals, endeavoring to achieve the plans, and ultimately reaching the goal. Volitional support is necessary when there is resistance to realizing or reaching these expectations. In this respect, volition helps administrators, teachers, and learners to remove these resistances to reach the goals set in learning environments (Gollwitzer, 2015; Ottingen, Schrage, & Gollwitzer, 2016). Within these concerns in mind, this study targeted to contribute to literature on learning by presenting an applied measure of volition that can be used to evaluate the learners’ volitional competency and integrated with the ARCS-V model. The conceptual foundation for this model has already been established (Keller, 2008a) and will now be supported by a volition scale that can be added to the model for better understanding the individual differences in learning environments.

**Motivation and learning**

Similar to the general paradigm shifts in the field of education, there have been considerable trends in regard to conceptualizing motivation. In face-to-face and online learning environments, counseling, guidance, support, and incentives are considered to be external effects for learners. In extensive learning environments where massive open online courses are conducted, the presentation of content prepared previously by the tutor and assessment based on that content can be given as an example of a behavioral approach (Bonk & Khoo, 2014). Researchers have introduced different perspectives to the behavioral approach to make sense of learning processes and types. By the end of the 1950s, a paradigm shift had begun to take place in learning theory in which educators began to better understand learning processes, and placed emphasis on more sophisticated cognitive structures, such as reasoning, problem-solving, information processing and language, rather than on behaviors that can be easily observed (Ertmer & Newby, 1993). Through such a cognitive approach, more sophisticated structures related to learning began to come into prominence with the advent of computers and other ICTs in education. In this approach, learning is considered to be a process of knowledge acquisition, and the instructor is seen as a consultant who conveys information,
provides meaningful learning experiences and increases motivation to facilitate learning. In learning environments, cognitive psychology has been considered to harmonize teaching materials, motivation and learning strategies to suit the learners' learning styles (Bonk & Khoo, 2014). However, in the constructivist approach, learners relate to, make discoveries, learn and make sense of things based on their past learning and experiences. In this regard, it is the learner who is at the core rather than the instructor, who is seen as a facilitator and guide. It is, therefore, very important that the instructor uses motivational strategies to support learners and to improve learning.

Of the many concepts and theories of human motivation, one that has proven to be valid and practical for measuring and promoting learning motivation is called the “ARCS” model (Keller, 2010). This acronym is based on the four primary components of this theory which integrates attention (A) getting activities, such as curiosity arousing tactics, with stimulus characteristics that generate a sense of relevance (R) or perceived importance of the subject matter, combined with confidence (C) in one’s ability to learn it, and stimuli that confirm one’s success and provide a positive feeling of satisfaction (S). Each of these four components contains subcomponents and together they provide a holistic model of motivation to learn.

This model has been empirically validated in many contexts and is supported by measurement instruments that have been translated into numerous languages (Keller, 2010). However, one limitation of the model has been in the area of volition (Keller, 2008a) which is a concept that explains the transition from desire, or motivation, to action especially when faced with competing goals. A strong desire can lead directly to actions aimed at achieving given goals but not always. For example, assume that on Thursday I need to finish writing a term paper before it is due on Friday morning, but an unexpected invitation to play soccer with friends that afternoon could cause me to fail to achieve this goal. This is when volition becomes important. In order to achieve my goal in spite of this appealing distraction, I must use volitional strategies that strengthen my determination to stay on task. Thus, in order to study situations such as this and design interventions, it would be useful to have a measure of volition to supplement the four ARCS components.

The concept of volition was added to the ARCS model (Keller, 2008a) making it the ARCS-V model but a problem was that there was no efficient way to measure it. There are well-known concepts and measures related to volition such as action control (Kuhl, 1987), implementation intentions (Gollwitzer, 1999), and self-regulation (Zimmerman, 1989), but none of them is suitable for applied settings which require brief but effective measures especially when used in combination with other measures.

**Measuring volition**

Even though there are some instruments being used in both online and face to face learning environments to measure the volition construct, these instruments are not suitable for applied settings which require brief but effective measures, especially when used in combination with other measures related to motivational design model. For example, the Volition Persona Test (VPT) developed by Deimann, Weber and Bastiaens (2009), consists of 32 items measuring volitional competency of online learners in four factors, namely, volitional self-efficacy, consequence control, emotion control, and meta-cognition, but it does not address volition for learning. Instead, it addresses the level of volitional competency of learners. In this sense, the Volition Persona Test is a diagnostic tool. Similarly, the Academic Volitional Strategy Inventory (AVSI) (McCann & Turner, 2004) consists of 20 items with three factors assessing learners’ propensity for volitional control in academic environments. The scale mainly focuses on learners’ emotion and motivation. In another
approach Kuhl and Fuhrmann (1998) developed the Volitional Components Inventory (VCI) as a measure of volition in regard to volition competency, self-reflection, and volition inhabitation domains. The scale primarily focuses on beliefs, needs, and experiences of a person to his/her personal goals and expectations of others. Even though these scales are important and have value and expediency in their context, none of them specifically measures volition for learning nor are they compatible for integration with other elements of motivation as in the ARCS-V model. Also, the existing measurement scales of volition cannot be used to get volition for learning in interactive learning environments. Most of the learners, today, have touchy motivation and are easily dropping out the learning environment. Being able to measure the students’ volition for learning creates opportunities for using appropriate instructional designs and strategies in learning environments. The present new scale will allow instructional designers, instructors, and researchers to study volition for learning of students in both online and face to face learning environments. More specifically, this study aims to develop a reliable and valid scale to measure volition for learning to be used in the context of ARCS-V model in online and face to face learning environments. Therefore, the research questions for the present study are as follows:

1. To what extent can volition for learning be measured by a new measurement scale?
2. Does the volition for learning scale developed in the present study produce an acceptable level of reliability and validity?

Research methodology

Scale development

The scale development process and steps proposed by DeVellis (2012), Germain (2006), Hinkin, Tracey and Enz (1997), Netemeyer, Bearden and Sharma (2003) were taken into consideration in the development of the volition for learning scale (VFLS). In this process, research data were gathered from the learners who took online courses at a state university in Turkey. In addition to this, feedback was received from five field instructors who were working in the field and face-to-face interviews were held on the understanding of the scale items at two different times and with different groups of learners. The final state of the scales was obtained by performing explanatory and confirmatory factor analysis. SPSS 23.0 and Mplus 7 (Muthen & Muthen, 2012) programs were used in the reliability and validity analyses of the scale.

Determining the construct dimensions

In this study, volition for learning was addressed in the context of online learning motivation and volition to learn. This measure was based on Keller’s (2008a) motivation, action and performance (MVP) theory, ARCS-V motivation design model, and Kuhl’s (1987) action control theory. In order to understand the basic structure and conceptual framework of volition competency at the highest possible level, the researchers searched and reviewed the existing literature and content analysis were conducted accordingly. Besides, the previous scales related to volition concept were examined. Once the volition construct and its probable sub-components were defined, the researchers thought clearly about the construct to be measured. After understanding and determining the scope of the construct grounded in the related theories, questions as bases of the construct were formed. Within the substantive literature related to volition construct to be measured, two dimensions come up: volition planning and volition control.
Generating and reviewing the Item pool

Once the aim of the measurement scale has been defined clearly, the researchers began to write items. A set of 64 volition for learning items related to the two domains was initially generated from a review of a literature and content analysis. During the item pool generation, Volitional Components Inventory (Kuhl & Fuhrmann, 1998), Academic Volitional Strategy Inventory (McCann & Turner, 2004), and Volition Persona Test (Deimann et al., 2009) instruments were examined.

In order to ensure the content validity of the instrument, three experts reviewed the initial item pool. The experts have carried out research on motivation and volition. According to construct domain, experts are asked to assess each item using a 4-point measurement scale in which 1 stood for not representative and 4 stood for strongly representative. After the experts assessed the items and provided suggestions for some items, the researchers analyzed the results and comments. Accordingly, decisions were made on refinement of the items based on conformity at least between two experts. As a result of this refinement, a set of 57 items, 46 positive and 11 negatives, were decided for the instrument. After this process, the instrument was sent to another four experts who are proficient in scale development. These experts checked the items in terms of ambiguity. Some items were revised according to the experts’ suggestion. Then, the survey items were reviewed by 13 undergraduate seniors who took online courses before. The students responded to each item and discussed the items that seemed unclear or difficult to respond. Accordingly, the researchers revised the survey.

The items in the volition scale are written in the form of declarative statements; therefore, a 5-point Likert-type scale format was adopted. Participants indicated a varying degree of agreement with the statements. Participants scored the items on the Likert-type scale to measure each item ranging from completely disagree (1) to completely agree (5).

Data collection

The developed scale was administered at the end of the fall semester of the 2017–2018 academic year at Bilecik Seyh Edebali University, a state university, in Turkey. The reference population of the present study was students who were taking online English course at the university. There were 4,832 first-year college students taking at least one online course. Data for this study was collected through convenience sampling method from students enrolled in five faculties at the university. Regarding the sample size, even though there is no consensus on this matter, a sample size of 300 is generally accepted as an adequate number (DeVellis, 2012; Netemeyer et al., 2003, Tabachnick & Fidell, 2007) in scale development studies. In this study, it was aimed to have at least 10 participants per item. For this purpose, it was aimed to reach at least 570 participants for the initial scale that was comprised a pool of 57 items. Therefore, a total of 750 scale forms were distributed considering unreturned and incomplete forms. The scale was administered in two weeks and 617 scale forms were returned indicating a response rate of 82.3%. Of these returned scale forms, 23 were omitted because of incomplete items and the final data were driven from 594 forms available. Of the participants, 311 were female (52.4%) and 283 were male (47.6%). The majority of the participants (276 females, 232 males) were in the age group of 18 to 20. Students in this age group comprised 85.5% of the sample (508 students). Other respondents (35 females, 51 males) were in the age group of 21 and above and this group comprised 14.5% of the sample (86 students).
Refining of the measurement scale

Descriptive statistics of the instrument were examined before the scale was tested for validity and reliability. In this context, corrected item-total correlations and skewness and kurtosis values of the items were examined. The values of items for skewness and kurtosis measures were between -1 and +1. These values are considered acceptable for normal distribution (Huck, 2012). Then, in order to refine the measurement corrected item-total correlations of items were computed. For initial assessment and purification, items loading at 0.4 and above were retained for a valid and reliable measuring instrument (Chen, Bao, & Huang, 2014; Gliem & Gliem, 2003; Kim, Ritchie, & McCormick, 2012). Based on this criterion, items with the corrected item-total correlation of <0.4 were deleted. Within this context, 18 items (r <0. 4) with a low correlation and discriminative value were subtracted from the scale. This process resulted in 39 items. Accordingly, after this procedure, the internal consistency reliability coefficient (Cronbach’s alpha) of the scale increased from 0.919 to 0.937.

Exploratory factor analysis (EFA) was carried out on the remaining 39 items. Before performing EFA, the validity of the data for factor analysis was examined. For this purpose, the Kaiser-Meyer-Olkin (KMO) test was performed to determine the adequacy of sampling and the Bartlett’s Test of Sphericity was conducted to determine if there was a sufficient relationship between variables. The Kaiser-Meyer-Olkin (KMO) value was 0.943 and the Bartlett's Test of Sphericity was 8986.729, the degree of freedom= 741 and p<0.001. These results pointed out that the factor analysis was appropriate and would yield reliable results.

In the factor determination phase, when deciding on how many factors to be extracted, the parallel analysis method which is one of the reliable and popular methods was used. In parallel analysis, random data are generated parallel to the real data to determine the number of factors, and the eigenvalues of this parallel data are found. Then, by comparing the eigenvalues of the parallel data with the real data, the place where the parallel data eigenvalue is higher than the real eigenvalue is regarded as the appropriate factor number (DeVellis, 2012). As a result of parallel analysis, two factors were extracted for the scale. Table 1 shows the descriptive statistics of the items included in two factors.

<table>
<thead>
<tr>
<th>Item code</th>
<th>Item</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Corrected item-to-total correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VP7</td>
<td>My commitment to achieve the goals in this class was strong relative to the goals in my other classes.</td>
<td>3.19</td>
<td>1.247</td>
<td>-.169</td>
<td>-.898</td>
<td>0.447</td>
</tr>
<tr>
<td>VP8</td>
<td>I set up goals for my learning.</td>
<td>2.93</td>
<td>1.283</td>
<td>.025</td>
<td>-1.002</td>
<td>0.429</td>
</tr>
<tr>
<td>VP10</td>
<td>I was confident that I could avoid obstacles while doing my work.</td>
<td>3.16</td>
<td>1.222</td>
<td>-.190</td>
<td>-.841</td>
<td>0.449</td>
</tr>
<tr>
<td>VP11</td>
<td>I was prepared to work hard to achieve my goals no matter what my other classes required.</td>
<td>2.95</td>
<td>1.265</td>
<td>-.190</td>
<td>-.978</td>
<td>0.434</td>
</tr>
<tr>
<td>VP12</td>
<td>I was able to prepare a study plan that listed concrete tasks.</td>
<td>2.40</td>
<td>1.188</td>
<td>-.190</td>
<td>-.669</td>
<td>0.434</td>
</tr>
</tbody>
</table>
When making decision on keeping an item, the factor loading and the communality value of the items (r > 0.40) are checked through. Items with cross-loadings, a difference less than 0.10 between items, were extracted one after another. As a result, a two-factor structure with 13 items was gathered (Appendix A). The Cronbach’s alpha scores for the two extracted factors demonstrated acceptable values (Table 2).

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### Table 2: Exploratory factor analysis results for VFLS

<table>
<thead>
<tr>
<th>Dimensions and items</th>
<th>Factor loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factor loadings</strong></td>
<td><strong>Factor 1</strong></td>
</tr>
<tr>
<td><strong>Dimension 1: Volition Planning</strong></td>
<td></td>
</tr>
<tr>
<td>1. My commitment to achieve the goals in this class was strong relative to the goals in my other classes.</td>
<td>0.640</td>
</tr>
<tr>
<td>2. I set up goals for my learning.</td>
<td>0.737</td>
</tr>
<tr>
<td>3. I was confident that I could avoid obstacles while doing my work.</td>
<td>0.628</td>
</tr>
<tr>
<td>4. I was prepared to work hard to achieve my goals no matter what my other classes required.</td>
<td>0.723</td>
</tr>
<tr>
<td>5. I was able to prepare a study plan that listed concrete tasks.</td>
<td>0.658</td>
</tr>
</tbody>
</table>

**Table 1: Continued**

<table>
<thead>
<tr>
<th>Item code</th>
<th>Item</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Corrected item-to-total correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VC18</td>
<td>I kept my feelings under control while working to complete this class.</td>
<td>2.89</td>
<td>1.267</td>
<td>-.190</td>
<td>-1.023</td>
<td>0.506</td>
</tr>
<tr>
<td>VC19</td>
<td>I added more effort to stay on task if my focus on my goal in this class began to decline.</td>
<td>3.13</td>
<td>1.226</td>
<td>-.190</td>
<td>-.858</td>
<td>0.511</td>
</tr>
<tr>
<td>VC27</td>
<td>I was able to avoid being distracted by competing goals.</td>
<td>3.21</td>
<td>1.195</td>
<td>-.190</td>
<td>-.808</td>
<td>0.570</td>
</tr>
<tr>
<td>VC28</td>
<td>I was able to create a setting free of uncontrollable distractions.</td>
<td>3.01</td>
<td>1.248</td>
<td>-.190</td>
<td>-.978</td>
<td>0.605</td>
</tr>
<tr>
<td>VC29</td>
<td>I was able to know when to stop looking for more information to prepare for an exam.</td>
<td>3.21</td>
<td>1.349</td>
<td>-.190</td>
<td>-1.119</td>
<td>0.474</td>
</tr>
<tr>
<td>VC36</td>
<td>I didn’t let social pressure affect my performance.</td>
<td>3.15</td>
<td>1.297</td>
<td>-.190</td>
<td>-1.002</td>
<td>0.485</td>
</tr>
<tr>
<td>VC37</td>
<td>I anticipated personal or social events that might cause me to get behind.</td>
<td>2.96</td>
<td>1.306</td>
<td>-.190</td>
<td>-1.038</td>
<td>0.521</td>
</tr>
<tr>
<td>VC42</td>
<td>When my motivation decreased, I was able to think of things to do to build it back up again.</td>
<td>3.17</td>
<td>1.275</td>
<td>-.190</td>
<td>-.982</td>
<td>0.538</td>
</tr>
</tbody>
</table>
### Table 2: Continued

<table>
<thead>
<tr>
<th>Dimensions and items</th>
<th>Factor loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factor 1</td>
</tr>
<tr>
<td><strong>Dimension 2: Volition Control</strong></td>
<td></td>
</tr>
<tr>
<td>6. I kept my feelings under control while working to complete this class.</td>
<td>0.657</td>
</tr>
<tr>
<td>7. I added more effort to stay on task if my focus on my goal in this class began to decline.</td>
<td>0.594</td>
</tr>
<tr>
<td>8. I was able to avoid being distracted by competing goals.</td>
<td>0.697</td>
</tr>
<tr>
<td>9. I was able to create a setting free of uncontrollable distractions.</td>
<td>0.706</td>
</tr>
<tr>
<td>10. I was able to know when to stop looking for more information to prepare for an exam</td>
<td>0.525</td>
</tr>
<tr>
<td>11. I didn’t let social pressure affect my performance.</td>
<td>0.695</td>
</tr>
<tr>
<td>12. I anticipated personal or social events that might cause me to get behind.</td>
<td>0.617</td>
</tr>
<tr>
<td>13. When my motivation decreased, I was able to think of things to do to build it back up again</td>
<td>0.622</td>
</tr>
<tr>
<td>Eigen values</td>
<td>3.412</td>
</tr>
<tr>
<td>Total variance (%)</td>
<td>26.464</td>
</tr>
<tr>
<td>Cumulative variance (%)</td>
<td>26.246</td>
</tr>
<tr>
<td>Cronbach’s alpha</td>
<td>0.732</td>
</tr>
<tr>
<td>Cronbach’s alpha (total)</td>
<td></td>
</tr>
<tr>
<td>Items per factor</td>
<td>5</td>
</tr>
</tbody>
</table>

The two factors explicated 45.354% of the total variance. The Cronbach’s alpha scores for the two factors were 0.732 and 0.809 respectively. The total Cronbach’s alpha was 0.825. These values indicated sufficient reliabilities.

## Results

### Confirming the measurement model

In order to assess the latent structure of the measure, confirmatory factor analysis (CFA) was performed. Before performing the CFA, a process proposed by Kim et al. (2012), and Chen et al. (2014) was followed. Accordingly, the sample (594 individuals) was divided into two random subsamples using SPSS 23.0 routine random case selection. One sample was a calibration sample with 291 cases, while the other sample was a validation sample with 303 cases. The 13 measurement items with two-factor structure were tested for internal consistency and validity in Mplus version 7.0 (Muthen & Muthen, 2012).

When assessing the model fit, several stand-alone and comparative indices that evaluated the goodness of fit of the CFA to the data were used. In this context, the value of Chi-square to the degree of freedom ($\chi^2/df$), the root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), standardized root mean square residual (SRMR) indices were examined.
When evaluating the model fit indices, the following values were used: $\chi^2$/sd $<$ 3.00, RMSEA $<$ 0.07, CFI $>$ 0.90, TLI $>$ 0.95 and SRMR $<$ 0.07 (Hu & Bentler, 1999; Schermelleh-Engel & Moosbrugger, 2003). The results of CFA demonstrated that both calibration and validation samples fit the data optimally. The calibration sample fit indices were $\chi^2 = 122.64$, $\chi^2$ to df = 2.31, RMSEA = 0.06, CFI = 0.95, TLI = 0.94, and SRMR = 0.05. The validation sample fit indices were $\chi^2 = 128.78$, $\chi^2$ to df = 2.01, RMSEA = 0.58, CFI = 0.96, TLI = 0.95, and SRMR = 0.05. All fit indices were acceptable values and the CFA model fitted well. Although the TLI index in the calibration sample was slightly below the accepted value, this result was acceptable because it was 0.964 and very close to 0.950.

**Validation of the measure**

As the CFA model fits well, parameter estimates, and related diagnostics are used to further assess the model. For this aim, convergent validity, composite reliability, and average variance extracted were used. Firstly, convergent validity was evaluated by controlling the factor values of 0.40 and above, and the values of average variance extracted near the 0.50. However, if the composite reliability of the factors is greater than 0.60, the average variance extracted can be accepted to be 0.40 (Fornell & Larcker, 1981; Huang, Wang, Wu & Wang, 2013). Accordingly, it can be said the convergent validity of the scale is acceptable. Secondly, the internal consistency of the items in the measure was calculated by composite reliability. The composite reliability of the constructs was between 0.77 and 0.84 and these values seem reasonable (Bagozzi & Yi, 1988). Lastly, the average variance extracted, a measure of internal consistency-based diagnostic, was used. The acceptable value for this measure is near 0.50 (Fornell & Larcker, 1981), but as the composite reliability of the factors is greater than 0.60, the value of 0.40 and above can be reasonable for this newly developed measure (Table 3).

<table>
<thead>
<tr>
<th>Factors and Items</th>
<th>Calibration sample (n=291)</th>
<th>Validation sample (n=303)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FL</td>
<td>$R^2$</td>
</tr>
<tr>
<td><strong>Factor 1: Volition Planning</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My commitment to achieve the goals</td>
<td>0.56</td>
<td>0.31</td>
</tr>
<tr>
<td>in this class was strong relative to the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>goals in my other classes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I set up goals for my learning.</td>
<td>0.56</td>
<td>0.31</td>
</tr>
<tr>
<td>I was confident that I could avoid</td>
<td>0.68</td>
<td>0.47</td>
</tr>
<tr>
<td>obstacles while doing my work.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I was prepared to work hard to achieve</td>
<td>0.70</td>
<td>0.49</td>
</tr>
<tr>
<td>my goals no matter what my other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>classes required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I was able to prepare a study plan that</td>
<td>0.68</td>
<td>0.47</td>
</tr>
<tr>
<td>listed concrete tasks.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Factor 2: Volition Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I kept my feelings under control while</td>
<td>0.62</td>
<td>0.39</td>
</tr>
<tr>
<td>working to complete this class.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued
Table 3: Continued

<table>
<thead>
<tr>
<th>Factors and Items</th>
<th>Calibration sample (n=291)</th>
<th>Validation sample (n=303)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FL</td>
<td>R²</td>
</tr>
<tr>
<td>I added more effort to stay on task if my focus on my goal in this class began to decline.</td>
<td>0.62</td>
<td>0.38</td>
</tr>
<tr>
<td>I was able to avoid being distracted by competing goals.</td>
<td>0.66</td>
<td>0.44</td>
</tr>
<tr>
<td>I was able to create a setting free of uncontrollable distractions.</td>
<td>0.69</td>
<td>0.47</td>
</tr>
<tr>
<td>I was able to know when to stop looking for more information to prepare for an exam.</td>
<td>0.49</td>
<td>0.24</td>
</tr>
<tr>
<td>I didn’t let social pressure affect my performance.</td>
<td>0.62</td>
<td>0.39</td>
</tr>
<tr>
<td>I anticipated personal or social events that might cause me to get behind.</td>
<td>0.68</td>
<td>0.46</td>
</tr>
<tr>
<td>When my motivation decreased, I was able to think of things to do to build it back up again.</td>
<td>0.62</td>
<td>0.38</td>
</tr>
</tbody>
</table>

FL = Standardized factor loading; CR = composite reliability; AVE = average variance extracted.

Discussion

The main aim of this study was to develop a reliable and valid instrument to measure the volitional aspects of online and face to face learners. In this process, the scale development routines proposed by DeVellis (2012), Germain (2006), Hinkin et al. (1997), Netemeyer et al. (2003) were followed and a reliable and valid VFLS was developed and validated. Based on the results of item analysis and factor analysis, a two-factor structure with 13 items was gathered. The CFA using Mplus was performed for the validity of the scale. In this analysis, the data were divided into two, as calibration and verification, to provide cross-validation. 291 data were obtained for the calibration sample, and 303 data for the verification sample. Similar valid and reliable values were obtained in both samples according to the model compliance values.

These findings were important in terms of contributing to the learning process and instructional design in the context of volition for learning in self-directed learning settings such as online education. It is considered that the online learners’ volition competence can be examined in theoretical and practical context and planning of appropriate processes and strategies can contribute to learning and system. It can be said that the findings of this research are important when considering the lack of studies conducted in this field in learning environments especially online learning. These findings are fundamentally different from those found in the literature (Deimann & Bastiaens, 2010; McCann & Turner, 2004; Kuhl & Fuhrmann, 1998). While other studies have independently addressed the volition factor on a theoretical basis, this study has been developed with the theoretical background taking into consideration Keller’s MVP theory and the last factor in the ARCS-V motivation design model. It can be said that the scale developed in this sense is the first
Conclusion

The concept of volition is especially important in online education because learners are away from both the teachers and the learning environment physically. Online learners need self-regulation skills as well as adequate level of motivation and volition (Hartnett, 2016; Keller, 2010, 2017). For this purpose, the VFLS was developed in the context of Keller’s MVP theory and ARCS-V motivation model. The results of the analysis show that this scale is reliable and valid. In addition, the scale can be used to determine the volition competences of both online and face to face learners. Moreover, instructional designers and teachers can employ this scale in the development of volition strategies and tactics for learners in the context of the ARCS-V model and measure the effectiveness of these strategies. Accordingly, effective and efficient instructional designs can be made considering the scale results. As a last point, researchers can benefit from this scale when conducting various types of research in the context of volition for learning.

Limitations and future research

This study has some limitations. The data for this study were collected from online learners who also took some courses face to face. Therefore, it can be an important future study to examine whether the same factor structures are obtained in a validity study of the scale with the learners who take all courses via online or face to face. In addition, within the ARCS-V model, researchers can be advised to test the effectiveness of strategies to be prepared based on this scale. The participants in this study were Turkish learners. Therefore, researchers in different countries are recommended to verify the instrument in different cultural milieus. Finally, the validity of this study in different educational contexts may also be an important study.

Acknowledgments

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References

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Appendix A. Volition for learning scale (VFLS)

The VFLS survey consists of 13 statements with two subscales, namely action planning (items 1–5) and action control (items 6–13). In the survey, a 5-point Likert-type scale format was adopted (1-Completely disagree through 5-Completely agree).

1. My commitment to achieve the goals in this class was strong relative to the goals in my other classes.
2. I set up goals for my learning.
3. I was confident that I could avoid obstacles while doing my work.
4. I was prepared to work hard to achieve my goals no matter what my other classes required.
5. I was able to prepare a study plan that listed concrete tasks.
6. I kept my feelings under control while working to complete this class.
7. I added more effort to stay on task if my focus on my goal in this class began to decline.
8. I was able to avoid being distracted by competing goals.
9. I was able to create a setting free of uncontrollable distractions.
10. I was able to know when to stop looking for more information to prepare for an exam.
11. I didn’t let social pressure affect my performance.
12. I anticipated personal or social events that might cause me to get behind.
13. When my motivation decreased, I was able to think of things to do to build it back up again.
Exploring the Predictive Role of E-Learning Readiness and E-Learning Style on Student Engagement

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Abstract
The aim of this study was to determine the factors predicting student engagement. The sample of the study consisted of 527 students from Karabuk University Distance Education Center. Independent variables of the study were e-learning style and online learning readiness. The data were analyzed using the stepwise multiple regression analysis. The findings revealed that students, who set a learning goal, can manage their time in line with this goal, put effort, organize their learning considering their needs, pay attention to learning situations or the learning object, prefer to work with visual elements, enjoy doing research, can remember easily and study with visuals that facilitate retrieval, prefer to work independently, take responsibility for their learning, and believe in their learning ability, have higher levels of engagement.

Keywords: Student engagement, online learning readiness, e-learning style

Introduction
Electronic learning (e-learning) can support active learning without time and space barrier. It has also introduced significant innovation for educational environments in the twenty-first century, benefiting from web-based communication, collaboration, multimedia and information transfer (Motaghian, Hassanzadeh, & Moghadam, 2013). With e-learning, content can be managed through various learning activities and the quality of teaching can be improved. For example, LMSs can influence students’ engagement with the environment, change collaboration and communication, and help access learning materials. E-learning environments enhance student learning by providing a broader source of interaction, making course content more accessible, providing automated and adaptable assessment styles, and improving technology literacy. Although e-learning classroom has advantages over traditional learning environments, it can also have significant limitations. In the traditional classroom, learning communities can be seen by the teacher, and students can easily communicate with their friends thanks to the rich visible social clues in the environment. However, in e-learning environments, students are often isolated from each other and from the educator, and it may be difficult to develop community feeling (Daniel & Schwier, 2010). This may be due to the fact that online students cannot allocate time for the course and participate in learning environments (Mupinga, Nora & Yaw, 2006); they do not expend enough effort to learn, and they have low level of readiness or some differences in learning styles.

Theoretical Framework
The effort and time spent by students in the learning environment is called student engagement (Ergün & Usluel, 2015). Astin (1984) defines engagement as “the amount of physical and psychological energy the student devotes to academic experience” (p. 297). Chakraborty and Nafukho (2014) found four factors that are important in engaging students online: “creating and maintaining positive learning environment; building learning community; giving consistent

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feedback in timely manner; and using the right technology to deliver the right content”. Skilling, Bobis and Martin (2020) examined the relationships between student engagement and mathematics achievement. They revealed that students with low levels of engagement tend to have low mathematics performance. They further stated that students with high engagement levels believe in the importance of the subject they learn.

Fredricks, Blumenfeld and Paris (2004) discuss three types of engagement, namely behavioral, affective and cognitive engagement. Each type of engagement has positive, neutral and negative aspects. Accordingly, while behavioral engagement of a learner is positive, his/her cognitive engagement can be negative (Trowler, 2010). Therefore, in this study, it was thought that conducting separate regression analyses for behavioral, affective and cognitive engagement, which are the sub-factors of engagement, would facilitate the understanding of the engagement construct.

High level of engagement enables students to learn the course content more effectively. It enables students to expand the knowledge obtained by creating new ideas or to critically examine the existing ideas to produce new solutions (Strachan & Liyanage, 2015). According to the social learning theory, engagement of learners is the primary element in the emergence of desired learning outcomes and motivation of students to learn (Bandura, 1977). Student engagement has the mediating role in learning participation and educational outcomes (Inkelas, Szelenyi, Soldner & Brower, 2007). Hampton and Pearce (2016) note that being focused and engaged in course work as an online student is critical for success.

Student engagement is an important part of the learning and teaching process; however, as students have different learning styles, achieving this engagement is difficult. Each learner approaches the materials in the environment in various ways. For example, visual materials may be useful to a student, yet they may not be useful as a learning tool for someone else. For this reason, teachers should discover the needs of their students and what to do about those needs. Teachers need to provide a safe environment for students so that they all believe that they can learn. Furthermore, students must have some competences in online learning environments. They must be responsible for their own learning, be able to manage time well, adjust the speed of learning, use technological tools in the environment, and do their homework on time (Hung, Chou, Chen & Own, 2010). In order to achieve this, they must have the necessary competencies and attitude. A student who feels uncomfortable in the learning environment will not make an effort to learn, and it will be difficult to encourage this student to learn. Thus, student engagement will be adversely affected. The stakeholders in this process need to pay attention to students’ learning styles and level of e-readiness to design and implement effective e-learning programs.

Student Engagement and Online Learning Readiness

In e-learning, learners need to manage their own learning. Students with such an ability can work alone, insist on learning, use the computer, make a plan in order to complete a task, and read (Piskurich, 2003). The ability to use multimedia technologies and learning resources to improve the quality of learning is expressed as student readiness. It is stated that online learning readiness has the dimensions of technology and student characteristics (Kaymak-Demir & Horzum, 2013), and is an important part of distance education as it is associated with the success of e-learning programs (Kaur & Abas, 2004). In order for e-learning programs to be successful, it is essential to evaluate the e-readiness levels of students as well as providing them with the necessary infrastructure and materials. Hong and Gardner (2018) maintain that e-readiness involves self-efficacy, self-regulation, social competence, and digital competence. They further state that low level of readiness has an important effect on the engagement level of students and depth of learning. Parkes, Stein
and Reading (2015) argue that unprepared learners cannot actively participate and use critical thinking skills. They investigated the perceptions of university students about online learning readiness using the LMS. The findings indicated that the students were prepared to engage in e-learning technology, whereas they were unprepared for such activities as being clear and concise in responses, reading and writing, synthesizing ideas, planning strategies, having discussions, and working with other students. Engagement and in-depth learning levels of learners who are unprepared for online learning environments are particularly adversely affected. It is stated that such unprepared students cannot actively participate in the process and cannot use their critical thinking skills. Students need to have certain technical skills and be ready to learn online to take advantage of online learning.

**Student Engagement and E-learning Style**

Research suggests that each student learns in a unique way and prefers specific learning activities. Students use different cognitive, affective and metacognitive learning skills. They develop their own learning styles adopting a learning method. Learning styles are the result of the interaction between personal and contextual factors (Schmeck, Geisler-Brenstein & Cercy, 1991). Examples of personal factors include intelligence, age, educational experience and prior knowledge, while contextual factors include task structure, complexity of information, learning objectives, and teaching methods. Personal factors lead to consistency in the way students learn, while contextual factors lead to variation (Vermunt, 2005).

Having knowledge about the learning processes of students is an important variable in collecting information about the quality of the learning environment since students learn in different ways. Techniques, tools, or examples that are effective in helping a student learn the course concepts and methods may be less effective or ineffective in helping other students understand and learn the same concepts and methods. During a face-to-face course, an instructor can understand which content or method is effective in student learning. In this way, s/he can change his/her approach if necessary and receive immediate feedback on what additional information or explanation s/he needs to give. However, due to the asynchronous nature of the online learning environment, such changes cannot be made directly. Students may choose not to use videos and interactive tools and applications, and can only review course readings, and thus, they can only obtain superficial knowledge about course concepts and methods. Learning styles influencing how students respond to materials and the online environment are critical to student engagement. For this reason, online courses should include elements that increase the behavioral, cognitive and affective engagement of students.

Beer, Clark, and Jones (2010) argue that although some studies took participation into account while assessing online learning, this assessment does not represent the online learning process of students and does not provide information about the quality of online learning. The researchers maintain that student engagement may help in such an assessment. The aim of the present study is to investigate whether e-learning styles in electronic environments and online learning readiness are the predictors of student engagement. The following research questions are addressed in this study:

1. Are e-learning styles in electronic environments and online learning readiness the predictors of students’ behavioral engagement?
2. Are e-learning styles in electronic environments and online learning readiness the predictors of students’ affective engagement?
3. Are e-learning styles in electronic environments and online learning readiness the predictors of students’ cognitive engagement?
**Method**

The aim of this study was to determine the predictive role of e-learning styles and online learning readiness in student engagement. The research method is correlational.

**Participants**

527 senior students of a public university in Turkey who took the Measurement and Evaluation in Education course through distance education during the 2016–2017 academic year constituted the study group. The primary aim of the course is the upskilling of teacher candidates before they enter the teaching profession.

**Instruments**

The e-Learning Styles Scale for electronic environments (Gülbahar & Alper, 2014), The Scale of Online Learning Readiness (Hung et al., 2010) and Student Engagement Scale (Sun & Rueda, 2012) were used to collect data.

**The e-Learning Styles Scale**

The scale was developed by Gülbahar and Alper (2014). In the validity study of the scale, principle component analysis and confirmatory factor analysis were used. As a result of the principle component analysis, the factor loadings for 38 items were found to be between .46 and .82. The results of the CFA produced the following values:

\[ \chi^2(632, N=2344) = 5195.95, p<.000, \text{RMSEA}= 0.056, \text{S-RMR}= 0.047, \text{GFI}= 0.90, \text{AGFI}= 0.88, \text{CFI}= 0.98, \text{NNFI}= 0.97, \text{IFI}= 0.98. \]

These values indicate that the model fits well to the data. Cronbach alpha reliability for the scale and the factors of the scale vary between .72 and .82, which indicates that the e-Learning Styles Scale is reliable and valid. The scale consists of seven factors (independent learning, social learning, audio-visual learning, active learning, verbal learning, logical learning, and intuitive learning) with a total of 38 items.

**The Scale of Online Learning Readiness**

The scale was developed by Hung et al. (2010), and it was adapted to Turkish culture by Yurdugül and Alsancak Srakaya (2013). The 5-Likert type scale consisting of 18 items is used to measure the readiness of preservice teachers for online learning. The factors of the scale are self-directed learning, computer/internet self-efficacy, learner control, motivation for learning, and online communication self-efficacy. After the original form of the scale was adapted to Turkish culture, it was applied to a group of 724 university students. In the validity study, confirmatory factor analysis was used. The results of the CFA produced the following values:

\[ \chi^2/df=4.63; \text{RMSEA}=0.07; \text{GFI}=0.94; \text{CFI}=0.94; \text{NFI}=0.92. \]

These values indicate that the model fits well to the data. Cronbach alpha reliability for the scale and the factors of the scale changed between .80 and .92. The findings indicated that the scale is reliable and valid.

**Student Engagement Scale**

The scale was developed by Sun and Rueda (2012) and it was adapted to Turkish culture by Ergün and Usluel (2015). During the adaptation process, first, the original form was translated into Turkish by five experts, followed by the process of back translation into English. This translation
was evaluated by the researchers, and the most appropriate form for each item was used in the study. The data was analyzed with the CFA, which produced the following values: $\chi^2(84, N=393) = 453.93$, $p<.000$, RMSEA = .072, S-RMR = 059, GFI = .89, AGFI = .86, CFI = .96, NNFI = .96, IFI = .96. These values indicate that the model fits well to the data. According to the results of the CFA, the Student Engagement Scale consists of three factors, namely behavioral, affective and cognitive factors. The behavioral engagement factor includes 5 items, while the affective engagement factor and the cognitive engagement factor include 6 and 8 items, respectively. The alpha values for the factors and item total correlations and the overall scale success were satisfactory. The analysis showed that the psychometric properties of the Turkish version of the Student Engagement Scale were acceptable, indicating that the scale is reliable and valid for use in Turkish.

**Data Collection**

During 14 weeks, only online classes were given using Moodle. Weekly lecture topics and notes were available to revise on demand on Moodle. Digital instruments were used in the classes, and the students were able to contribute to class only by using the chat window. The e-Learning Styles Scale was applied after the midterm exam. The Scale of Online Learning Readiness and the Student Engagement Scale were applied after the final exam.

**Data Analysis**

The stepwise multiple regression analysis, which is a statistical method for prediction studies, was used to analyze the data. The stepwise multiple regression analysis identifies the independent variables affecting one dependent variable (Albayrak, 2006; Büyükoztürk et al., 2017). In the present study, prior to the stepwise multiple regression analysis, the reliability of the collected data was examined and the Cronbach $\alpha$ coefficients were calculated for each scale used in the study. Table 1 shows the Cronbach $\alpha$ coefficients of the scales.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Cronbach $\alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Scale of Online Learning Readiness</td>
<td>.87</td>
</tr>
<tr>
<td>The e-Learning Styles Scale</td>
<td>.86</td>
</tr>
<tr>
<td>The Student Engagement Scale</td>
<td>.85</td>
</tr>
</tbody>
</table>

The Cronbach $\alpha$ co-efficients of the scales used in the present study changed between .85 and .87, which indicates that data is reliable.

Whether the normality and linearity assumptions were met was investigated, and histograms and scattering diagrams were given in Figure 1 and Figure 2.
When Figures 1 and 2 are examined, it can be said that the histogram and normal distribution curves for the predicted values show a distribution close to normal, that the points in the scattering diagram tend to gather around an axis, and that the scattering diagram defines a linear and positive relationship. These results suggest that the data were appropriate for stepwise multiple regression analysis. However, to implement the stepwise multiple regression, the presence of a multicollinearity problem must be investigated.

The results as to whether there is multicollinearity between fixed variance, autocorrelation, and independent variables were examined. The results obtained and the criteria with which the results were compared (Albayrak, 2006; Büyüköztürk et al., 2017; Kalaycı, 2009) are given in Table 2.

Table 2: Evidence showing that there is no multicollinearity problem with the results obtained

<table>
<thead>
<tr>
<th>Student Engagement Scale and Factors</th>
<th>Criterion</th>
<th>Behavioral</th>
<th>Affective</th>
<th>Cognitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durbin-Watson</td>
<td>1,5-2,5</td>
<td>1,75</td>
<td>2,00</td>
<td>1,87</td>
</tr>
<tr>
<td>Tolerance</td>
<td>1-R² &gt; 0,20</td>
<td>0,59-0,99</td>
<td>0,52-0,72</td>
<td>0,64-0,76</td>
</tr>
<tr>
<td>VIF</td>
<td>VIF &lt; 10</td>
<td>1,01-1,68</td>
<td>1,37-1,91</td>
<td>1,30-1,57</td>
</tr>
<tr>
<td>CI</td>
<td>CI &lt; 30</td>
<td>17,238</td>
<td>26,43</td>
<td>24,64</td>
</tr>
</tbody>
</table>

*Open Praxis, vol. 12 issue 2, April–June 2020, pp. 175–189*
When the criteria in Table 2 that can be used to determine whether there is a multicollinearity problem are compared with the results obtained, it can be concluded that none of the tested models has a multicollinearity problem and autocorrelation. This evidence shows that the assumptions of the stepwise multiple regression are accepted.

The online learning readiness variables were first entered together, and then, the variables for e-learning styles for electronic environments were entered together as a set. The stepwise regression was then used to determine which, if any, contextual variables might explain the significant amount of variance beyond that explained by these independent variables.

Findings

Whether e-learning styles and readiness predict the behavioral engagement factor was analyzed using the stepwise multiple regression. The regression analysis results and the regression equation are given in Table 3.

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>R</th>
<th>ΔR²</th>
<th>b</th>
<th>T</th>
<th>p</th>
<th>Pairwise r</th>
<th>Partial r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>9.285</td>
<td>9.952</td>
<td>.000</td>
<td>8.203</td>
<td>.000</td>
<td>.34</td>
<td>.33</td>
<td></td>
</tr>
<tr>
<td>Online Learning Readiness</td>
<td>Self-directed learning ([X_1])</td>
<td>0.415</td>
<td>0.402</td>
<td>0.162</td>
<td>0.362</td>
<td>2.096</td>
<td>.037</td>
<td>.09</td>
</tr>
<tr>
<td>Computer/internet self-efficacy([X_2])</td>
<td>0.130</td>
<td>0.411</td>
<td>0.007</td>
<td>0.093</td>
<td>9.285</td>
<td>0.415</td>
<td>0.130</td>
<td></td>
</tr>
</tbody>
</table>

R = 0.411 R² = 0.169 F = 53,321 sd = 2.525 p = .000
Behavioral Engagement = 9.285 + 0.415 X₁ + 0.130 X₂

Stepwise regression analyses were performed to predict behavioral engagement. As depicted in Table 3, self-directed learning was the strongest predictor of behavioral engagement. In combination with self-directed learning, computer/internet self-efficacy accounted for 16% of the variance in behavioral engagement (R = 0.411; R² = 0.169; p <.05).

When the contribution of the predictor variables to the variance was examined, it was seen that self-directed learning variable explained 16% of the total variance and computer/internet self-efficacy 1% of the total variance. The standardized regression coefficients (β) give the relative order of importance of the predictor variables. It can be concluded that the self-directed learning variable was more important in explaining behavioral engagement compared to the computer/internet self-efficacy variable.

When the paired and partial correlations between the predictor variables and the predicted variable were examined, it was found that there was a close to moderate \(r = .34, r = .33\) positive relationship between self-directed learning and engagement, while there was a low positive correlation between computer / internet self-efficacy and engagement \(r = .09, r = .08\). When other variables were controlled, these relationships remained about at the same level.
Whether e-learning styles and readiness predicted the affective engagement factor was analyzed through stepwise multiple regression. The regression analysis results, and the regression equation are given in Table 4.

Table 4: Results of the Multiple Regression Analysis of the Affective Engagement Factor

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>R</th>
<th>ΔR²</th>
<th>b</th>
<th>T</th>
<th>p</th>
<th>Pairwise r</th>
<th>Partial r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>7,699</td>
<td>4,160</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online Learning Readiness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learner control [X₁]</td>
<td>0,683</td>
<td>0,286</td>
<td>0,082</td>
<td>0,235</td>
<td>4,854</td>
<td>.000</td>
<td>.21</td>
<td>.20</td>
</tr>
<tr>
<td>Self-directed learning [X₂]</td>
<td>0,333</td>
<td>0,304</td>
<td>0,011</td>
<td>0,173</td>
<td>3,029</td>
<td>.003</td>
<td>.13</td>
<td>.13</td>
</tr>
<tr>
<td>Motivation for learning [X₃]</td>
<td>-0,397</td>
<td>0,320</td>
<td>0,010</td>
<td>-0,176</td>
<td>-3,089</td>
<td>.002</td>
<td>-.13</td>
<td>-.13</td>
</tr>
<tr>
<td>Online communication self-efficacy [X₄]</td>
<td>0,299</td>
<td>0,333</td>
<td>0,008</td>
<td>0,112</td>
<td>2,221</td>
<td>.027</td>
<td>.10</td>
<td>.09</td>
</tr>
</tbody>
</table>

R = 0.333 R² = 0.111 F = 16,308 sd = 4,523 p = .000
Affective Engagement = 7,699 + 0.683 X₁ + 0.333 X₂ – 0.397 X₃ + 0.299 X₄

When the paired and partial correlations between affective engagement and its predictors were examined, it was seen that there was a low positive relationship between learner control (r = .21, r = .20), self-directed learning (r = .13, r = .13) and online communication self-efficacy (r = .10, r = .09). When other variables were controlled, these relationships remained approximately at the same level. It was also seen that there was a low and negative relationship between affective engagement and motivation for learning (r = - .13), and the relationship remained the same when the other variables were controlled.

Four predictors of affective engagement were found and these predictors accounted for 11% of the total variance in affective engagement (R = 0.333; R² = 0.111; p <.05). When the change in squares of the regression coefficients (ΔR²) was examined, it was seen that the variables of learner control, self-directed learning, motivation for learning, and online communication self-efficacy contributed to the total variance by 8%, 1%, 1%, and 1%, respectively. The standardized regression coefficients (β) show the relative order of importance of the predictors in explaining affective engagement. The relative order of importance of the predictors explaining affective engagement was found to be learner control, self-directed learning, motivation for learning, and online communication self-efficacy.

Whether e-learning styles and readiness predict the cognitive engagement factor was analyzed using the stepwise multiple regression. The regression analysis results and the regression equation are given in Table 5.
Table 5: Results of the Multiple Regression Analysis of the Cognitive Engagement Factor

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>R</th>
<th>ΔR²</th>
<th>b</th>
<th>T</th>
<th>p</th>
<th>Pairwise r</th>
<th>Partial r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>8.410</td>
<td>5.618</td>
<td>.000</td>
<td>.35</td>
<td>.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Online Learning Readiness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-directed learning [X₁]</td>
<td>0.665</td>
<td>0.500</td>
<td>0.250</td>
<td>0.383</td>
<td>8.418</td>
<td>.000</td>
<td>.015</td>
<td>.11</td>
</tr>
<tr>
<td>Learner control [X₂]</td>
<td>0.277</td>
<td>0.510</td>
<td>0.010</td>
<td>0.105</td>
<td>2.488</td>
<td>.015</td>
<td>.11</td>
<td>.09</td>
</tr>
<tr>
<td><strong>e-Learning Styles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audio-visual learning style [X₃]</td>
<td>0.159</td>
<td>0.532</td>
<td>0.023</td>
<td>0.159</td>
<td>3.766</td>
<td>.000</td>
<td>.14</td>
<td>.14</td>
</tr>
<tr>
<td>Logical learning style [X₄]</td>
<td>-0.310</td>
<td>0.544</td>
<td>0.013</td>
<td>-0.177</td>
<td>-4.267</td>
<td>.000</td>
<td>-.19</td>
<td>-.15</td>
</tr>
<tr>
<td>Intuitive learning style [X₅]</td>
<td>0.282</td>
<td>0.561</td>
<td>0.019</td>
<td>0.160</td>
<td>3.760</td>
<td>.000</td>
<td>.16</td>
<td>.14</td>
</tr>
</tbody>
</table>

R = 0.561 R² = 0.315 F = 47,846 sd = 5.521 p = .000
Cognitive Engagement = 8.410 + 0.665 X₁ + 0.277 X₂ + 0.159 X₃ - 0.310 X₄ + 0.282 X₅

As seen in Table 5, there was a low positive relationship between cognitive engagement and self-directed learning (r = .35, r = .30), learner control (r = .11, r = .09), audio-visual learning style (r = .16, r = .14), and intuitive learning style (r = .16, r = .14). When other variables were controlled, it was observed that these relationships remained approximately the same. A low and negative relationship (r = -.16) was found between cognitive engagement and logical learning style. When other variables were controlled, the relationship did not change significantly (r = -.14).

The stepwise multiple regression analysis revealed that self-directed learning, learner control, audio-visual learning style, logical learning style, and intuitive learning style were the predictors of cognitive engagement and these variables together explained 31% of the total variance in cognitive engagement (R = 0.561; R² = 0.315; p <.05). When the change in the squares of the regression coefficients (ΔR²) was examined, it was seen that the variables of self-directed learning, learner control, audio-visual learning style, logical learning style, and intuitive learning style contributed to the total variance by 25%, 1%, 2%, 1%, and 2%, respectively. The standardized regression coefficients (β) show the relative order of importance of the predictors in explaining cognitive engagement. When the standardized regression coefficients (β) were examined, it was seen that three variables (audio-visual learning style, logical learning style, intuitive learning) were included in the regression equation in contrast to the results concerning the behavioral and affective sub-dimensions. The relative order of importance of the predictive variables was found to be self-directed learning, learner control, audio-visual learning style, logical learning style, and intuitive learning.

Discussion

This study investigated whether the level of readiness and learning styles of students in online learning environments predict student engagement. The findings are discussed below.

The self-directed learning and computer/internet self-efficacy variables together explained 16% of the total variance of behavioral engagement. As far as behavioral engagement was concerned, the contribution of self-directed learning to the total variance was found to be greater than that of computer/internet self-efficacy. The self-directed learning factor is related to time management, preparing a
study plan, seeking help when needed, and setting learning goals. Behavioral engagement involves behavioral situations such as paying attention to the subjects related to the course, asking questions, and having motivation and making effort to learn (Finn & Rock, 1997) Behavioral engagement also includes observable actions and refers to the participation of students in academic activities and their effort to perform academic tasks (Fredricks et al., 2004; Suarez-Orozco, Pimentel & Martin, 2009). Students with a high level computer/internet self-efficacy (with a belief in their ability to use the online learning environment) develop more behavioral engagement in learning environments, and this can also be observed in behaviors such as participating in conversations, attending classes, and being motivated to learn. Based on these findings, it can be said that students who have high computer/internet self-efficacy, who can set learning goals, and who can manage time and prepare a study plan have higher levels of engagement, and this engagement is reflected in their behaviors.

The variables predicting affective engagement are learner control, self-directed learning, motivation to learn, and online communication self-efficacy. These four variables accounted for 11% of the total variance in affective engagement. In this study, the regression results revealed that learner control was the most influential variable on students’ interest in and positive feelings about the course. Learner control is defined as paying attention to learning situations or the learning object, identifying learning needs, and guiding the learning process. Affective engagement involves situations such as paying attention to the subject and the course and developing positive feelings about the online course (Stipek, 2002). When students identify their own needs and organize their learning in this direction, their affective engagement levels are positively affected. Learner control as well as self-directed learning contribute to affective engagement. Self-directed learning, which is the ability of students to direct their own learning, is an important aspect of online learning environments (Song & Hill, 2007). In self-directed learning, learners are active in the process of determining their learning objectives, activities, needs and competence levels, and they take more responsibility for their own learning (Eunjoo, 2006). Furthermore, Floratos, Guasch, and Espasa (2015) state that the more the student is active within a course, the more engaged she/he is with this course.

Motivation to learn is another predictor of affective engagement. It includes behaviors such as being open to new ideas, being motivated to learn, drawing lessons from mistakes, and sharing ideas with others. Students who have a flexible approach in learning, who can discuss their opinions, and who see their mistakes as a new learning experience have higher levels of affective engagement in online courses. Online learning environments, where learning responsibility is largely in the hands of students, require more effort, responsibility, motivation and self-directed control (Sakal, 2017). Online communication self-efficacy is the fourth variable predicting affective engagement. Students who are confident in terms of sending online e-mail, chatting, participating in chats, and starting discussions etc. can develop more positive emotions towards the course and pay more attention to it. Hung et al. (2010) state that in online learning, communication self-efficacy is a necessary dimension to overcome the limitations of online communication. For this reason, learning environments need to include communication tools to facilitate communication between teachers and students. Students need to ask questions and exchange ideas to improve their learning using synchronous tools such as live chat, instant messaging, audio discussions like Skype, and asynchronous tools such as e-mail.

In this study, the predictors of cognitive engagement were found to be self-directed learning, learner control, audio-visual learning style, logical learning style, and intuitive learning style. These five variables together explained 31% of the total variance in cognitive engagement. When the regression results of behavioral and affective engagement were examined, it was seen that learning styles did not predict affective and behavioral engagement. Pedone (2014) stated that cognitive strategies can help students identify their learning styles and strategies. However, when the regression results
related to cognitive engagement were examined, it was concluded that audio-visual learning, logical learning and intuitive learning style predicted cognitive engagement, followed by readiness in terms of relative order of importance. Here, firstly, the relationship between self-directed learning, learner control, and cognitive engagement is discussed, followed by the discussion on the relationship between learning styles and cognitive engagement.

The mental effort students expend to deal with learning materials is defined as cognitive engagement (Richardson & Newby, 2006; Walker, Greene & Mansell, 2006). Cognitive engagement is a prerequisite for meaningful learning (Shukora, Tasira, Meijdenb & Harun, 2014), and it involves behaviors such as willingness to make the necessary effort to understand complex situations or problems associated with learning situations. The results of our study revealed that students who can pay attention to learning situations or the learning object, who identify their learning needs, and who guide the learning process (students with high levels of learner control) have higher cognitive engagement. It can further be said that students who choose the appropriate learning strategies, who are willing to study and who can evaluate their own learning outcomes (Knowles, 1975), i.e. who have high self-directed learning level, are willing to use their cognitive processes. Students with visual-auditory learning skills believe that they can distinguish between different sounds, they enjoy listening, and they prefer to learn with tools such as shapes, comic strips, charts and so on (Gülbahar & Alper, 2014). According to the results of the study, it can be said that students who have these characteristics make the necessary effort to understand the complex situations or problems related to their learning situations. In other words, they have high levels of cognitive engagement. In particular, emerging new web technologies provide a variety of tools to engage with the learning environment. Advances in educational technology create powerful and innovative ways through which learners can engage in all kinds of content and activities in their self-learning experiences (Saeed, Yang & Sinnappan, 2009). In addition to audiovisual learning, intuitive learning style, which includes choosing to work independently, taking responsibility for learning, and believing in one’s ability to learn, also predicts cognitive engagement. Hung et al. (2010) maintain that online students who create and implement their own learning methods can show a better learning performance. Beeland (2002), on the other hand, states that visual and auditory elements affect student engagement in the learning process. These results suggest that the search for learning in different ways and the effort students devote to find solutions to the course-related problems affect their cognitive engagement positively.

Logical learning style has an inverse correlation with cognitive engagement. In other words, students who like doing calculations or who are interested in science and mathematics were found to have lower levels of cognitive engagement, which may be affected by the course content. However, the course within the scope of this study includes subjects that require calculation and numerical reasoning. Therefore, the inverse relationship between logical learning style and cognitive engagement cannot be explained by the course content. The way classroom activities are performed, and the limitations of the interface used (the lack of opportunities for students to express themselves) may have made it difficult for students with a logical learning style to express themselves. Mupinga et al. (2006) highlight the importance of considering multiple learning styles in the design of online learning activities and proposed several strategies. The first recommendation is identifying the learning preferences, technical skills, prior knowledge and specific interests of students, as well as their learning and technological needs. The second recommendation is to provide students with information in various formats. Some students need time to internalize new ideas before participating in the class. Electronic discussions or chat rooms can ensure the participation of these students. A third approach is adding pictures, graphs, tables, or audio to lecture notes that summarize the main points of the course to accommodate audiovisual students. Such an approach attracts students’
attention, and information can be communicated more easily than with verbal explanations. In addition to all these recommendations, the changes that could occur in the engagement levels of the students who have different learning styles when different interfaces are used could be investigated.

**Conclusion**

It is difficult to maintain student engagement in e-learning environments because learners and the instructor are not in the same place. However, an increase is observed in the sense of engagement of students if they set a learning goal, can manage time in line with this goal, put in effort, identify their needs and organize their learning to meet those needs, pay attention to learning situations or the learning object, prefer to work with visual elements, enjoy doing research, find it easy to remember and study with visuals facilitating retrieval, prefer to work independently, take responsibility for their learning, and rely on their learning ability. The emotional and intellectual investment are important considerations for course design and pedagogy for lecturers seeking to maximise the engagement of online students (Redmond, Heffernan, Abawi, Brown, & Henderson, 2018). The contribution of these characteristics to academic achievement may be the subject of other research studies. Furthermore, there may be an increase in student engagement through training on time management, self-regulation, working with visual elements, independent study and taking responsibility for learning or through guidance on these aspects. In future studies, students with low levels of engagement may be given training so that they develop their skills in the aspects listed above, and the changes in student engagement levels can be investigated.

Students need to interact with their friends, teachers or tools in the online learning environments during the learning process. As interaction increases, the likelihood of meeting student learning needs also increases (Kaymak-Demir & Horzum, 2013). Group work, doing assignments regularly, feedback, and interaction between students are necessary to achieve success in the online learning environment (Levy, 2008). Positive emotions are important in initiating an interaction between students. While students need to strive to develop their knowledge and skills and manage their own learning process, the institution needs to provide and organize appropriate environments that facilitate student learning. In online courses, direct instructor-to-student interaction may not be the primary factor affecting student engagement (Bryan et al., 2018). Improving student-faculty interaction or student-institution interaction and diversification of student-student and student-instructor communication channels contribute to increasing student engagement (Dixson, 2010). At this point, the effort of the instructor to increase student engagement is important and necessary (Saeed & Zygier, 2012).

**References**


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Online Distance Learning in Higher Education: E-Learning Readiness as a Predictor of Academic Achievement

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Abstract

The purpose of this study was to examine the relationship between e-learning readiness and academic achievement in an online course in higher-level education. The survey method was employed when collecting the study data, and the data-collection instrument used was the E-Learning Readiness Scale. The scale comprises 33 items and six sub-dimensions, including (1) computer self-efficacy, (2) internet self-efficacy, (3) online self-efficacy, (4) self-directed learning, (5) learner control, (6) motivation toward e-learning. The study participants comprised 153 freshmen who were taking an online English as a Foreign Language course. A relational model is proposed in this study to measure the predicted levels of readiness on academic achievement in online learning. Reliability analysis, Pearson correlation, linear regression analysis, and structural equation modelling were used to analyze and model the study data. Results indicated that self-directed learning is the strongest predictor of academic achievement, while motivation toward e-learning was found to be another predictor of academic achievement. Internet/online/computer self-efficacy and learner control were not found to be among significant predictors of academic achievement. It is concluded that, especially with the spread of Covid-19 worldwide, education is currently switching from face-to-face to online learning in an immediate and unexpected way; therefore e-learning readiness has to be carefully taken into consideration within this new educational paradigm.

Keywords: E-learning readiness, self-directed learning, self-efficacy, academic achievement, online learning readiness, motivation, English as a Foreign Language.

Introduction

Distance learning in higher education is a key and constantly evolving concept the aim of which provides e-learning practices to students at university level. At higher education levels, distance learning involves many different application types. Some institutions adopt a wholly online instruction approach, while others provide a blended learning type, using supportive systems and implementing tools such as Moodle, Blackboard, Atutor, and CanvasLMS among others. Since the mainstream adoption of online distance learning practices and applications at a higher education level, societies are increasingly replacing their traditional educational paradigms (Santosh & Panda, 2016).

Implementing effective e-learning is important for achieving institutional goals of both teaching and learning in higher education. Existing literature and research on e-learning has mainly be conducted with an in-depth focus on certain e-learning dimensions such as technology, faculty, support, pedagogy, readiness, management, ethics, evaluation, planning, and institution (Al-Fraihat, Joy & Sinclair, 2017). Among these e-learning sub-dimensions, e-learning readiness is one of the most important and studied. Learner readiness was first proposed for the Australian vocational education system, and three characteristics of e-readiness were specified: (1) students’ preferences of delivery as opposed to face-to-face classroom instruction, (2) student confidence in using the internet and computer-mediated communication, and (3) the ability to engage in autonomous learning (Warner, Christie & Choy, 1998).
Determining student readiness levels regarding e-learning practices is a key factor among the successful practices of e-learning. For the decision makers, e-learning programmers, and researchers, knowing the readiness levels of the students and its direct and indirect effects can provide a planning guide for better learning and better student achievement. It is not only the success of e-learning applications administered by educational institutions that are important; the effects of e-learning readiness on learners’ own learning progress, outcomes, and academic achievement are also other key factors in maintaining the main goals of education and learning online.

**Literature Review and Theoretical Framework**

**E-learning Readiness**

E-learning readiness is regarded as a kind of skill (Lopes, 2007) or ability (Kaur & Abas, 2004) for increasing the quality of learning and for taking advantage of the benefits of e-learning. Tang and Lim (2013) describe the main features of readiness in online learning environments as online learning choices, and these can be compared with readiness concerning face-to-face learning instructions, technological tool usage confidence and ability to learn individually.

Low readiness levels among students cause failure in e-learning environments. Accordingly, recent literature reports on the relationship between e-learning readiness and achievement (Kruger-Ross & Waters, 2013; Kirmizi, 2015; Çiğdem & Öztürk, 2016). Forcing learners to e-learn when they are not ready might cause them to develop a negative e-learning experience, and can increase their prejudice toward upcoming e-learning activities (Guglielmino & Guglielmino, 2003). Drop-out risk is reported as another key factor in e-learning readiness (Muse, 2003). Guglielmino and Guglielmino (2003) identify learners who are ready for e-learning and discuss an instrument for determining learner readiness to support their success in e-learning environments. The current study investigates participants who are experiencing e-learning for compulsory courses; accordingly, it will be important to see whether the results of this research are in line with existing studies in the literature.

Since there are many reasons for failure in e-learning, many of which have already been identified, when students are not ready to learn a course online, this causes a failure. To prepare learners for e-learning and make them ready to consume related e-learning content successfully, specific classroom mechanisms have to be implemented to enhance self-directed learning among e-learners (Piskurich, 2003). At higher education levels, the roles of learner and instructor are related to one another for the development of a better university e-learning practice (Siemens & Yurkiw, 2003). Before commencing any e-learning activity, it is critical for the e-learning readiness levels of learners be better understood in regard to the provided learning activity (Yurdugül & Alsancak-Sirakaya, 2013). With the increasingly substantial usage of e-learning in higher education, it is important that e-learning practitioners provide guidance and help for online learners with the awareness of these learners’ preparation/readiness levels, and the awareness of whether they are ready to experience the online education program concerned.

**The E-readiness Scales**

In the last two decades researchers have been developing instruments to determine the e-learning readiness (Evans, 2000; McVay, 2000; Smith, Murphy & Mahoney, 2003; Pillay, Irving & Tones, 2007; Hung, Chou, Chen & Own, 2010; Yurdugül & Demir, 2017). Internet/computer/online self-efficacy (Compeau & Higgins, 1995a; Eastin & Larose, 2000; McVay 2000; Roper 2007), learner control (Shyu & Brown, 1992), self-directed learning (Garrison, 1997; McVay 2000) and motivation toward e-learning (Ryan & Deci, 2000) dimensions were added to the e-readiness research by Hung et al. (2010).
**Computer Self-Efficacy**

Computer self-efficacy is defined as an individual’s belief of their ability to use a computer and their judgments about the application of computer-related skills to broader tasks (Compeau & Higgins 1995b). Computer self-efficacy is a significant predictor of students’ satisfaction with web-based distance education (Lim, 2001). It was found that computer self-efficacy was a reason for college students choosing web-based online courses, because computer self-efficacy was related to their final exam results (Wang & Newlin, 2002). These students’ perceived ability to transfer computer and ICT usage skills has a positive relationship with computer self-efficacy, while anxiety has a negative relationship with computer self-efficacy (Vuorela & Nummenmaa, 2004). It is indicated that self-efficacy has a predictive role in learner performance and success levels (Wang & Newlin, 2002; Lynch & Dembo, 2004; Bell & Akroyd, 2006).

**Internet Self-Efficacy**

Internet self-efficacy is defined as the trust of an Internet user while using the Internet. Internet self-efficacy differs from computer self-efficacy in that it may require a series of behaviors for establishing, maintaining, and using the Internet (Hung et al., 2010). Internet and computer self-efficacy are among those e-readiness sub-dimensions that are relatively infrequently addressed, among other sub-dimensions in the literature (Kuo, Walker, Belland & Schroder, 2013). Positive contributions of Internet and computer self-efficacy in e-learning environments are reported in previous research (Eastin & LaRose, 2000; Wang & Newlin, 2002; Chu & Chu, 2010).

Originating with Bandura’s original Social Cognitive Theory (Bandura, 1977), self-efficacy provides a set of practices for the route to academic achievement in e-learning environments. It is known that higher Internet self-efficacy leads to better achievement levels in web-based learning settings (Tsai & Tsai, 2003).

**Online Self-Efficacy**

Online learning provides regular communication between teacher and student without the need for face-to-face interviews. In online learning environments, it is important to communicate with others using the system, and individuals’ online self-efficacy should be considered as attempts to overcome the limitations of online learning. Effective communication improves the chances of successfully learning in e-learning environments (Gülbahar, 2009) and helps students engage in classroom discussions more successfully (Roper, 2007). For this reason, online self-efficacy can be considered as a dimension of online learning readiness. Online self-efficacy is an important sub-dimension of e-readiness for overcoming the challenges of online learning.

**Self-directed Learning**

Self-directed learning is defined in association with certain terms, such as the learner’s own goals, their learning strategies, their decision making, their outcome evaluation, and the clarification of learning needs, all of which underpin autonomous learning as controlled by the learner’s own monitoring (Knowles, 1975; Paris & Paris; 2001). In online learning, the self-directed learning process is in accordance with the original self-directed learning paradigm (Lin & Hsieh, 2001). Self-regulated learning is a constructive process for learners, one in which learners regulate their own learning by monitoring and setting their own learning goals (Pintrich, 2004). A skillful self-directed learner is expected to diagnose their own learning needs, formulate learning goals, and find adequate learning.
resources (Jossberger, Brand-Gruwel, Boshuizen & Van de Wiel, 2010). Self-directed learners learn independently and have more freedom in pursuing their learning goals compared with learners who are supposed to self-regulate their own learning by initiating an appropriate learning task. Therefore, in self-regulated learning, tasks are usually set by the instructor (Robertson, 2011). While self-regulated learners are supposed to self-regulate, they may not do so because self-regulated learning is the micro level concept that concerns processes within task execution (Saks & Leijen, 2014). Jossberger et al. (2010) indicate that providing students with opportunities for self-directed practice can help to improve their self-regulation.

Recent research on the positive relationship between self-directed learning and academic achievement in e-learning environments has yielded more relevant findings (Yukselturk & Bulut, 2007; Lee, Shen & Tsai, 2008; Wang, Shannon & Ross, 2013; Cigdem & Ozturk, 2016). In online learning environments, the learning process is characterized by the autonomy of the learner, and self-regulation plays an important role in taking advantage of learning environments. To test this hypothesis, the relationship between self-regulated learning and academic achievement, and technology-based learning is investigated by the researchers; thereby according with findings of the literature it is revealed that self-regulated is a predictor of academic achievement (Greene & Azevedo, 2009; Cho & Shen, 2013). Duncan and McKeachie (2005) developed a measurement instrument for self-regulated learning and suggest that students can improve their learning when they are provided with effective learning environments.

**Learner Control**

Web-based learning environments provide learners the opportunity to choose the information they access, with their information being sorted so to facilitate flexible and individualized learning opportunities (Lin & Hsieh, 2001); this compares with traditional learning environments, wherein system is structured with acquired and comprehended information. Shyu and Brown (1992) define learner control as the process whereby learners come to have control over their learning by self-guiding their own learning experiences. The Elaboration Theory of Instruction proposes seven major strategy components such as an elaborative sequence, learning prerequisite sequences, summary, synthesis, analogies, cognitive strategies and learner control. The theory suggests that when the highly motivated learners are given the appropriate level of authority and responsibility for providing their own learning, their learning occurs in a more attractive and efficient way (Reigeluth, 1983). In online learning environments, learners are given the opportunity to have their own preferences and can access to educational content according to their needs, regardless of a specific educational sequence. Online learning environments allow learners to control their own learning by choosing the most appropriate learning process and steps for their best learning (Brown, Howardson & Fisher, 2016; Alqurashi, 2016; Fisher, Howardson, Wasserman & Orvis, 2017; Jung, Kim, Yoon, Park & Oakley, 2019). It is expected that learners with better learner control will be able to better determine their own learning process and obtain a better learning performance as an outcome (Hung et al., 2010).

**Motivation**

There are many definitions of motivation in the field of education, and motivation has been put forward according to many theoretical approaches. In general, motivation is defined as a state of empowerment that causes learners to engage in certain activities which have physiological, cognitive, and affective dimensions that occur within. Motivation, as the structure of an online education program is largely self-directed, as it is in the traditional education process, and also comprises an important
part of the learning process in distance education. Motivation is regarded as one of the requirements of successful online learning (Lim, 2004). As learning is a more individual and independent activity within the online learning process, motivation is therefore essential for effective online learning in relation to success, dropout rate, and qualified learning (Grolnick & Ryan, 1987).

According to the famous study by Deci and Ryan (1985), motivation toward e-learning plays an important role in e-learning readiness when measuring academic achievement and satisfaction. Motivation is found to be a required component of online learning (Lim, 2004), and positive relationships have been found between motivation and academic success (Saade, He & Kira, 2007). Baeten et al. (2016) states that motivated students yield better outcomes in online learning environments.

**Toward a Proposed E-readiness and Academic Achievement Model for the Current Study**

E-learning readiness is associated with satisfaction and motivation (Yılmaz, 2017), as well as with academic achievement (Kırmızı, 2015). In time, practices of teaching and learning, in regard to the aims of higher academic achievement outcomes in traditional face-to-face learning environments, such as classroom teaching, can be expected to be similar to those employed through e-learning environments. Learner readiness levels and determining the effects of these levels on academic achievement can be assumed to involve similar processes in regard to both teaching and learning. Additionally, the institution wherein the current study was held, provide additional online courses applied for some of the basic freshman year courses, such as History, Literacy, and English as a Foreign Language (EFL), which are required courses in the curriculum for all of the students enrolled in-campus face-to-face learning. Taking into consideration the leveraging cost-effectiveness of e-learning in higher education, the applications of e-learning practices for concurrently learnt courses may be adopted en masse by such institutions in the future. To overcome the barriers of face-to-face in-campus learning, some curriculum courses are already being taught online by higher education institutions.

Since the research on e-learning readiness provides a substantially relevant literature to the current study, only a few number of studies in the literature address the relationship between academic achievement/success and relationship between predictive role of e-learning readiness and its sub-dimensions (Keramati, Afshari-Mofrad & Kamrani, 2011; Cigdem & Öztürk, 2016).

Common compulsory courses (CCCs) such as History, Literacy, and EFL which are good examples of such courses for all university students from different fields of study are being scheduled as required online courses in weekly teaching programs.

E-readiness levels of students are also crucial at this point, as they are for all types of e-learning when the courses concerned are compulsory. Students will not have any other preferences for online compulsory courses when these compulsory courses are required online courses. This study attempts to hypothesize a relational model of e-learning readiness to predict the effects on learner academic achievement in terms of internet/computer/online self-efficacy, self-directed learning, motivation toward e-learning and learner control. Moreover, this study addresses the readiness–achievement relationship of a required online course, which means that the possible results of this study will be more important in understanding the e-readiness levels of the students in higher education. The research questions of the study are as follows:

1. Is e-learning readiness a predictor of academic achievement?
2. How correlated are e-learning readiness sub-dimensions (computer self-efficacy, Internet self-efficacy, online self-efficacy, self-directed learning, learner control, motivation) and academic achievement?
Consequently, and in accordance with the current study’s background analysis as seen in the literature review, a relational model is hypothesized. The structural relations model is proposed with the complementary hypothesis given below (Figure 1).

**Hypothesis 1:** E-learning readiness is significantly associated with academic achievement.

**Hypothesis 2:** Sub-dimensions (“Computer self-efficacy”, “Internet self-efficacy”, “Online self-efficacy”, “Self-directed learning”, “Learner control”, “Motivation toward e-learning”) of e-learning readiness are the predictors of academic achievement.

**Hypothesis 2a:** Computer self-efficacy has a positive influence on academic achievement.

**Hypothesis 2b:** Internet self-efficacy has a positive influence on academic achievement.

**Hypothesis 2c:** Online self-efficacy has a positive influence on academic achievement.

**Hypothesis 2d:** Self-directed learning has a positive influence on academic achievement.

**Hypothesis 2e:** Learner control has a positive influence on academic achievement.

**Hypothesis 2f:** Motivation toward e-learning has a positive influence on academic achievement.

**Method**

**Research Context**

Most public and private universities are switching from campus education to online distance education platforms for CCCs in their own curriculums. CCCs are the basic courses that are mostly taught in the first year of the university. These basic courses are compulsory for those students in the curriculum. An EFL course was a compulsory five-credit course, and was provided online by the university as one of the basic introductory courses in the freshman curriculum. EFL courses with 3–5 credits each semester are among the basic CCCs of the freshman. A basic EFL course in the fall freshman curriculum, one that was entirely carried out on an online distance education platform, was selected for the current study.

CCCs are taught online via the university’s distance education platform. The course instructors are the lecturers and academicians of the university. The instructor carries out a blended or totally online teaching process by using the platform. The midterms and finals are applied in a paper-based classical exam setting. By administrating distance education for CCCs, the university aims to use a less burdening but wholly equal and independent type of education for all their students. Figure 2 displays a screenshot from the distance learning platform’s EFL course. After enrollment, students can join the lessons taught synchronously, and watch them repeatedly and asynchronously when
they want from the saved library of recorded video lectures, ask questions, and follow up their activity. Students can also take quizzes from the test bank for their own self-evaluation and immediately view their own reports. Surveys are held to monitor and get feedback, the students so to improve the system’s functioning in case of any technical problems.

![Figure 2: A Screenshot of the Online Distance Learning Student Portal.](image)

**Participants**

A total of 155 students from a public university participated in this study. Two sets of responses were excluded from the study due to missing data, and so a total of 153 subjects were ultimately enrolled in the study; accordingly, the study subjects comprised 79 female (51.63%) and 74 male (49.37%) freshmen who were enrolled in an English as a Foreign Language class. All the freshmen were from the university’s Communication, Business, Engineering and Education school. Overall, 55.2% of the students (n=84) reported that they did not have an online course participation experience, while 44.8% of the students (n=69) reported that they had at least one online course experience (Table 1).

Table 1: Demographics

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>79</td>
<td>51.63</td>
</tr>
<tr>
<td>Male</td>
<td>74</td>
<td>49.37</td>
</tr>
<tr>
<td><strong>Prior E-Learning/online course participation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>84</td>
<td>55.2</td>
</tr>
<tr>
<td>At Least One</td>
<td>69</td>
<td>44.8</td>
</tr>
<tr>
<td><strong>School</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>54</td>
<td>35.29</td>
</tr>
<tr>
<td>Business</td>
<td>42</td>
<td>27.45</td>
</tr>
<tr>
<td>Education</td>
<td>34</td>
<td>22.22</td>
</tr>
<tr>
<td>Engineering</td>
<td>23</td>
<td>15.03</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>153</td>
<td>100</td>
</tr>
</tbody>
</table>

Instruments

The E-learning readiness (ELR) scale, and an additional personal information and demographics form, were used to collect the study data. The personal information form collected student demographics such as data on their gender, attended department/schools, and prior e-learning/online course participation experiences.

ELR scale (Yurdugül & Demir, 2017) is a 33-item scale with six sub-dimensions. The sub-dimensions of the instrument are computer self-efficacy (five items), Internet self-efficacy (four items), online self-efficacy (five items), self-directed learning (eight items), learner control (four items), and motivation toward e-learning (seven items). The freshmen who attended the EFL course for the 2019–2020 fall semester answered questions of the e-learning readiness scale voluntarily.

Data Collection Procedure

The EFL course was taught online to freshmen by instructors during the 2019–2020 fall semester. The course lasted 15 weeks during the fall semester of the 2019 academic calendar. The attendance levels of students were recorded by the online monitoring system in terms of hours attended for each course. A purposely designed learning management system (LMS) for the online distance CCCs developed by the university’s distance education center was used as the teaching platform, regardless of the LMS system was used for the traditional on-campus courses. During the semester, students attended their classes for the EFL course, and completed midterm and final exams. Concerning the study data, academic achievement is calculated using the results of midterm and final exams of the EFL course. Each student’s average midterm and final grades (maximum grade is 100) were tracked from the system and were recorded as “academic achievement” data for the study.

At the end of the semester after 15 weeks, the data collection instruments were administered online. The students answered the questions of the personal information form and ELR scale, respectively.

Data Analysis

The data analysis started with skewness and kurtosis analysis in order to find the normal distribution of the data. Based on the results, the whole data did not show a normal distribution. Measures of the sampling adequacy and sphericity tests were then undertaken. The results of the KMO (Kaiser-Meyer-Olkin) coefficient and the Bartlett’s test of sphericity showed that the data are suitable for SEM. The KMO value was calculated as 0.712, and KMO values between 0.7–0.8 are considered to be good. The sphericity test (\( p = 0.000 \)) was significant at the \( p < 0.05 \) level. According to these results, the data were found out to be adequate for SEM to test the hypothesized constructs. KMO values can range from 0–1, and KMO values above 0.5 are considered acceptable. Furthermore, KMO values between 0.5–0.7 are moderate, values between 0.7–0.8 are good, values between 0.8–0.9 are very good, and values of KMO above 0.9 indicate excellent relational patterns among or between the items (Hutcheson & Sofroniou, 1999).

To calculate the relationships between the hypothesized variables, the correlation coefficients are calculated, and the regression analysis is applied. Starting with the calculation of the reliability of the scale and its various subscales, descriptive statistics analysis was conducted to determine average scores, mean scores, and total averages. To confirm the correlation and regression results, SEM is applied with incremental, absolute, and parsimony fit indices. The estimates, model fit, chi-square, Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Squared Residuals (SRMR), Goodness of Fit (GFI), Adjusted Goodness of Fit (AGFI), Normed Fit (NFI), Non-normed
Fit (NNFI), and Comparative Fit (CFI) index values were then calculated and assessed in accordance with the acceptance criteria to test the proposed model fit for e-readiness.

**Results**

The ELR scale was found to have a Cronbach’s Alpha value of 0.81, indicating a good level of reliability. Internal reliability coefficients were calculated as 0.79–0.86 (Table 2).

<table>
<thead>
<tr>
<th>Sub-dimensions</th>
<th>Cronbach’s alpha</th>
<th>Number of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-learning Readiness Scale</td>
<td>0.81</td>
<td>33</td>
</tr>
<tr>
<td>Computer self-efficacy</td>
<td>0.79</td>
<td>5</td>
</tr>
<tr>
<td>Internet self-efficacy</td>
<td>0.86</td>
<td>4</td>
</tr>
<tr>
<td>Online self-efficacy</td>
<td>0.82</td>
<td>5</td>
</tr>
<tr>
<td>Self-directed learning</td>
<td>0.83</td>
<td>8</td>
</tr>
<tr>
<td>Learner control</td>
<td>0.78</td>
<td>4</td>
</tr>
<tr>
<td>Motivation toward e-learning</td>
<td>0.79</td>
<td>7</td>
</tr>
</tbody>
</table>

Descriptive statistics for the ELR sub-dimensions are given in Table 3. Responses to the ELR are given according to a sliding scale from 1 = “Never”, to 7=“Always”. As can be seen in Table 3, the total average ELR score is 153.68 (Mean = 4.66). On examination of the sub-dimension averages, it can be seen that the students reported the highest readiness level of motivation toward e-learning (Mean = 5.08). Additionally, online self-efficacy and self-directed learning have both equivalent, and the second-highest mean, values (Mean = 4.84). Following these, it was found that internet self-efficacy (Mean = 4.77), computer self-efficacy (Mean = 4.20) and learner control (Mean=3.78) sub-dimensions have above average and relatively high readiness scores.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Number of items</th>
<th>Min. score</th>
<th>Max. score</th>
<th>X</th>
<th>SD</th>
<th>X/k</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELR</td>
<td>33</td>
<td>33</td>
<td>231</td>
<td>153.68</td>
<td>1.12</td>
<td>4.66</td>
</tr>
<tr>
<td>Computer self-efficacy</td>
<td>5</td>
<td>5</td>
<td>35</td>
<td>21</td>
<td>1.36</td>
<td>4.20</td>
</tr>
<tr>
<td>Internet self-efficacy</td>
<td>4</td>
<td>4</td>
<td>28</td>
<td>19.08</td>
<td>1.16</td>
<td>4.77</td>
</tr>
<tr>
<td>Online self-efficacy</td>
<td>5</td>
<td>5</td>
<td>35</td>
<td>24.2</td>
<td>1.21</td>
<td>4.84</td>
</tr>
<tr>
<td>Self-directed learning</td>
<td>8</td>
<td>8</td>
<td>56</td>
<td>38.72</td>
<td>1.11</td>
<td>4.84</td>
</tr>
<tr>
<td>Learner control</td>
<td>4</td>
<td>4</td>
<td>28</td>
<td>15.12</td>
<td>1.27</td>
<td>3.78</td>
</tr>
<tr>
<td>Motivation toward e-learning</td>
<td>7</td>
<td>7</td>
<td>49</td>
<td>35.56</td>
<td>1.19</td>
<td>5.08</td>
</tr>
</tbody>
</table>
Correlation for Academic Achievement (AA)

Table 4 displays the relationships between AA (average of the midterm and final grades of the EFL course) and ELR, based on the Pearson correlation coefficient calculations. The relationship between academic achievement and ELR were all found to be positive. As can be seen in Table 4, there are strong (r > 0.50) correlations between self-directed learning (r = 0.824, p = 0.000) and motivation toward e-learning (r = 0.508, p = 0.000). Moderate (r is between 0.30 and 0.49) correlation is calculated for learner control (r = 0.375, p = 0.000). The correlations are small (r < 0.29) for online self-efficacy (r = 0.225, p = 0.005), Internet self-efficacy (r = 0.170, p < 0.05) and for the computer self- efficacy (r = 0.095, p > 0.05). The correlation between computer self-efficacy and ELR was not found to be statistically significant.

<table>
<thead>
<tr>
<th></th>
<th>AA</th>
<th>ELR1</th>
<th>ELR2</th>
<th>ELR3</th>
<th>ELR4</th>
<th>ELR5</th>
<th>ELR6</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>r</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELR1</td>
<td>r</td>
<td>0.824**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELR2</td>
<td>r</td>
<td>0.508**</td>
<td>0.492**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELR3</td>
<td>r</td>
<td>0.375**</td>
<td>0.468**</td>
<td>0.154</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.000</td>
<td>0.000</td>
<td>0.057</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELR4</td>
<td>r</td>
<td>0.225**</td>
<td>0.283**</td>
<td>0.319**</td>
<td>0.391**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.005</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELR5</td>
<td>r</td>
<td>0.170*</td>
<td>0.247**</td>
<td>0.289**</td>
<td>0.289**</td>
<td>0.472**</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.036</td>
<td>0.002</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>ELR6</td>
<td>r</td>
<td>0.095</td>
<td>0.112</td>
<td>0.320**</td>
<td>0.085</td>
<td>0.579**</td>
<td>0.498**</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.241</td>
<td>0.169</td>
<td>0.000</td>
<td>0.295</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.001 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
ELR1: Self-directed learning, ELR2: Motivation toward e-learning, ELR3: Learner control, ELR4: Online self-efficacy, ELR5: Internet self-efficacy, ELR6: Computer self-efficacy, AA: Academic Achievement

The directions of the Pearson correlation coefficient relationships of the sub-dimensions of ELR were all positive on AA (Table 5). That means AA is in positive relationship with computer-internet-online self-efficacy, self-directed learning, learner control, and motivation toward e-learning. When students’ ELR is high, this makes greater contributions to higher academic achievement levels, and self-directed learning seems to be the variable that most affects AA. To be able to see the linear model of the variables together and interpret the total effects regression analysis, SEM were then conducted using the study data.

Table 5: Pearson Correlations of AA and ELR Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sub-dimensions / Factors</th>
<th>Pearson correlations</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Achievement</td>
<td>Computer self-efficacy</td>
<td>0.095</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td>Internet self-efficacy</td>
<td>0.170*</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td>Online self-efficacy</td>
<td>0.225**</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td>Self-directed learning</td>
<td>0.824**</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td>Learner control</td>
<td>0.375**</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td>Motivation toward e-learning</td>
<td>0.508**</td>
<td>153</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.001 level (2-tailed).**
*Correlation is significant at the 0.05 level (2-tailed).

Regression Analysis for Academic Achievement

Linear regression analysis is administered to predict the effects of ELR on AA in the online EFL course. The relationship between self-directed learning and AA was found to be strong (β = 0.820, p = 0.000) and positive. The analysis showed motivation toward e-learning as indicating the second biggest relationship between ELR and AA (β = 0.157, p = 0.006) among other variables. Self-directed learning (p < 0.001) and motivation toward e-learning were found to be the only significant (p < 0.05) variables on AA.

Table 6: Regression Analysis for E-Learning Readiness in Predicting Academic Achievement

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>SE</th>
<th>b</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.249</td>
<td>0.235</td>
<td>1.057</td>
<td>0.292</td>
<td></td>
</tr>
<tr>
<td>Computer self-efficacy</td>
<td>0.000</td>
<td>0.054</td>
<td>0.000</td>
<td>0.002</td>
<td>0.988</td>
</tr>
<tr>
<td>Internet self-efficacy</td>
<td>-0.61</td>
<td>0.058</td>
<td>-0.059</td>
<td>-1.058</td>
<td>0.292</td>
</tr>
<tr>
<td>Online self-efficacy</td>
<td>-0.20</td>
<td>0.062</td>
<td>-0.020</td>
<td>-3.20</td>
<td>0.750</td>
</tr>
<tr>
<td>Self-directed learning</td>
<td>0.820</td>
<td>0.064</td>
<td>0.758</td>
<td>12.841</td>
<td>0.000</td>
</tr>
<tr>
<td>Learner control</td>
<td>0.020</td>
<td>0.053</td>
<td>0.022</td>
<td>0.384</td>
<td>0.701</td>
</tr>
<tr>
<td>Motivation toward e-learning</td>
<td>0.157</td>
<td>0.056</td>
<td>0.155</td>
<td>2.790</td>
<td>0.006</td>
</tr>
</tbody>
</table>

Regression analysis revealed that self-directed learning was the strongest predictor of academic achievement in online learning. Motivation toward e-learning was the second predictor of e-learning readiness. Computer self-efficacy, Internet self-efficacy, online self-efficacy and learner control were not the significant predictors of e-learning readiness. In this study, the most important variable among other ELR variables—such as, computer-internet-online self-efficacy, learner control, and motivation toward e-learning—was the self-directed learning. Confirming the research hypothesis, standardized regression coefficients indicated that e-learning readiness was a predictor of academic achievement (β = 0.67, p < 0.001).
Hypothesized Model Testing

Incremental, absolute, and parsimony fit indices were calculated and interpreted for the model fit. The results demonstrated contradictory constructs in this study in that the most appropriate indices were selected for the model fit. Since the sample size is smaller \((n = 153)\), the chi-square was calculated as 255.334 \((p = 0.000)\), which indicates a poor model of fit \((Hu \& Bentler, 1999)\). However, the results were found to be statistically significant \((p < 0.001)\). It is possible for the chi-square to be affected by both the size of the correlations and the latent variables. The total variance explained in the model was 65.79\%, thereby revealing a good variance of explanation rate. Remaining overall fit and \(R^2\) measurements of the proposed model to test the direct and indirect effects of ELR variables on AA were not found to satisfy the acceptable or perfect-fit criteria. The indices and their acceptance criteria are given in Table 7.

<table>
<thead>
<tr>
<th>Fit Index</th>
<th>Perfect Fit Criteria</th>
<th>Acceptable Fit Criteria</th>
<th>Reference Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>(x^2/SD)</td>
<td>(0 \leq x^2/SD \leq 2)</td>
<td>(2 \leq x^2/SD \leq 3)</td>
<td>Hu and Bentler (1999)</td>
</tr>
<tr>
<td>GFI</td>
<td>(0.95 \leq \text{GFI} \leq 1.00)</td>
<td>(0.90 \leq \text{GFI} \leq 0.95)</td>
<td>Marsch, Balla and Mcdonald (1988), Jöreskog and Sörbom (1993), Schermelleh-Engel and Moosbrugger (2003).</td>
</tr>
<tr>
<td>AGFI</td>
<td>(0.90 \leq \text{AGFI} \leq 1.00)</td>
<td>(0.85 \leq \text{AGFI} \leq 0.90)</td>
<td></td>
</tr>
<tr>
<td>CFI</td>
<td>(0.95 \leq \text{CFI} \leq 1.00)</td>
<td>(0.90 \leq \text{CFI} \leq 0.95)</td>
<td>Bentler (1980), Bentler and Bonnett, (1980), Marsch, Hau, Artelt, Baumertv and Peschar, (2006).</td>
</tr>
<tr>
<td>NFI</td>
<td>(0.95 \leq \text{NFI} \leq 1.00)</td>
<td>(0.90 \leq \text{NFI} \leq 0.95)</td>
<td></td>
</tr>
<tr>
<td>NNFI</td>
<td>(0.97 \leq \text{NNFI} \leq 1.00)</td>
<td>(0.95 \leq \text{NNFI} \leq 0.97)</td>
<td></td>
</tr>
<tr>
<td>RMSEA</td>
<td>(0.00 \leq \text{RMSEA} \leq 0.05)</td>
<td>(0.05 \leq \text{RMSEA} \leq 0.08)</td>
<td>Browne and Cudeck (1993), Byrne and Campbell (1999), Hu and Bentler (1999), Schermelleh-Engel and Moosbrugger (2003).</td>
</tr>
<tr>
<td>SRMR</td>
<td>(0.00 \leq \text{SRMR} \leq 0.05)</td>
<td>(0.05 \leq \text{SRMR} \leq 0.10)</td>
<td></td>
</tr>
</tbody>
</table>

The hypothesized model did not provide an acceptable model of fit \((Hu \& Bentler, 1999)\) based on the fit indices criteria. The calculated indices were not acceptable, including the RMSEA and SRMR values and the values were not within the acceptable range. Comparatively, the proposed model generated by AMOS 23 is displayed in Figure 3, indicating the direct effects of ELR on students’ academic achievement.

![Diagram](image-url)
As expected, there were direct effects of self-directed learning and motivation toward e-learning on AA, as can be seen in the hypothesized model depicted in Figure 3 ($\beta = 0.79, p < 0.001; \beta = 0.16, p < 0.001$). Learner control was found to have a positive but weak direct effect on AA ($\beta = 0.02, p < 0.001$), whereas Internet self-efficacy and online self-efficacy were found to have negative direct effects on AA ($\beta = -0.06, p < 0.001; \beta = -0.02, p < 0.001$). Computer self-efficacy effect was calculated as neutral providing a result of zero direct effect on AA ($\beta = 0.00, p < 0.001$).

Discussion and Conclusion

This study aims to contribute to literature on role of e-learning readiness in predicting academic achievement. To determine the predictive roles of Internet self-efficacy, computer self-efficacy, online self-efficacy, learner control, self-directed learning, and motivation toward e-learning on academic achievement in e-learning, relational analysis and SEM were used to analyze the study data.

The results of the study revealed that self-directed learning is the most important predictor of academic achievement in online EFL courses. Self-directed learning predicted online academic achievement to a statistically significant degree according to the study’s regression analysis, and this prediction effect was also confirmed with structural equation modelling. The hypothesized model confirmed the strong relationship between self-directed learning of e-learning readiness and academic achievement. SEM also confirmed that motivation toward e-learning was second most predictor of academic achievement. Consequently, the model proposed in this study emphasizes the importance of e-readiness to increase academic achievement in e-learning. For students’ positive academic achievement in e-learning, it is important that they have high levels of e-readiness for e-learning in terms of the various e-readiness sub-dimensions.

The results of the effects of self-directed learning on academic achievement are supported by the existing literature and closely accord with previous research (Pintrich, 2004; Lee et al., 2008; Wang et al., 2013; Kirmizi, 2015; Çiğdem & Öztürk, 2016). As was confirmed through the hypothesized model that is proposed in the current study, self-directed learning emphasizes the effect of e-learning readiness on students’ academic achievement when taking online courses. It is evident from this result that better self-directed learning processes contribute to better learning outcomes and academic achievement among students learning in online learning environments. These results confirm that self-directed learning processes in online learning are in accordance with the original self-directed learning paradigm (Lin & Hsieh, 2001). Therefore, it is recommended that e-learning practitioners support students in establishing the relationship between students’ own learning objectives and learning needs in e-learning. Additionally, giving students the responsibility to choose and implement the appropriate learning strategy can also increase their academic achievement.

Self-efficacy, as a sub-dimension of e-learning readiness, was not predictive on academic achievement in terms of Internet, computer, and online self-efficacy. In student-centered learning, students are expected to have competencies such as controlling learning, defining learning needs, determining learning strategies, and interest in and attitudes toward their own learning. This concept, expressed as readiness for learning, constitutes an important dimension of online learning environments. However, due to the online learning context involved in distance education, other student readiness structures gain importance in e-learning environments, such as computer, Internet, and online-communication self-efficacy. Today, social networks play an important role in student communication, and it can be said that social networks are more advanced in terms of interaction, increasing student motivation in e-learning, and enriching online communication. Therefore, the effect of social network usage in e-learning can be tested to measure the online communication self-efficacy sub-dimension of e-readiness.
Based on the descriptive data collected for this study (Table 3), learners indicated the highest mean on motivation toward e-learning (Mean = 5.08). This result pointed to a strong motivational readiness toward learning EFL online, and it is supported by Hung et al. (2010), Tang and Lim (2013), and Çiğdem and Öztürk’s (2016). According to the descriptive statistical analysis, this relationship between motivation and e-learning readiness resulted as a predictive e-readiness factor on academic achievement. Therefore, it is important that educators are unable to provide activities, content, and tools to motivate students when learning online, and also to facilitate their adaptation to the system for more sustainable motivation during online learning.

The overall readiness scores of the learners who participated in the current study were of a high value (Mean = 4.66) and above average (Mean > 3.5). Learners’ lowest readiness level was found in regard to learner control. A reason for this finding may be due to the small number of the students who were experiencing e-learning for the first time; accordingly, students were about to experience an unforeseen and tacit type of EFL learning process through e-learning, and so were unable to control their own learning. Furthermore, EFL course was of a common and compulsory type, and was taught online without a face-to-face or blended-learning alternative.

The correlations between e-learning readiness and academic achievement were positive among the e-learning readiness sub-dimensions. A very strong correlation was found for self-directed learning and academic achievement, and the correlation between motivation toward e-learning and academic achievement was also found to be strong. A moderate correlation was reported for the learner control sub-dimension while the correlations between the sub-dimensions of self-efficacy—including online, Internet, and computer, dimensions—were all found to be small. The correlation for computer self-efficacy was not statistically significant. These results imply that learners who can make appropriate arrangements of their own learning and choose learning materials and activities they like on online training courses, can generate better learning outcomes. Additionally, learners’ self-directed learning was more important than their self-efficacy, learner control, and motivation affecting the outcome of online learning effectiveness regarding their academic achievement. According to this result, students with a relatively high self-directed learning capability performed better in learning English online. In light of this information, online learning and education designers are recommended to focus on improving students’ self-directed learning skills. The support of the instructors will be needed in determining the learning needs of the students’ and their basic tasks required to reach them to their learning goals. Accordingly, in addition to helping learners acquire technical skills utilized in online courses, educators or e-learning practitioners should note the great influence of self-directed learning in facilitating learners to develop positive online learning experiences.

In this study, data instrumentation comprised a single measurement tool and the data analyses were carried out using a quantitative research design. Future studies in the field might add to the literature by collecting more detailed data, and could analyze these data using a mixed-method research design. This study was carried out to investigate the online distance learning practices appertaining to a required EFL course, one was carried out wholly online, results may vary in other types of distance education settings. Future research might also address different types of practices in higher education and use larger sample sizes. Similar research could also be carried out for different courses using participants from different student groups. Results of different studies might also be compared for improved generalization of their findings. Additionally, satisfaction, memory performance, cognitive task analysis, and meta-cognitive strategies in e-learning could also be investigated along with e-readiness.

While this research article was being written, the Covid-19 pandemic commenced. In many affected countries, universities ended normal education suddenly and quickly switched to using distance education. However, this transition brought with it a wide range of challenges in regard...
to enabling rapid activation of both infrastructure and distance education within a limited period. Many universities started online distance education directly, without conducting readiness research to determine the readiness of their students or their instructors. All face-to-face classes in higher education—and indeed in all steps of education, including elementary and secondary education—are now undertaken on online platforms; this not only unexpectedly resulted in common compulsory courses being conducted online, but also the totality of higher education teaching. Therefore, the e-readiness of both faculty and students regarding distance education is controversial, and so much so that quick and rigorous e-readiness research is recommended in order to help practitioners concerned to better maintain e-learning practices.

References


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Examining e-Learners’ Preferences and Readiness Satisfaction: A Holistic Modelling Approach

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Abstract

Over the past several years, online learning has become an extremely popular research topic. Nevertheless, there continues to be a need for a holistic approach when examining online learning. To examine issues related to online learning as well as the effects caused to online learners; researchers in this study developed and tested a model that employed a holistic approach. The aim of this study was to investigate the effect of participants’ learning preferences and readiness to participate in online learning had on their overall satisfaction. The researchers utilized structural equation modelling to determine the relationships that occurred between variables. It was revealed in the results that e-Learners preferences and readiness, which constituted the primary components of this research model, did predict their level of satisfaction with e-learning.

Keywords: e-Learning, distance education, SEM, satisfaction, preferences, readiness, e-learner

Introduction

As technology improves and access to the Internet continues to become more affordable and easier to obtain, a greater number of people are becoming technology-literate. As a result, there appears to be a need among adults for increased technology learning and use. In recent years, e-learning has increased in popularity and is preferred by a greater number of learners (Paechter & Maier, 2010). To address the educational needs of e-learning, a variety of options are available for distance learning. To provide distance and e-learning opportunities for all interested parties (e.g., university students, working professionals, retirees, etc.), universities are offering more online learning resources to meet various educational needs. These opportunities cover a multitude of topics and meet the increasing need for the latest online technologies.

Even though increases in e-learning appear to be positive, if educational retention rates are fully considered, then the e-learning picture becomes less promising. Interestingly, a variety of factors seems to be contributing to why individuals are unable to complete online programs (Kara, Erdoğan, Kokoç & Cagiltay, 2019). For example, whilst some learners are unable to manage their time between work, family, and study (Yasmin, 2013); others are unable to cope with instructional content and the process of online learning. In some cases, the inability to continue the e-learning curriculum was not related to content difficulty (Barefoot, 2004; Bunn, 2004; Ivankova & Stick, 2007), but instead, the primary reason for the lack of retention among online learners was more a result of personal traits (e.g., learning styles and/or difficulties, personality traits, etc.) (Harrell & Bower, 2011; Hart, 2012). According to Zawacki-Richter (2009), “learner characteristics” which appear at the micro level and deal with the teaching and learning aspect of distance education, are of utmost importance. By utilizing a holistic approach, the researchers’ in this current study investigated learning characteristics of e-Learners to determine relationships between variables such as individual preferences, e-readiness, and satisfaction from the e-learner’s point of view.
Learning Preferences of e-Learners

Do individual differences and/or learning preferences affect how learners study? Should these differences and preferences be considered when designing online courses? Discussion regarding these questions has gone on for many years, yet a lack of consensus continues among instructional designers. Some believe that e-learning should be developed with learners’ preferences in mind (Garland & Martin, 2005; Lee, Barker & Kumar, 2016; Siddique, Durrani & Naqvi, 2017; Wang, Wang, Wang & Huang, 2006), while others believe it unnecessary to consider learners’ preferences (Butler & Pinto-Zipp, 2005; Gupta & Anson, 2014; Lu, Yu & Liu, 2003; Santally & Senteni, 2013). The belief by many is that today’s learners are flexible and can adapt their learning preferences to any instructional experience. However, problems can arise if content and learning activities are not a match to individual expectations and/or preferences (Ali, Uppal & Gulliver, 2018). Thus, the role of learning preferences within e-learning continues to be unaddressed (Lu & Chiou, 2010). Research investigations should be conducted to understand the role learning preferences play in e-learning design (Mohr, Holtbrugge & Berg, 2012). Akdemir and Koszalka (2008) propose a similar argument that designing content according to individual preferences enhances learner achievement and satisfaction.

Differing researchers have categorized and labelled learning preferences, but the reality of considering these individual differences while designing instruction seems intuitive. Considerations of learning preferences are difficult because they may change according to content format and learner expectations. Teaching styles can also change, develop, and be altered. Rather than categorize learners it is important instead to understand the overall nature of learning. This should be done as part of the design process.

As stated by Gülbahar and Alper (2014), online learning preferences can be utilized to enhance the quality of learning, especially for learners who can adapt to different ways of learning. It is important if learners understand their idiosyncratic traits and consequences that arise from their divergent choices.

To reveal students’ online learning preferences, Gülbahar and Alper (2014) developed a scale consisting of seven factors: independent learning, social learning, audio-visual learning, active learning, verbal learning, logical learning, and intuitive learning. Following reliability and validity analysis, it was determined that the scale was valid and reliable. The scale was utilized as one aspect of the research model for this current study.

e-Readiness of e-Learners

The e-Readiness construct is composed of several dimensions that work in unison and directly affect e-learning. The primary factors, which determine learners’ readiness are; effective use of information technologies, technical competencies, and individual preferences. Their level of access to technology and resources (Dada, 2006; Hanafizadeh, Hanafizadeh & Khodabakhshi, 2009; Mutula & Van Brakel, 2006) should also be considered. Watkins, Leigh, and Triner (2004) found that access to technology, technical skills, motivation, online audio and video, and Internet discussions are factors most affecting success.

Çiğdem and Öztürk (2016) examined the relationship between factors of online learning readiness and learners’ end-of-course achievements, stating, “The inferential results revealed that the students’ end-of-course grades had significantly positive relationships with their computer/Internet self-efficacy and self-directed learning orientations” (p. 98).

Different research studies regarding e-Readiness point to personal characteristics, technical competencies, access to technology and overall motivation as key factors determining readiness that affects success.
Satisfaction of e-Learners

The determination of learner satisfaction can be a difficult prospect. There are a variety of opinions throughout the literature, for example, timely feedback (Lee, 2010), social presence (Abdous & Yen, 2010; McGorry, 2003), support services (Lee, 2010), technical support, and course technology (McGorry, 2003).

Beqiri, Chase, and Bishka (2009) investigated factors affecting student satisfaction and determined the highest level of satisfaction related to particular e-learning technologies. Learners with a positive attitude and an adequate level of competency in e-learning technologies reported satisfaction. In, Pena and Yeung (2010), it was determined that there is a direct relationship between online learning satisfaction and competency in computer use. Jung-Wan and Mendlinger (2011) investigated personal competence perception on learners’ acceptance and satisfaction of e-learning. Two findings were revealed: the perception of personal competence affects attitude towards e-learning, and the concept of usefulness positively affects satisfaction.

According to Palmer and Holt (2009), the satisfaction level of 70% of e-Learners is related to confidence in learning and technology use, understanding of what is expected for success and the quality of education they received throughout the process.

Similarly, Bray, Aoki, and Dlugosh (2008) found satisfaction of students who preferred individual learning is higher among those who can self-manage difficulties associated with e-learning, can find computer use easy, can communicate with instructors, and who prefer lack of social interaction while learning. Palmer and Holt (2010) determined an Instructional Management System increased students’ satisfaction when they could locate and utilize lesson information as well as had sufficient support from instructors and technical services. Reading online contributions from their classmates was also important for student satisfaction.

To determine learner satisfaction, Ilgaz and Askar (2013) developed a satisfaction scale regarding “acceptance of technology in distance education and contribution of community feeling to learning satisfaction”. The dimensions of the six-factor scale were; student-student interaction, student-teacher interaction, online lessons, technical support, printed materials, and face-to-face activities.

Bolliger and Martindale (2004) conducted a study of factors influencing student satisfaction in online courses. Their instrument was comprised of three factors: instructor, technology, and interactivity. The research determined, “Clearly, student satisfaction is a key variable in determining the success or failure of online learners, courses, and programs” (p. 66).

Kuo, Walker, Belland, and Schroder (2013) investigated how interaction and other predictors contribute to student satisfaction in online settings. The results revealed learner-content interaction accounted for the largest unique variance in students’ levels of satisfaction. It was also highlighted that, “gender, class level, and time spent online per week seemed to have an influence on learner-learner interaction, Internet self-efficacy, and self-regulation” (p. 16).

The aim of the current study was to determine learners’ satisfaction levels regarding the effectiveness of e-learning systems and their level of interaction in computer use, teaching processes, teaching content, e-Instructor competence, e-learning technologies, and positive attitude towards learning.

Literature on Conceptual e-Learning Models

As e-learning continues to grow further research should be conducted to determine ways of improving the e-learning process. Moreover, making reasonable and informed judgments should be made.
regarding the quality of e-learning provided to learners, instructors, and policymakers. Roach and Lemasters (2006) suggest, “Researchers need to vary designs and methodologies in the study of online programs to not only compare online and on-ground instruction and learning, but also assess the importance of the findings” (p. 330).

Al-Azawei and Lundqvist (2015) concentrated on the Technology Acceptance Model (TAM) when examining satisfaction among learners. The factors considered were deep level (learning styles), surface level (gender), and cognitive (online self-efficacy). Their aim was to reveal pedagogical implications of learning styles on learner satisfaction, and their model achieved an acceptable fit and explained for 44.8% of variance, thus, “Perceived usefulness represented the best predictor; whereas, online self-efficacy and perceived ease of use failed to show a direct impact on perceived satisfaction” (p. 408).

Artino (2008) investigated students’ motivational beliefs, perceptions of the learning environment, and satisfaction with a self-paced online course. Their results revealed that task value, self-efficacy, and instructional quality were positive predictors of student satisfaction, and the final regression model accounted for 54% of variance occurring in the outcomes.

Literature review revealed that a modelling study by Toral, Barrero, Martinez-Torres, Gallardo, and Duran (2009) significantly explained learners’ satisfaction relating to content and feedback, learning community, learner responsibility, and previous learner experience. Joo, Lim, and Kim (2011) determined teaching presence, cognitive presence, perceived usefulness, and ease of use predicted learner satisfaction. Lee and Choi (2013) established a direct relationship between satisfaction and student retention, internal academic locus of control, and flow in regards to learner retention for online learning environments. Ke and Kwak (2013), on the other hand, determined learner relevance, active learning, authentic learning, learner autonomy, and computer technology competence to be the most significant predictors of learner satisfaction. Finally, Sahin and Shelley (2008), perceived usefulness and flexibility of distance education were determined to most significantly predict satisfaction in distance education.

By reviewing previous research regarding learner satisfaction, educational quality, and other aspects of online learning, it was determined there is a need for a holistic approach for gathering data and insight into e-learning. Through a holistic approach, researchers’ in this current study provided an integrative perspective to the e-learning process.

**Research Aim & Hypotheses**

Determining variables that predict student satisfaction within e-learning was the aim of the current study. The researchers’ conducted inquiries into whether or not there was a relationship between learners’ e-learning preferences and their readiness for e-Learning. The hypotheses and theoretical model for this study are:

H1: There is a significant relationship between individuals’ learning preferences and their satisfaction within an e-learning environment.
H2: There is a significant relationship between individuals’ readiness and their satisfaction within an e-learning environment.
H3: The delivery and usability, teaching process, instructional content and interaction and/or evaluation components predict satisfaction within an e-learning environment.

Theoretical model presented in Figure 1.
Method

Study Context

Researchers’ conducted this study within an e-learning program that employed a blended learning model with synchronous and asynchronous practices combined. This study was carried out at Ankara University in Turkey. At the start of the school semester, students and instructors were notified about their synchronous lesson, schedule via Adobe Connect Virtual Classroom. Each lesson was recorded and uploaded, so that students could follow up at any time. Each course included a syllabus, SCORM (Sharable Content Object Reference Model) package, course notes, presentations and supplementary materials. Students could freely access course resources 24 hours a day, 7 days a week. Students were able to interact with their course peers and/or course instructors through course discussion boards. Every semester for 2 or 3 days, there were face-to-face sessions where learners could attend courses and meet with course instructors and peers.

Research Design

In this study the researchers’ examined participants’ prior-learning preferences and readiness in regards to their satisfaction of e-learning. To determine if relationships occurred between the stated variables Structural Equation Modelling was employed. SEM (Structural Equation Modelling) is defined as a combination of statistical processes including regression, path analysis, and factor analysis. SEM is a specific methodology used to determine relationships between latent variables observed in relation to a theoretical structure (Kline, 2010).
**Participants**

The participants’ of this study were 363 individuals enrolled in a distance learning associate degree program or undergraduate degree completion program at Ankara University. The demographic data of participants is provided in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Participant demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>Married</td>
</tr>
<tr>
<td><strong>Age</strong></td>
</tr>
<tr>
<td>18–25</td>
</tr>
<tr>
<td>26–33</td>
</tr>
<tr>
<td>34–41</td>
</tr>
<tr>
<td>42–49</td>
</tr>
<tr>
<td>50 and more</td>
</tr>
</tbody>
</table>

**Data Collection and Analysis**

To identify participants’ level of e-learning readiness an e-Readiness Scale was carried out at the start of the semester. The e-Readiness scale was a 5-point likert scale, including 26 likert scale items and one additional open-ended question. There were five scale factors: individual properties, ICT competencies, access to technology, motivation and attitude, and factors that affect success. Prior to use of this scale it was determined to be reliable and valid through Cronbach’s alpha analysis with a Cronbach $\alpha$ value of .93 (Gülbahar, 2012).

At the end of the school semester an e-Satisfaction Scale was used to identify participants’ satisfaction with e-learning. The e-Satisfaction scale was designed as a 5-point likert scale, including 29 likert scale items and one additional open-ended question. The scale had four factors: delivery and usability, teaching process, instructional content, and interaction and evaluation. The scale was determined to be reliable and valid by means of Cronbach’s alpha analysis with a Cronbach $\alpha$ value of .97 (Gülbahar, 2012).

An e-Learning Styles Scale developed by Gülbahar and Alper (2014) was used to determine study participants’ learning preferences. This instrument was a 5-point likert scale that included 38 likert scale items. The e-Learning Styles Scale had seven factors: independent learning, social learning, audio-visual learning, active learning, verbal learning, logical learning, and intuitive learning. Reliability coefficients for the seven factors of the e-Learning Styles Scale varied with Cronbach $\alpha$ values falling between .72 and .87.

To carry out quantitative data analysis and conduct SEM, the LISREL 8.71 and SPSS 17.0 statistical analysis programs were used.
Results

SEM analysis was employed to determine participants’ learning preferences and readiness prior to online learning in regards to their e-learning satisfaction.

Latent variable learning preferences were composed of seven observed variables: independent learning, social learning, audio-visual learning, active learning, verbal learning, logical learning, and intuitive learning. Latent variable readiness consisted of five observable variables: individual properties, ICT competencies, access to technology, motivation and attitude, and factors that affect success. Latent dependent variable satisfaction was made up of four sub-dimensions: delivery and usability, teaching process, instructional content, and interaction and evaluation. These all made up the dimensions for the e-Satisfaction Scale. The fit indices obtained after primary analysis of the model were $\chi^2 (100, N = 363) = 245.99, p < .000, \text{RMSEA} = .064, \text{S-RMR} = .050, \text{GFI} = .92, \text{AGFI} = .89, \text{CFI} = .97, \text{NNFI} = .96$. The model was determined to be within an acceptable value range. However, to develop the model further, relationships recommended by modification indices generated in the original analysis were introduced and the model subsequently re-tested. Recommendations determined from this analysis were audio-visual and independent, logical-intuitive and social-active. The observed variable individual properties were related not only to the latent variable “readiness”, but also the latent variable of learning preferences. The relationship between these variables was also introduced into the model. Further fit indices were achieved when the model was re-executed: $\chi^2 (95, N = 363) = 178.43, p < .000, \text{RMSEA} = .049, \text{S-RMR} = .045, \text{GFI} = .94, \text{AGFI} = .92, \text{CFI} = .98, \text{NNFI} = .98, \text{IFI} = .98$. The resulting model is provided in Figure 2.

![Figure 2: Results of the proposed research model (standardized coefficients).](image-url)
A comparison of the model’s fit indices generated by LISREL in regards to other indices defined in the literature is provided in Table 2.

### Table 2: Model fit indices for the measurement model (Schermelleh-Engel, Moosbrugger & Müller, 2003)

<table>
<thead>
<tr>
<th>Fit indexes</th>
<th>Perfect fit</th>
<th>Accepted values</th>
<th>Model Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>χ²</td>
<td>χ²/d &lt;3</td>
<td>3&lt; χ²/d &lt;5</td>
<td>1.87</td>
</tr>
<tr>
<td>RMSEA</td>
<td>0&lt;RMSEA&lt;0.05</td>
<td>0.05&lt;RMSEA&lt;0.08</td>
<td>0.049</td>
</tr>
<tr>
<td>S-RMR</td>
<td>0≤S-RMR≤.05</td>
<td>.05≤S-RMR&lt;.1</td>
<td>0.045</td>
</tr>
<tr>
<td>NNFI</td>
<td>0.97≤NNFI≤1</td>
<td>0.95≤NNFI&lt;0.97</td>
<td>0.98</td>
</tr>
<tr>
<td>CFI</td>
<td>0.97≤CFI≤1</td>
<td>0.95≤CFI&lt;0.97</td>
<td>0.98</td>
</tr>
<tr>
<td>GFI</td>
<td>0.90≤GFI≤1</td>
<td>0.85≤GFI&lt;0.90</td>
<td>0.94</td>
</tr>
<tr>
<td>AGFI</td>
<td>0.95≤AGFI≤1</td>
<td>0.90≤AGFI&lt;0.95</td>
<td>0.92</td>
</tr>
<tr>
<td>IFI</td>
<td>0.95≤IFI≤1</td>
<td>0.90≤IFI&lt;0.95</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Through analysis, the researchers determined the fit indices exhibited a very good fit model. The factor load between the independent latent variable of learning preferences and expectations, along with the indicator variables (Lambda x, λ), t values, measurement errors of independent indicator variables (delta, δ) and indicator variable rate of explanation for the latent variable (R²) are provided in Table 3.

### Table 3: λ, δ, t and R² values for the model

<table>
<thead>
<tr>
<th>Independent Latent Variable</th>
<th>Observed Variables</th>
<th>λ</th>
<th>δ (Measurement Error)</th>
<th>t</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Preferences</td>
<td>Active Learning</td>
<td>0.68</td>
<td>0.54</td>
<td>12.99</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>Independent Learning</td>
<td>0.43</td>
<td>0.82</td>
<td>7.51</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>Audio-Visual Learning</td>
<td>0.68</td>
<td>0.53</td>
<td>13.39</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>Logical Learning</td>
<td>0.41</td>
<td>0.83</td>
<td>7.28</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>Intuitive Learning</td>
<td>0.60</td>
<td>0.64</td>
<td>11.35</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td>Social Learning</td>
<td>0.66</td>
<td>0.57</td>
<td>12.51</td>
<td>0.43</td>
</tr>
<tr>
<td></td>
<td>Verbal Learning</td>
<td>0.76</td>
<td>0.42</td>
<td>15.37</td>
<td>0.58</td>
</tr>
<tr>
<td>e-Readiness</td>
<td>Individual Properties</td>
<td>0.60</td>
<td>0.56</td>
<td>11.71</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>ICT Competencies</td>
<td>0.73</td>
<td>0.47</td>
<td>14.81</td>
<td>0.54</td>
</tr>
<tr>
<td></td>
<td>Access to Technology</td>
<td>0.73</td>
<td>0.46</td>
<td>14.65</td>
<td>0.53</td>
</tr>
<tr>
<td></td>
<td>Motivation &amp; Attitude</td>
<td>0.77</td>
<td>0.40</td>
<td>16.11</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>Factors that Affect Success</td>
<td>0.76</td>
<td>0.42</td>
<td>15.53</td>
<td>0.58</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>Delivery &amp; Usability</td>
<td>0.90</td>
<td>0.18</td>
<td>Constant</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>Teaching Process</td>
<td>0.96</td>
<td>0.08</td>
<td>32.38</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td>Instructional Content</td>
<td>0.91</td>
<td>0.18</td>
<td>27.81</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>Interaction &amp; Evaluation</td>
<td>0.92</td>
<td>0.15</td>
<td>29.20</td>
<td>0.85</td>
</tr>
</tbody>
</table>

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The regression equation between latent variables was examined, the correlation coefficient between satisfaction variable and learning preferences was found to be .29 and the relationship was determined as significant ($t = 4.93$). The correlation coefficient between the satisfaction variable and readiness was .18, resulting in a significant relationship ($t = 3.11$). In the generated model, learning preferences and readiness explained for 15% of variable satisfaction. While the rate of explanation does appear to be low, the significance indicates that Hypothesis 1 and Hypothesis 2 were accepted.

$$\text{satisfaction} = 0.29 \times \text{preferences} + 0.18 \times \text{readiness}, \text{ Errorvar.} = 0.85, R^2 = 0.15$$

(0.060) (0.058) (0.079)

4.93 3.11 10.79

The correlation coefficient between the satisfaction variable and explanatory delivery and usability variable was .90 ($p < .05$), indicating a significant and positive relation between satisfaction and delivery and usability. It explained for a percentage of satisfaction at 82%. A significant and positive relationship between teaching process and satisfaction was determined. The correlation coefficient and $t$ value were .96 and 32.38 respectively ($p < .05$), while the variable of teaching process explained for the percentage of satisfaction at 92%.

A significant and positive relationship was determined between the variable of instructional content and satisfaction. The resulting analysis suggested a correlation coefficient of .91 and a $t$ value of 27.81 ($p < .05$), and the variable of “instructional content” explained for satisfaction at 82%.

A significant and positive relationship between “Interaction and Evaluation” and satisfaction was determined. A correlation coefficient of .92 and a $t$ value of 29.20 were observed. The variable of “Interaction and Evaluation” explained satisfaction at 85%. In light of these findings, Hypothesis 3 was also accepted.

**Discussion & Conclusion**

In this study, through a holistic approach, researchers’ examined the effect of learning preferences and readiness on satisfaction of e-learning participants. TA model was established based on the collected data and then tested to insure its validity and reliability.

The e-learning programs included in this study consisted of several participation modalities: note sharing, participants studying through course notes, attendance of synchronous lessons through virtual classrooms, and/or listening to recordings of e-learning course lessons. The value of the course recordings was due to the convenience of use because participants could access course recordings at their convenience. Course materials were recorded and available to attendees at any time in an asynchronous manner. The SEM analysis indicated verbal and audio-visual learning the best predicted participants learning preferences 58% and 47% respectively. This finding was a result of the materials and structure provided through e-learning. Learning preferences are occasionally referred to as learning styles, the current study did not consider preferences as styles, but instead focused on individuals’ general preferences and considered them to be individual differences within the existing environment.

In regards to readiness, “Motivation & Attitude”, was the most important structure prior to e-learning. This finding is understandable because motivation and attitude are consistently the most important variables of the learning process. Hurd (2006) determined motivation as the most important factor of distance education. Other studies revealed motivation had an important effect on student achievement (Song, Singleton, Hill & Koh, 2004; Yukselturk & Bulut, 2007), dropout rates (Lee & Choi, 2011; Park & Choi, 2009), and engagement (Barak, Watted & Haick, 2016; Richardson & Newby, 2006). Findings from this current study concurred with the aforementioned findings regarding motivation in e-learning.
Another important variable revealed “factors that affect success”, resulted from participants’ expectations of technical support and interaction opportunities in e-learning. Gray (2004) observed technical support in e-learning facilitated learning. Wiesenmayer, Kupczynski and Ice (2008), had similar findings that technical support in online learning was an important components of e-learning. Bunn (2004) revealed participants’ perception of being deprived technical support was actually to worse than an actual lack of technical support. It was also determined that interaction opportunities through e-learning had positive effects on perceived learning (Gray & DiLoreto, 2016) and satisfaction (Ilgaz & Gülbaşaran, 2015; Wu, Tennyson & Hsia, 2010).

In this current study it was determined that readiness and learning preferences predicted satisfaction at a rate of 15%. It was observed that “teaching process” most directly predicted satisfaction and did so at the highest rate. The variable of “teaching process” incorporates features that guide students through e-learning; namely, the study guide, syllabus, orientation process, and feedback. In past studies it was suggested that orientation and guidance services for students had an effect on learning and satisfaction (Lee, Srinivasan, Trail, Lewis & Lopez, 2011; Lim, Morris & Kupritz, 2007; Richardson & Swan, 2003).

“Interaction & Evaluation” was another predictive structure. It was observed that providing differing communication tools and evaluation processes in a flexible manner predicted students’ satisfaction. The flexibility of structures within an existing system was crucial for satisfying needs. Flexibility of structures in systems ultimately leads to satisfaction within the systems (Kuo, Walker, Schroder & Belland, 2014; Sun, Tsai, Finger, Chen & Yeh, 2008; Yüksel Türk & Yıldırım, 2008). The effect of two other structures, “Delivery & Usability” and “Instructional Content,” was observed to be rather low. The LMS in this environment or the nature of content presentation had less effect on satisfaction. This can be interpreted as students’ placing importance on being together and/or interacting with an instructor. Results from this study supported the “factors that affect success” structure where students’ satisfaction increased as their expectations from the program were fulfilled.

In this study, e-learning participant satisfaction was considered in respects to learning preferences and readiness. It is crucial that other studies be conducted to better understand further aspects of learner satisfaction that were not determined in this research model. The current study was conducted via a student-oriented approach and consequently the student properties were more prominent. The fact that the research variables considered in this study were not found together within the literature set this research study apart from others.

While some structures in this study can be externally manipulated, other structures cannot be manipulated because they are specific to the participants who were involved. Future instructional designers should address variables that can be altered as a way of ensuring system sustainability. Non-student variables, excluded from this current study such as system, instructor, institutional operation, and external factors, can be utilized in future model type studies. It is also recommended that participants be interviewed regarding which system features they believe lead to satisfaction and then conduct analysis to related to their responses.

References


Factors for Success and Course Completion in Massive Open Online Courses through the Lens of Participant Types

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Abstract
The main purpose of this study is to investigate the factors for success and course completion through the lens of participants in a Massive Open Online Courses (MOOCs) system implemented in Turkey. Thirty-two participants were selected on the basis of purposive sampling among 5000 enrolled users from 10 MOOCs, who were then classified into 3 types – lurking, moderately active, memorably active – based on their participation rate in the course activities. The data were collected via the use of two semi-structured interviews. According to the findings, the factors for success in MOOCs to the participants were divided into three categories: instructor effectiveness, course design, and personal factors. As to the factors for course completion, the categories identified were the instructor, course design, personal factors, technical issues, and affordability/clarity. The findings regarding success and course completion were discussed in detail and recommendations were provided to enhance participation in MOOCs.

Keywords: open and distance education, massive open online courses (MOOCs), success factors, course completion.

Introduction
The integration of new technologies through the use of specific online platforms developed is becoming widespread in education; however, due to the higher costs of developing these e-learning platforms, only a small number of people can access them. In this regard, Massive Open Online Courses (MOOCs) have emerged to address this raising issue by improving accessibility.

MOOCs as a concept was first introduced by George Siemens and Stephen Downes when they opened an online course, “Connectivism and Connected Knowledge”, and, as the courses in MOOCs are open and free of charge, they are unique in the system compared to the other courses (Yuan & Powell, 2013). Specifically, there are two types of MOOCs: Connectivist Massive Open Online Courses (cMOOCs) and Extended Massive Open Online Courses (xMOOCs) (Lin & Zhang, 2014; Liyanagunawardena, Adams, & Williams, 2013; Yuan & Powell, 2013). cMOOCs, are semi-structured online practices where the instructors work as a mentor or model to reinforce the learning of participants. Student-student and student-teacher interaction are important in this process since the participants are the creator of the content (Hollands & Tirthali, 2014; Lin & Zhang, 2014; Liyanagunawardena et al., 2013; Yuan & Powell, 2013). On the other hand, xMOOCs, which is the
type implemented in the research setting of this study, are structured on the basis of online practices where instructors are the subject-matter expert and organize the course content depending on the curriculum. Participants take a passive role and receive the information. An xMOOC consists of formative and summative evaluation and the platforms encourage the interaction between teacher-student, student-student and student-content (Conole, 2013; Hollands & Tirthali, 2014; Lin & Zhang, 2014; Yousef et al., 2014).

Researchers have been investigating the factors affecting learners’ participation to open and distance learning environments for a long time. Several articles reported the high level of drop-out rates and regarded it as a problem in distance education courses (Nistor & Neubauer, 2010; Park & Choi, 2009; Yukselturk & Inan, 2006). Regarding MOOCs, the two points similarly discussed in the literature are course completion and success. The course completion in MOOCs refers to the fulfillment of course activities (Kizilcec, Piech & Schneider, 2013; Morris, Finnegan & Wu, 2005) and is divided into two categories: successful or unsuccessful completion (Morris et al., 2005). Success in MOOCs, on the other hand, refers to the completion of the tasks, scoring satisfactory grade from measurement and evaluation practices and earning a certificate (Breslow et al., 2013). In this aspect, as the number of MOOCs grows and, as a result, the number of users enrolled in the courses has increased as well (DiSalvio, 2012; Onah, Sinclair & Boyatt, 2014), these two phenomena, success and course completion, have become the common concerns of studies focusing on MOOCs. The relevant literature puts that, although many people register for the courses, only about 10% of participants complete the courses (Jordan, 2014; Liyanagunawardena et al., 2013; Rai & Chunrao, 2016). According to a study by Ho et al. (2014), 35% of the users enrolled in the courses did not participate in any activities related to the course; 56% of them engaged in less than half of the course activities, and about 5% of them completed the activities and earned a certificate. In another study, only 7% of the 55,000 users enrolled in the Software Engineering course offered via Coursera by the University of California Berkeley were reported to have completed the course (Yuan & Powell, 2013). These findings suggest that course completion and success rates are very low in MOOCs. Moving on these data, research studies in the literature have distinguished MOOC users in terms of their participation rate in the course activities. According to Hill (2013), there are five types of participants in MOOCs: no-shows, observers, drop-ins, passive participants and active participants. Similarly, de Waard et al. (2011) categorize users as lurking, moderately active, and memorably active participants.

Many post-secondary institutions are now offering MOOCs but these courses tend to have a high percentage of non-completers as well (Ho et al., 2014; Jordan, 2014; Rai & Chunrao, 2016). Although the reasons behind the dropout rates in MOOCs have been discussed in a number of studies (Liyanagunawardena, Parslow, & Williams, 2014; Onah et al., 2014), it is rare to find research studies focusing on the factors for success and course completion in MOOCs, especially from learners’ perspectives. Hence, in addition to the reasons for drop-out, it is also critical to investigate the decisions of learners pursuing distance education. Consequently, the current study will explore success and course completion issues from participants with different characteristics to put a further explanation of the facts behind learners’ success and course completion in MOOCs. Revealing these factors can help prevent existing MOOC structural shortcomings and design high-quality courses that can enhance participation; thus allowing successful and sustainable implementation of MOOCs.

**Purpose of the Study**

This study aims to explore the factors for success and course completion through the lens of different participant types who completed a course and received certificates in an xMOOCs program in Turkey. On this basis, the following research questions guide the study:

1. What are the factors for success in MOOCs through the lens of different participant types?
2. What are the factors for the course completion in MOOCs through the lens of different participant types?

Method

The design of current research was qualitative paradigm based case study design (Stake, 1995; Yıldırım & Şimşek, 2008); particularly, an instrumental case study (Stake, 1995) was used to accomplish in-depth analysis related to the factors affecting participants’ success and course completion.

Research Setting and Participants

This study was conducted in AtademiX, which is one of the first examples of a MOOC in Turkey. The AtademiX initiative, founded by Atatürk University, as an example of the effort to provide an education of high quality in MOOC (Aydemir et al., 2016). AtademiX can be considered as an example of xMOOC in regard to not only using instructional design processes as a base in course design but also including courses with a syllabus and start and end dates. AtademiX accommodates courses appealing to different interest groups and does not require any prerequisites or criteria. Up to now, sixteen courses have been managed in AtademiX from different areas of expertise (AtademiX, 2017; Aydemir et al., 2016).

The participants in this study were selected among 5000 enrolled users from 10 courses in AtademiX. Criterion sampling (Büyüköztürk et al., 2008), one of the purposive sampling methods (Patton, 1997), was utilized to select the participants. While the criteria were to have a certificate from an AtademiX course to investigate the factors affecting the success of participants, the criteria for course completion were to fulfill the requirements of at least one course in AtademiX.

Participants were selected based on the logs of AtademiX. Moreover, every activity attached to the course was considered in the logs such as viewing documents and videos, submitting assignments, attending forums, or taking quizzes and final exams. The number of activities that they completed in a course was counted to categorize the level of involvement. Accordingly, participants were divided into three categories: Lurking, Moderately Active, Memorably Active Participants. The reason why we utilized these categories in the present study is that it is comprehensive enough to define the participant types in the AtademiX context. Besides, some research studies (Bozkurt & Aydin, 2015; Honeychurch et al., 2017; Stephens & Jones, 2014) also adopted these categories in different types of MOOC to describe the participant types. In this direction, while those who were involved in less than 50% of the course activities were considered in the first category, the ones who participated in between 50% and 65% of the course activities were considered in the second category. Similarly, the participants fell into the third category if they were involved in more than 65% of the course activities. In this way, the factors affecting the completion of the courses were examined according to the participant types and suggestions, and guidance would be made accordingly. The characteristics of the participants are provided in Table 1.

<table>
<thead>
<tr>
<th>Type of Participant</th>
<th>Male</th>
<th>Female</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lurking Participants</td>
<td>5</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Moderately Active Participants</td>
<td>6</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Memorably Active Participants</td>
<td>7</td>
<td>8</td>
<td>15</td>
</tr>
</tbody>
</table>
**Data Collection and Instruments**

Two semi-structured interview forms prepared by the researchers were used to collect data. The first one was for successful participants and the second one was for participants who completed the course. In order to ensure validity and reliability, the interview questions were first checked by another doctoral student at the Department of Educational Technology and a language expert and then finalized by four experts. The following are the primary questions asked in the interviews apart from the prompt questions to elaborate on the participants’ views during the interview and demographic questions. The questions indicating with star signs were included in both forms.

- *Have you ever taken a MOOC before and been successful?
- *What was your purpose to attend the AtademiX course?
- *When we reviewed the logs of the AtademiX, we saw that you have completed some/more than half/most of the course activities? What made you complete the course activities?
- What influenced your success in the course?
- *What features would you like to have in a new AtademiX course to be able to complete course activities easier?
- What features would you like to have in a new AtademiX course to be more successful in the course?

To conduct the interviews, the participants were first contacted via email and phone and then an appointment was arranged from them. While 31 participants joined the interviews on the phone, only one participant attended the interview face to face. The participants were called by phone at the time of the appointment. Then, the interview questions were asked and their answers were recorded accordingly. The interviews were conducted in the native language, which is in Turkish, of both researcher and participants.

**Data Analysis**

Maxqda-12 was used to analyze the interview data by using the content analysis procedures (Büyüköztürk et al., 2008; Yıldırım & Şimşek, 2008). According to Büyüköztürk et al. (2008), the content analysis is described as a scientific approach that investigates the truth by classifying the verbal or written materials and converting into the numbers to provide in-depth understanding. In this direction, the recorded interviews were first transcribed verbatim. Then, data reduction and data display phases were implemented. Lastly, conclusion drawing/verification phases were followed to complete the content analysis. Besides, two experts with a decent research background in the field of MOOCs helped to code and develop themes. During the experts’ review, they checked each finding, code, and themes.

**Credibility and Trustworthiness**

In qualitative research, the concepts of credibility, transferability, consistency, and confirmability must be established in order to ensure the validity and reliability of the data (Miles & Huberman, 1994; Patton, 2001). In this study, credibility involved the collection of the data based on voluntary participation, the analyses of data by two experts, giving direct quotes from participants, and providing the inter-rater reliability score. Miles and Huberman’s (1994) formula was used to calculate the inter-rater reliability scores.

\[
\text{Reliability} = \frac{\text{Number of agreements}}{\text{Number of agreements} + \text{Number of disagreements}}
\]
According to the above formula, the scores were found to be 77%, 81%, 75%, 76%, 75%, and 77% which were appropriate in terms of reliability since they were above 70% (Miles & Huberman, 1994). As for the transferability, the reasons why research methods were chosen, the characteristics of the participants and why they were selected as a sample in the study, data collection instruments, and analyses of the data were explained. While interview data was reviewed by experts to ensure the consistency, raw data and codes were kept for confirmability.

Findings

The Factors Affecting Participants' Success in MOOCs

The factors affecting success in MOOCs mainly stemmed from course design, as well as a range of personal factors related to the participant and the style and effectiveness of the course instructor. Of the 32 participants, 27 individuals successfully completed the courses. All the analyses were made in line with the data collected from those 27 individuals. The results of the analysis are presented in Table 2.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Category</th>
<th>n</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Design</td>
<td>Course Planning</td>
<td>12</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Interaction with participants</td>
<td>9</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Accessibility</td>
<td>5</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Flexibility</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Technical factors</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Being free of charge</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Personal</td>
<td>Internal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prior knowledge</td>
<td>14</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Interest</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Desire</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fulfilling course requirements</td>
<td>24</td>
<td>31</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Online course experience</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>University factor</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Certificate</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Instructor</td>
<td>Teaching Style</td>
<td>11</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Professional Knowledge</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

\(f = \text{Code Frequency}, \ n = \text{Number of Participants}, \ % = \text{the percentage of each code against the total number of words in the interview}\)

Course Design. As shown in Table 2, participants said that their success in MOOCs was mostly affected by course planning (course structure, design, syllabus, clarity, etc.). In this regard, participants...
mentioned the clarity of course content, having a comprehensive course syllabus and the amount of interaction with the instructor. One of the participants said that “...a bit of a struggle happened because everything was so clear. The rest was my responsibility, so I fulfilled my responsibility and that brought me success...”. One can see from the above quote that a well-planned course can help participants put in less effort and become successful.

Interaction with participants is the second most commonly indicated factor. Participants stated that interacting with other participants and seeing their posts and comments contributed to their success. Accessibility was another factor after the interaction. In this regard, participants said that keeping the course content on the internet and being able to access them anytime and anywhere helped them succeed in the course. One of the participants said “of course, being able to see the course content online and using it to study for exams helped me succeed.”

Within the scope of the flexibility category, the research participants noted that having courses online made attending courses easier for people who are not able to attend in-class sessions and thus contribute to their success. Regarding technical factors, the participants stated that the absence of technical problems and the provision of instant technical support affected their achievement. Lastly, the least mentioned factor was that the course was free of charge. Since the courses were free of charge, participants did not experience financial limitations.

Personal factors. In addition to the course design, personal factors were also influential on participants’ success. Personal-related factors divided into two categories: internal and external. Among the internal factors, prior knowledge was the most mentioned category. Participants expressed that having prior knowledge regarding the topic affected their success in the course. One of the participants said “So I know a bit of knowledge about the field. I was more prepared because I had prior knowledge. I thought it was because of my previous experience. Because I already have information ...”. Thus, possessing prior knowledge can help facilitate course-related activities and contribute to the success of participants.

The other most mentioned factor in the internal factors was the participant’s interest and willingness to complete the course. Participants stated that interest in the course topic and feeling as a necessity for completing the course affected their success.

When external factors were examined, participants attributed their successes to the fulfillment of the course requirements. According to participants, the factors such as doing assignment/homework, participating in discussions, etc. were the reasons for positive impacts on their success. The external factors that were least discussed as having an impact on participants’ success were prior online course experience, provision of courses by favorite universities, and earning an official document.

Instructor. Instructor-driven factors were expressed to influence participants’ success. It was frequently expressed that instructors’ subject matter knowledge and teaching style affected participants’ achievement. In this regard, participants expressed that teaching course content clearly, giving feedback and having content knowledge are influential on their success. One participant expresses this point as “…I can say that it is very important instructors have a lot of information on the topic and can transfer the information in a good way ... The rest is my responsibility and I fulfilled my responsibilities and was successful." As expressed, participants’ success can be enhanced when instructors have adequate knowledge of their subject and the capability of clearly conveying the knowledge to their students.
The Factors Affecting Online Course Completion with Respect to Participant Type

The results of the analyses culminated with five groups of factors and each factor group were accompanied by several codes. All participants were included in this research question since the successful ones completed the course at the same time.

**Affordability/Clarity.** As indicated in Table 3, lurking (LP), moderately active (AP), and memorably active participants (MAP) stated that affordability, openness to everyone and not having any pre-requisites influenced them to enroll in and subsequently complete the course. In addition, the same three participant types attributed their completion of a MOOC to the usefulness of the platform.

**Technical.** Regarding technical factors, participants mentioned that user-friendliness impacted the likelihood of completing a MOOC. Not having any technical problems and the simplicity of the webpage encouraged participants to complete the course. As indicated in Table 3, LP, AP, and MAP made similar remarks regarding this factor. One of the participants said “…It wasn't difficult. I mean it was easy to use it. That had a positive impact on my completion.”

**Instructor.** Regarding the instructor-related factors, participants especially expressed the importance of instructors' behavior and teaching styles. While APs and MAPs often pointed out the effectiveness of an instructor’s teaching style and attitude, the same factors were less commonly expressed by LPs. The teaching style was the most commonly specified factor by participants. MAPs mentioned the influence of teaching style on course completion more than both LPs and APs.

**Personal.** Personal factors were divided into two groups as indicated in Table 3: internal and external factors. Internal factors that were described by participants to have effects on the course completion were: willingness to learn the course topic, interest in the topic, prior knowledge related to the topic, self-efficacy (finishing the job once started, believing in their abilities), and gaining new information by refreshing prior knowledge. Among the internal factors, the most expressed one was 'prior knowledge', whereas the least mentioned was 'curiosity.' One of the participants said "I took a first-aid seminar for basic life support in the school before which had a huge impact on completing the lesson."

The external factors that had a positive effect on the course completion included having enough time to do the course tasks, not experiencing technical problems, earning a certificate, the prospect of benefiting from the course, and participation of friends in the course. Among these factors, the most mentioned one was ‘time,’ the least refereed was ‘friend.'
### Table 3. The Factors Affecting Course Completion in MOOC According to Participant Type

<table>
<thead>
<tr>
<th>Category</th>
<th>Factors</th>
<th>LP</th>
<th>AP</th>
<th>MAP</th>
<th>f</th>
<th>%</th>
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<td>Affordability/Clarity</td>
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<td>10</td>
<td>12</td>
<td>29</td>
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<td>Usability of MOOC</td>
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<td>3</td>
<td>4</td>
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<td>Instructor</td>
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<td>8</td>
<td>7</td>
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<td>2</td>
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<td>5</td>
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<td>2</td>
<td>8</td>
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<td>Learning</td>
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<td>8</td>
<td>8</td>
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<tr>
<td></td>
<td>Refresh Prior Knowledge</td>
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<td>1</td>
<td>1</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Curiosity</td>
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<td>0</td>
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<td>1</td>
<td>6</td>
</tr>
<tr>
<td>External</td>
<td>Having Time</td>
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<td>10</td>
<td>10</td>
<td>36</td>
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<td>4</td>
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<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Enjoyment -Expectation</td>
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<td>8</td>
<td>25</td>
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<td>Difficulty Level</td>
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<td>3</td>
<td>1</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Structure</td>
<td>Course Length</td>
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<td>7</td>
<td>5</td>
<td>15</td>
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<td></td>
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<td>1</td>
<td>5</td>
<td>8</td>
<td>2</td>
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<td>0</td>
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<tr>
<td></td>
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<td>0</td>
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<td>7</td>
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<td></td>
<td>Voluntary Participation in</td>
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<td>3</td>
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</tr>
<tr>
<td></td>
<td>the Course</td>
<td></td>
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</tbody>
</table>

*Lurking Participant = LP, Moderately Active Participant = AP, Memorably Active Participants = MAP, f = Code Frequency, N = Number of Participants, % = the percentage of each code against the total number of words in the interview*
Course Design. Course design-related factors were divided into ‘Flexibility,’ ‘Content’ and ‘Structure.’ Regarding flexibility, it was stated that the provision of access to the courses over the internet without constraints of time drove participants to complete the course. While many participants expressed having ‘unlimited time,’ a few participants mentioned about ‘being distance’ as a factor influencing their course completion. One of the participants said “I see the benefit of being accessible from anywhere on the Internet. Because one day I had forgotten my lesson and I was outside. I could go straight to a café. That also gave me great pleasure ...”

When the factors derived from the course content were examined, it can be seen that the enjoyment of the courses, meeting participants’ expectations, up-to-date course content, and difficulty level of the course affected course completion in MOOCs. Additionally, the planning and length of the course, participants’ age levels, provision of immediate feedback and giving of the course voluntarily were the course structure-related factors. Compared to the length of a course, less number of participants noted age level, feedback, and giving of the course voluntarily as factors. In summary, the factors affecting course completion were compared in terms of participant types in Table 4.

Table 4. Comparison of Factors Affecting Course Completion in MOOCs with Respect to Participant Types

<table>
<thead>
<tr>
<th></th>
<th>LP</th>
<th>AP</th>
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<td>Clarity</td>
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<td>Learning</td>
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<tr>
<td>Prior Knowledge</td>
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<tr>
<td>Interest</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
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<td>Being distant</td>
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<td>Unlimited time</td>
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<tr>
<td>Enjoyment -Expectation</td>
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<td>Course length</td>
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<td>Feedback</td>
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</tr>
<tr>
<td>Difficulty level</td>
<td>√</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Lurking Participant = LP, Moderately Active Participant = AP, Memorably Active Participants = MAP, N = Number of Participants, MSF = Most Stated Factor

As can be seen in Table 4, the most expressed factors that affected course completion for MAPs were clarity, instructors’ teaching style, and adequate time to do course tasks. Similarly, enjoyment-expectation, instructors’ teaching style, and clarity were the most mentioned factors referred to by APs to affect the completion of an online course. LPs did not mention learning, unlimited time, the distance of the course, and feedback. As a result, while the MAPs dealt with the factors related to
the essence of learning, LPs generally considered external factors. This could be considered as an important finding of the study because it provides critical information to enhance the participation in MOOCs by revealing the factors in regard to the considerations of participants.

Discussion of Findings
The Factors Affecting Participants' Success in the MOOC

This study culminated with the identification of three main factors affecting participants’ success in MOOCs. These three factors are related to course design, personal, and instructor.

Course design seems to be the most important factor affecting success in MOOCs. The findings of the study indicate that participants’ success is enhanced when the course level suits the participant level, the course materials are clear and understandable, the course can be accessed anywhere and anytime, student-instructor interaction is established, and the infrastructure is well structured. It could be stated that since many participants are familiar with conventional education, they might prefer to see these factors in online education as well. In this direction, Loizzo and Ertmer (2015) stated that course design affects achievement. They pointed out that clarity of the course materials and being able to access them via different mediums affects achievement in MOOCs. Similarly, Wright (2003) expressed that quick access to course materials, appropriateness of course content with the target group level, and presentation of the course contents according to participant goals and in a logical sequence should be done for the course design in MOOCs.

Student-student interaction is another course design factor found to have an impact on achievement. Participants stated that receiving help from their peers and exchanging their ideas affected their achievement. AtademiX courses were designed as an interaction-based to facilitate student-student interaction (AtademiX, 2017). Therefore, the emergence of this factor might stem from the features of course design. A number of studies have also underlined the importance of interaction among students as an ingredient for success in the MOOC (Brooker et al., 2018; İbicioğlu & Antalyalı, 2005; Koutropoulos & Hogue, 2012; Loizzo & Ertmer, 2015; Soong et al., 2001). Consequently, designing online courses which can enhance interaction among participants and offer collaborative activities can promote participants’ achievement in the MOOC.

In addition to the factors derived from course design, personal factors also affected the success of participants. Personal factors can be categorized as internal and external factors. Of personal factors, the most crucial one is having prior knowledge. Previous studies indicated that having prior knowledge facilitated participants’ learning (Bosker, 1999; Kiamanesh, 2004; Senemoğlu, 2005; Papanastasiou, 2000; Zhou, 2017). According to Gagne’s teaching model, meaningful learning occurs when new information is built upon previously learned information (Smith & Ragan, 2000). In this respect, having prior knowledge can affect the success of participants. In previous studies, prior knowledge was also found to be one of the factors affecting success in the MOOC (Belanger & Thornton, 2013; Demirci, 2014). Therefore, having prior knowledge of the subject matter can be considered as an important factor in participants’ success in the MOOC.

In this study, interest was found to be another factor affecting success. Participants said that the trending topics and the content related to their fields triggered their interests towards the course and hence influenced their success. It was stated in previous studies that students’ interests and needs must be met for effective learning to take place (Seven & Engin, 2008). Therefore, preparing the trending topics that are relevant to the participants’ fields might be an important drive for success in the MOOC.
Regarding the external factors, it was revealed that the fulfillment of course requirements and active participation in the tasks had a great influence on participants’ success. Hence, motivating participants to fulfill the course requirements and supporting them in this process can help them successfully complete the course (Deshpande & Chukhlomin, 2017; Lee & Choi, 2011).

Lastly, the findings indicated that the instructor can play a considerable role in participant success. The instructor’s teaching style and knowledge of the content can affect the participants’ success. This finding is also corroborated by another study (Kassabian, 2014). Accordingly, the provision of the online courses by instructors who are well-known and experts in their fields can attract participants’ attention and then contribute their success in the MOOC.

The Factors Affecting Online Course Completion with Respect to Participant Type

In the present study, the factors affecting course completion were explored and found that there were five categories: affordability/clarity, technical, instructor, personal and course.

In this study, it could be said that the course being online is one of the most important factors in affecting course completion because there is no cost and it is accessible to everyone. Since the free online courses foster participation (Hew & Cheung, 2014) and tuition fees are the main reason why distance education students drop out the school (Esgice, 2015), it could be said that this is an important factor affecting course completion in the MOOC.

Related to the technical factors, participants attributed the completion of online courses to easy use of website and lack of technical problems. According to Norman’s gulf of evaluation (Norman, 1988), the distance between the expectations of users and the representations of the system should be small so that users can do what they intend to do. Hence, providing platforms that match the way users think can increase the completion rate. Similarly, Morrison (2014) concluded that one of the three factors that negatively affected the course completion rate in the MOOC was the technical factor. Since the technical problems can decrease the motivation of participants (Hew & Cheung, 2014), providing robust technical infrastructure and easy-to-use platforms can contribute to the course completion rate in the MOOC.

Regarding instructor-related factors, participants attributed course completion to not only instructors’ attitudes, content knowledge, and teaching style but also their acquaintance with instructors. Previous studies indicated that instructor performance affects the motivation and academic success of the learner (Göçer & Deryakulu, 2004; Tatar, 2005) and learners tend to take a course from well-known and expert instructors (Kassabian, 2014). Therefore, it can be concluded that having decent content knowledge in their field, demonstrating a positive attitude toward participants and teaching styles of instructors are important factors which can help participants complete online courses.

In the present study, personal factors were found to be another important element affecting course completion in the MOOC. Personal factors are divided into internal and external factors. Regarding the internal factors, it was found that participants completed the course to learn something. The findings indicated that this factor was most often mentioned by APs and MAPs. Since APs and MAPs are more motivated to learn and thus more involved in course activities, they might have mentioned these factors more than LPs. In this direction, Hew and Cheung (2014) stated that learning is one of the reasons for individuals to participate in MOOCs. Similarly, Vázquez, Ramirez-Montoya, and Gónzalez (2018) expressed that completers in MOOCs have more motivation at the beginning of the course. Therefore, determining the initial motivations of participants can help to prepare remedial interventions.

The other internal factor influencing course completion was found to be willingness. Participants stated that interest in subject matter and willingness to take the course encourage them to complete
the course. This factor can be related to learning motivation. In this respect, it can be said that the high motivation of MAPs can lead them to emphasize more about the effect of the willingness-interest factor on their course completion. Wang and Baker (2015) expressed that the tendency to complete the course is related to the interesting course content. Similarly, self-efficacy has been identified as another factor affecting course completion. This factor is expressed more by APs and MAPs. It can be noted that the high levels of self-efficacy might stem from the high motivation to learn and interest levels of APs and MAPs.

Regarding external factors, time is the most important factor affecting course completion. Participants stated that having sufficient time encouraged them to complete the course. According to the findings, this factor has been found to affect all participant types similarly. In this direction, Jordan (2014) pointed out that participants’ course completion rates were positively related to time. Loizzo and Ertmer (2015) found that it was one of the factors preventing participants from completing the course. Lukes (2012) expressed that people drop out the course because of time constraints. On the other hand, the participants also said that time constraints are influential on the course completion but not success. This might stem from the participants who take only course completion exams and earn a certificate. Since they do not engage with all of the course activities, time may not be an issue for them.

Another factor influencing course completion was the course design. The factors derived from course design are divided into flexibility, content, and structure. Regarding flexibility, it was determined that being online and not having specific times to attend the courses are important factors for MAPs because they might ask to learn anytime and anywhere depending on their needs.

Regarding content-related factors; it was seen that the most important factor influencing the participants’ course completion was the enjoyment of the course activities and meeting participant expectations. All three types of participants mentioned this factor in a similar way. In this direction, Hew and Cheung (2014) said that the participants’ motivation to attend the MOOC is reduced when the expectations of individuals are not met. Alraimi, Zo, and Ciganek (2015) stated that enjoying the course encourages participants to complete the course. Similarly, Loizzo and Ertmer (2015) noted that course enjoyment and meeting the expectations of participants influenced course completion. In this study, it can be said that the emergence of participants’ reference to this factor might be due to the well-structured AtademiX courses. Therefore, implementing instructional design principles when planning the courses can help participants enjoy and complete the courses.

When the course-related factors are examined, participants mostly emphasized the length of the course and said that the long length of the course negatively affects course completion. APs commonly mentioned this factor. In this direction, Goldberg et al. (2015) reported that low completion rates were associated with a long course duration ranging from 5 to 25 weeks. Jordan (2014) stated that the course completion rate is negatively correlated with the duration of the course. Therefore, it can be concluded that it is important to determine the optimal length of the courses so as not to adversely affect the participants.

Lastly, regarding the importance of feedback on learning (Hattie & Timperley, 2007) which is also another factor derived from course structure in this study, it was found that providing immediate feedback to participants’ assignments and questions influenced course completion. This factor has been underlined only by MAPs. This might stem from the learning motivations of MAPs since the inclusion of more of the learning activity may have created a need for feedback. As these participants seek higher quality learning experiences, they are more likely to be affected than other participants. Therefore, immediate and comprehensive feedback on the courses can positively affect participation.
Conclusion and Implications

The present study has merit for a better understanding of the factors affecting MOOC participants. Although there are research studies in the literature that explored some of the factors affecting participants in distance education environments, this study investigated all possible factors through the lens of participant types in a MOOC context. Therefore, the present study provided evidence from participants’ perspectives to further elaborate on the factors affecting their success and course completion. In this direction, the present study has many conclusions and implications which can guide the institutions and educators who perform MOOC applications. First, the present study categorized the participants based on their involvement in course activities to further identify the success and course completion factors in a MOOC context. Hence, administering diagnostic surveys at the beginning of the course can help identify participant types and accordingly precautions can be taken to increase the success in MOOC. For example; in order to motivate LPs, a clearly defined syllabus can be provided, the difficulty level can be stated and guidance can be done to inform them how to study during the course. Statements about the learning process can also be made to motivate participants in the process as well. In addition, a certificate of participation helps individuals to stay motivated and attend the course activities. A certificate, hence, must be given to participants in order to ensure their continuous participation. Therefore, it is important to consider these factors to promote the motivation of the participants in the MOOC.

Second, the present study revealed that the interaction is one of the crucial elements in the MOOC. Although the research studies in the literature also state the importance of interaction in distance education and blended learning environments (Kayaduman, 2020; Mason, Shuman & Cook, 2013; Zainuddin & Attaran, 2015), this study expands this pool of knowledge for MOOC context. Furthermore, considering the participants who can learn from their peers and instructors, it is important to develop interaction-driven MOOC to facilitate student-student and student-instructor interaction. Besides, the instructors should also design course activities to encourage interaction between student-student and student-instructor so that they can learn from each other and their instructors. Thus, it is critical that MOOC has the necessary features that can promote the interaction and instructors should design their lesson activities to encourage interaction between student-student and student-instructor.

Lastly, the present study further identified that instructor is one of the critical factors have an impact on both course completion and success in the MOOC context. Therefore, instructors should have fluent teaching and positive attitudes since the participants are heavily influenced by the instructor’s professional knowledge and teaching style. Accordingly, the instructors should take continuous training not only about their major field to update their knowledge but also online teaching pedagogies to support learning in MOOCs.

As a consequence, informing educational planners, organizations, policymakers, faculty members about these factors can help design high-quality courses that can enhance participation; thus allowing successful and sustainable implementation of MOOCs.

Further Research

Despite the findings of the study, further researches are needed to acquire deeper understandings about the factors affecting success and course completion in MOOC. Firstly, survey research can be done based on the emerging factors in the present study. Secondly, further studies can explore the factors that may arise from cultural differences, global and local participants in terms of success and completion in the MOOC. Lastly, further studies can also examine the factors that affect success and completion from different stakeholders’ (MOOC administrators, instructors) point of view.
Limitations

Although the current study provided useful findings related to the factors that affect success and completion in MOOC, it has limitations. Firstly, the current study is limited by the participants of the AtademiX platform which is one of Turkey’s first MOOC initiatives. Secondly, only qualitative data were collected in the scope of the study to answer the research questions; hence, quantitative data can also help extend the findings. Thirdly, this study only focused on the participants’ point of view, it is also important to take the course instructors' thoughts to gain deeper understandings about the factors. Lastly, the present study only explored the success and completion factors for those who obtained a certificate or completed course activities. Hence, the success and completion factors for participants falling outside of this scope should also be investigated to provide a better understanding of the success and course completion factors in MOOC.

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**Abstract**

This paper reports on the first stage of an international comparative study for the project “*Digital educational architectures: Open learning resources in distributed learning infrastructures–EduArc*”, funded by the German Federal Ministry of Education and Research. This study reviews the situation of digital educational resources (or (O)ER) framed within the digital transformation of ten different Higher Education (HE) systems (Australia, Canada, China, Germany, Japan, South Africa, South Korea, Spain, Turkey and the United States). Following a comparative case study approach, we investigated issues related to the existence of policies, quality assurance mechanisms and measures for the promotion of change in supporting infrastructure development for (O)ER at the national level in HE in the different countries. The results of this mainly documentary research highlight differences and similarities, which are largely due to variations in these countries’ political structure organisation. The discussion and conclusion point at the importance of understanding each country’s context and culture, in order to understand the differences between them, as well as the challenges they face.

**Keywords:** digital educational resources, comparative case study, digital infrastructures, digitalisation policies, digital transformation, open educational resources (OER)

**Introduction**

Digital transformation is broadly defined as “a cultural, technological, and workforce shift” (EDUCAUSE, 2018, p. 6). Whilst such transformation is undoubtedly driven by technological developments, it also encompasses a variety of transformation including pedagogical, instructional, and learning changes. A specific area of practice and research that has emerged over recent years is the concept of *open* (Weller, 2014), in the context of which, massive open online courses (MOOCs) and the creation, distribution and use of open educational resources (OER) occur, intended to open up education to new audiences and enable access to study (Orr, Rimini & van Damme, 2015). However, with research
focusing on the pedagogical merits and challenges of OER, the technical side of their distribution and storage has not yet been thoroughly analysed, let alone the establishment of standardised practice in higher education (HE). At first glance, it can be stated that OER are being produced somewhere, sometime, by someone. However, accessing them easily, beyond institutional IT systems—and subsequently leading to potentially higher use and acceptance amongst students and staff—is still an idea, rather than established practice. Despite an increasing number of initiatives in HE to establish OER repositories, such as open, institution-specific and state-wide initiatives, individualistic solutions are being sought. These individualistic initiatives can prohibit potential users and contributors being able to identify them (Atenas, Havemann & Priego, 2014), which arguably works against the very idea of open. Considering that educational materials within some repositories may not be open, we will hereafter use (O)ER to refer to both open and non-open educational resources.

The project EduArc (https://uol.de/coer/research-projects/projects/eduarcc) approaches this topic by seeking to model possible solutions to conceptualisations of either centralised repositories or hubs, enabling users and contributors’ greater access to (O)ER. In order to have the broader perspective in mind while developing such distributed technological solutions, an international comparative study across different levels (macro, meso and micro level, see Zawacki-Richter, 2009) is being conducted by the Center for Open Education Research – COER (http://www.uol.de/coer). Therefore, the present article is an exploration of preliminary project findings, focusing on the status and issues of international (O)ER infrastructure, quality, policy and change at the macro level (national and province/state). The framing of the study explores digital transformation in HE within the countries under investigation, which are COER members’ countries of origin (Australia, Canada, China, Germany, Japan, South Africa, South Korea, Spain, Turkey and the United States), from a comparative view, mainly based on documentary research.

**Theoretical and conceptual framework**

The most relevant concepts within the framework of this study are digital educational materials ((O)ER), OER and educational repositories, as components of digital transformation in HE (Rodés-Paragarino, Gewerc-Barujel & Llamas-Nistal, 2016), which are represented in Figure 1 and described and contextualised as follows:

![Figure 1: Conceptual framework of the study.](https://uol.de/coer/research-projects/projects/eduarcc)
According to Fernández-Pampillón (2014, p. 155), digital educational materials are “any digital entity that may be used for learning, teaching and training”. This understanding would also apply to our study, with the consideration that research outputs (articles, books, conference proceedings, master and doctoral thesis, etc.) were not included as digital educational materials.

When (O)ER are licensed with an open licence, they can be considered OER. Whilst it is recognised that a new OER definition was recently published by UNESCO (2019), the previous UNESCO definition of OER had received broad agreement across the countries under investigation, which was the available definition at the time of this study:

Open Education Resources (OER) are teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no limited restrictions (UNESCO, 2012, p. 1)

The main value of OER and their repositories is to achieve education for all, enabling universal education (Caswell, Henson, Jensen & Wiley, 2008) and, therefore, countries are encouraged to foster awareness and support capacity building for creating, using and sharing OER, along with understanding and using open licensing of digital educational materials (Marcus-Quinn & Diggins, 2013). However, as conceptions of (O)ER differ, OER may look rather different too, depending on whether education is regarded as a public or private good in each country. For instance, in the U.S., education is considered a private good where students bear most of the costs of HE (Saunders, 2010), and therefore, (O)ER are usually not (completely) free; whereas in Germany, education is a fundamental value and considered a public good (Kehm, 2017), and (O)ER are usually free. On another level, (O)ER can be considered as part of an educational system’s ideology, as noted in South Africa (Apple, 2010; Arinto, Hodgkinson-Williams, King, Cartmill & Willmers, 2017; Bernstein, 2015). The recently published recommendation on OER by UNESCO (2019) may offer new momentum at the international level in supporting strategic cooperation between Member States in OER development and sharing.

On the other hand, one of the polemic issues around (O)ER discussed in the literature concerns the difficulty to find them (Atenas et al., 2014). Repositories of (O)ER are “digital databases that house learning content, applications and tools such as texts, papers, videos, audio recordings, multimedia applications and social networking tools” (McGreal, 2011, as cited in Atenas & Havemann, 2014, p. 3). Therefore, these repositories aim at collecting (O)ER and their metadata to ease their search and make them visible, but they also present other challenges, for instance, the lack of use of educational standardised metadata. As Koutsomitropoulus, Alexopoulus, Solomou and Papatheodorou (2010) note, (O)ER require a more specialised treatment and characterisation than other kinds of digital objects; thus, the importance of using learning object metadata standards. However, studies on the evaluation of OER repositories show that few of them include the use of educational standardised metadata recommended for transferring information across repositories (Atenas & Havemann, 2013; Santos-Hermosa, Ferran-Ferrer & Abadal, 2017). On the other hand, as noted by Rodés-Paragarino et al. (2016), learning about the dimensions of the adoption of (O)ER by teachers is especially relevant to improve the usability of educational repositories. The main findings of the systematic literature review presented by Rodés-Paragarino et al. (2016) include: a shortage of teachers’ use and reuse of patterns of educational repositories, the lack of presence of studies that explore the reality of the potential of the use of (O)ER in HE, and the importance of cultural and institutional factors, as well as individual characteristics and professional experiences in the way teachers use educational repositories.
Although there are some studies that evaluate the repositories of (O)ER (e.g. Atenas & Havemann, 2013; Santos-Hermosa et al., 2017), there is a paucity of research related to the macro level factors that influence the development of (O)ER infrastructures in HE from an international comparative perspective, i.e. making a comparison of the state of digital transformation around the world, which is the focus of this study.

**Research methods**

The study followed a comparative case study approach, with a focus on examining the research questions in different cases (the countries) to better understand a particular topic ((O)ER national infrastructures), as well as the differences and similarities between the cases, without the intention of drawing statistically generalisable conclusions (Yin, 2009). Fourteen international experts from the COER were commissioned to prepare reports for 10 countries. For this first stage, the experts primarily undertook desk research of government/organisation websites and available literature. Where information was difficult to obtain, some used informal interviews and questionnaires to source relevant information. The final 10 reports were then used as data for this study. These reports were analysed through the comparison of additional data in form of descriptive statistics for the description of the countries’ specific contexts and through thematic analysis according to the four elements that are within the focus of the research questions (infrastructure, quality, policy and change).

The first part of the comparative case study reports on the comparison of the status of digital transformation of the countries. The second part reports on the contextual descriptions in terms of HE systems. Both are useful in order to understand the similarities and differences in terms of infrastructure, quality, policy and change.

Once a draft of this report was generated, it was shared with the experts originally involved in analysing their own country’s context. The results of the comparative work were discussed, and experts were invited to examine the report and offer suggestions. Once experts and the team of researchers agreed on the content of the report, the researchers finalised the study for submission to this journal.

The research questions of the study focused on the above-mentioned four elements, as follows:

- What is the influence of country-specific contexts on the development of national / state-wide infrastructure for the dissemination of (O)ER in HE?
- What is the influence of country-specific contexts on the development of national standards for the creation, dissemination and quality assurance of (O)ER in HE?
- What is the influence of country-specific contexts on the development of national / state-wide policies for (O)ER digital infrastructures and their implementation in HE?
- What is the influence of country-specific contexts on the promotion of change at the national level in terms of funding, managing and promoting (O)ER digital infrastructures in HE?

**Results**

**Contexts**

While ICT indexes can inform us about the general status of digital transformation of countries, as we will introduce later in this section, we need to put this status in the background to look at HE, which is the context of our study. Therefore, a description of the HE context for each of the countries...
involved in the study follows. Within the countries under investigation in this project, China has both the largest population and the largest number of university students (see Table 1), but it is the United States that has the largest number of higher education institutions (HEIs). Countries such as Japan and South Korea are experiencing a decrease in the number of HE students due to their ageing populations, whereas in Turkey a demand for HE is growing, given that a large majority of the population are young citizens.

Table 1. Summary of HE systems and population data, ranked on number of students

<table>
<thead>
<tr>
<th>Country</th>
<th>Population (Millions)</th>
<th>Number of HE students (Millions)</th>
<th>Number of HEIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1,404</td>
<td>37.8</td>
<td>2,914 (2,631 universities and colleges)</td>
</tr>
<tr>
<td>United States</td>
<td>327</td>
<td>20.2</td>
<td>4,298 (2,818 universities)</td>
</tr>
<tr>
<td>Turkey</td>
<td>83</td>
<td>7.5</td>
<td>205 (200 universities)</td>
</tr>
<tr>
<td>Germany</td>
<td>83</td>
<td>2.8</td>
<td>396 (121 universities &amp; 218 universities of applied sciences)</td>
</tr>
<tr>
<td>Spain</td>
<td>47</td>
<td>2.2</td>
<td>3,375 (84 universities)</td>
</tr>
<tr>
<td>Australia</td>
<td>25</td>
<td>1.5</td>
<td>176 (40 universities)</td>
</tr>
<tr>
<td>Canada</td>
<td>38</td>
<td>1.4</td>
<td>234 (72 universities)</td>
</tr>
<tr>
<td>South Africa</td>
<td>58</td>
<td>1.0*</td>
<td>143 (43 universities)</td>
</tr>
<tr>
<td>South Korea</td>
<td>52</td>
<td>0.7</td>
<td>359 (191 universities)</td>
</tr>
<tr>
<td>Japan</td>
<td>127</td>
<td>0.7</td>
<td>1,200 (778 universities)</td>
</tr>
</tbody>
</table>

*p=public sector

The differentiation between private and public HE systems is also relevant in understanding the differences between these countries (see Figure 2). On the extreme left of the spectrum, approximately 80% of HEIs in South Korea and Japan are private, and so too are around 62% of HEIs in the U.S., both non-profit and for profit. In South Africa, only 23 out of 143 HEIs are state-funded and the rest are private (84%). On the other extreme of the spectrum, the majority of German and 75% of the Chinese HEIs are state-funded, with HEIs in China affiliated with the Chinese Ministry of Education, with other ministries or with provincial governments. Turkey and Spain have a higher number of public HEIs than private ones: Turkey has 129 public universities, 71 non-profit foundation universities and 5 foundation vocational schools, whereas Spain has 2,230 public HEIs, 50 of which are universities¹, and 34% of the HEIs are private (n = 1,145, 34 universities).

Figure 2: Spectrum Private HE system - Public HE system.

¹In Spain, HE includes university education, advanced vocational training and specialised education (artistic education, professional Plastic Arts and Design studies, and advanced Sports education).

As a macro factor connected to the development of (O)ER infrastructures, gaining an understanding of how the countries vary in terms of digital transformation provides some insights into the current situation. One of the most recent indexes that could be considered for this purpose is the *ICT Development Index* (see Table 2). This Index looks at indicators connected to ICT infrastructure and access (ICT readiness: availability of technology, such as telephone, mobile-cellular telephone, computer, and Internet access in households), ICT intensity (ICT use of Internet) and ICT skills (ICT capability: schooling) (ITU, 2017a). Looking at the countries of this study, we find within the 10 first positions South Korea (2<sup>nd</sup>) and Japan (10<sup>th</sup>), which stand out as the two most developed countries included in our study in terms of ICT, being closely followed within the 10 next positions by Germany (12<sup>th</sup>), Australia (14<sup>th</sup>) and the United States (16<sup>th</sup>). Spain and Canada come next (27<sup>th</sup> and 29<sup>th</sup>, respectively), and Turkey (67<sup>th</sup>), China (80<sup>th</sup>) and South Africa (92<sup>th</sup>) are in last positions of the Index.

### Table 2. IDI 2017 Rank of the countries of this international comparison (out of 176 countries)

<table>
<thead>
<tr>
<th>IDI 2017 Rank</th>
<th>Country</th>
<th>IDI 2017 Value</th>
<th>IDI 2016 Rank</th>
<th>IDI 2016 Value</th>
<th>Rank Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>South Korea</td>
<td>8.85</td>
<td>1</td>
<td>8.80</td>
<td>&lt;</td>
</tr>
<tr>
<td>10</td>
<td>Japan</td>
<td>8.43</td>
<td>11</td>
<td>8.32</td>
<td>&gt;</td>
</tr>
<tr>
<td>12</td>
<td>Germany</td>
<td>8.39</td>
<td>13</td>
<td>8.20</td>
<td>&gt;</td>
</tr>
<tr>
<td>14</td>
<td>Australia</td>
<td>8.24</td>
<td>16</td>
<td>8.08</td>
<td>&gt;</td>
</tr>
<tr>
<td>16</td>
<td>United States</td>
<td>8.18</td>
<td>15</td>
<td>8.13</td>
<td>&lt;</td>
</tr>
<tr>
<td>27</td>
<td>Spain</td>
<td>7.79</td>
<td>27</td>
<td>7.61</td>
<td>-</td>
</tr>
<tr>
<td>29</td>
<td>Canada</td>
<td>7.77</td>
<td>26</td>
<td>7.64</td>
<td>&lt;</td>
</tr>
<tr>
<td>67</td>
<td>Turkey</td>
<td>6.08</td>
<td>72</td>
<td>5.66</td>
<td>&gt;</td>
</tr>
<tr>
<td>80</td>
<td>China</td>
<td>5.60</td>
<td>83</td>
<td>5.17</td>
<td>&gt;</td>
</tr>
<tr>
<td>92</td>
<td>South Africa</td>
<td>4.96</td>
<td>88</td>
<td>4.91</td>
<td>&lt;</td>
</tr>
</tbody>
</table>

Source: own presentation based on data of the ICT Development Index 2017 (ITU, 2017b)

The *Index of Readiness for Digital Lifelong Learning (IRDLL)* (Beblavy, Baiocco, Kilhoffer, Akgüç & Jacquot, 2019) gives a supplementary perspective to the *ICT Development Index*, and provides another approach to digital transformation, more connected to learning, although only focused on European countries. This Index includes items related to learning participation and outcomes, institutions and policies for digital learning, availability and use of digital learning. Of the two EU countries in this present study, Spain is ranked 8<sup>th</sup> and Germany 27<sup>th</sup>, essentially having flipped their positions from the *ICT Development Index*. The report highlights for Germany that, “while Germany has a strong economy and fairly good education system, investment in digital infrastructure and programs is sorely lacking,” and “German policymakers are aware of the importance of digitalisation, but efforts to date lack ambition” (Beblavy et al., 2019, p. 53). On the other hand, the report states for Spain that “in higher education, blended learning and virtual campuses are more and more widespread” but “the autonomy of universities prevents the development of a comprehensive national digitalisation strategy in higher education” (Beblavy et al., 2019, p. 68).

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Infrastructure

Our first research question focused on the influence of country-specific contexts on the development of national / state-wide infrastructures for the dissemination of (O)ER in HE. The comparison of the different situations in the countries shows that, in order to understand HEI (O)ER infrastructure (or the lack thereof), the level of political structure centralisation should be examined as a cornerstone element of the cultural context, as this also influences the structure of the HEIs (see Figure 3).

![Figure 3: Spectrum Centralised HE system-Decentralised HE system.](image)

At the national or state level, countries in this study with a highly decentralised HE system do not have (O)ER infrastructures or have underdeveloped infrastructures at the macro level, as is the case in Germany and Canada, where education is a mandate of the provinces or states and not of the national government. In the case of the U.S., initiatives are also highly decentralised and collaboration between states about infrastructure happens, but without national coordination. Examples include Utah Open Courseware (OCW), Galileo Open Learning Materials, the North Carolina Open Learning Object Repository or Open Syllabus. Platforms arising from individual or company initiatives are used nation-wide (and worldwide). This strategy allows copyright for hosted (O)ER to be maintained as a private good in the U.S. Examples are iTunes U, Coursera and edX for MOOCs.

In Germany, where many provinces have developed or are developing their own repositories, the creation of parallel structures and the potential lack of interoperability have become evident. A possible solution is to create a central hub for all of them (Kerres, Hölterhof, Scharnberg & Schröder, 2019). Other countries, such as South Africa, state that there is no plan for such national infrastructure, even though they manifest interest for it due to its potential value to raise the profile of OER across institutions and general public. This potential value of OER, but at the same time lack of awareness, also is highlighted in Turkey (Kursun, 2011).

Many countries with a rather centralised HE system have national infrastructures, but most of them are not specifically targeted at HE or (O)ER, with some exceptions. For instance, in Spain, the public agency Foundation for Science and Technology (FECYT) has developed a national infrastructure to harvest institutional repositories, thematic repositories, journal portals and open access journals (RECOLECTA).

In terms of (O)ER production at the national level (see Figure 4), which involves (O)ER initiatives and repositories available, most countries have embraced OCW and MOOCs, which are considered

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2 An important exception to this is the Creative Commons (CC) licensing. It was created in the U.S. to meet the requirements of the national legal copyright system. CC continues to be a foundational element of many OER initiatives, as the “open” in open education is often about open licensing.

3 In interview with a number of key researchers, scholars, practitioners and national departments in the South African context.
two of the most popular OER initiatives in HE. The U.S., South Korea and China are high producers of (O)ER, whereas countries such as Japan and Germany are producing less OER at the national level, despite their position in the IDI 2017 rank. Furthermore, Canada and the U.S. are considered the OER pioneers, and many of their initiatives have been popularised and replicated in other countries. Examples are the Canadian Connectivism and Connective Knowledge MOOC (2008) and the popular U.S. MIT Open Courseware (2001).

In South Korea and Japan, MOOCs and OCW have been/are being developed; however, (O)ER production in South Korea is much higher than in Japan. Japan’s OCW and JMOOC are two membership-based consortia without governmental support. This could explain the differences in OER development and sharing compared to South Korea, where the main actors in OER infrastructure are two organisations funded by the Ministry of Education - the Korea Education and Research Information Service (KERIS), which is in charge of developing, managing and evaluating OER for HEI, including KOCW and videos; and the National Institute for Lifelong Education (NILE), which is hosting and developing K-MOOCs.

China is very much focused on the development of MOOCs (often called “top or high quality open courses” or “State-benchmarking Open Courses”) through its own national repository and other centralised platforms, for example, iCourse or the Chinese University MOOC (CUM). All of the repositories are operated (to a lesser or greater degree) by organisations that are affiliated with the Ministry of Education. In Spain, OCW-Universia unified different Spanish university OCW under the same infrastructure. Many Spanish universities use MiríadaX, a platform for Iberoamerican MOOCs, supported by the private telecommunications company Telefonica, for developing and hosting them. Along the same lines, in the context of the Turkish Academy of Sciences (TUBA), some Turkish HEIs took part in the OCW Project.

Even though innovative digital practices permeate the HE sector in Canada (e.g., MOOCs and Desire2Learn are Canadian innovations), there is a general belief that the sector must engage in radical transformation to remain relevant and successfully respond to the needs and pressures of a digital society (Bates, 2019). Furthermore, the lack of national oversight could be a major reason why this country seems to be rather an exception in the full adoption of these OER initiatives, and especially of OCWs. Across the Pacific Ocean, Australia has made some move toward national repositories. The Learning & Teaching repository houses OER materials from projects funded by the Australian Government between 1994 and 2018 and is run by the consortium Open Universities Australia.

Quality

The second research question addresses the influence of country-specific contexts on the development of national standards for the creation, dissemination and quality assurance of (O)ER.
in HE. Although not as prominent as for infrastructure, the level of political structure centralisation also has some effects on the quality issue for (O)ER and their repositories across countries.

A clear example of the effect of a centralised political structure on quality is China, where as early as May 2000, the Ministry of Education issued *Technical Specifications for Modern Distance Education Resources Construction*. This non-mandatory standard focuses on the guidelines for resource developers, production requirements, and functions of the management system. Nowadays, the *Chinese e-Learning Technology Standardisation Committee* has developed and issued numerous national standards and association standards on educational digitalisation.

However, most of the countries under investigation do not have any official national standards or quality frameworks specifically for (O)ER and their infrastructure and, therefore, political structure centralisation does not seem to have a high impact on them: this has been predominantly an issue left to institutions (e.g. South Africa) or even to individual faculty members (e.g. Japan). Despite this, some countries do have checklists, guidelines or evaluation guides related to (O)ER. In Spain, for example, the *Network of Spanish University Libraries* (REBIUN) is currently developing a guide for the evaluation of educational repositories, and it has produced multiple studies and reports on the status of the Spanish digital university repositories. In Germany, Mayrberger, Zawacki-Richter and Müskens (2018) proposed a quality assurance instrument for OER in the context of a HE network in Northern Germany. Likewise, Australia has developed different guidelines related to (O)ER such as the *Feasibility Protocol*, to assist HEIs to make informed decisions on the adoption of OER at various levels; alongside *Supporting OER engagement at Australian Universities*, which provides advice on intellectual property rights, copyright and policy. In South Korea, KERIS has developed *A Guidebook for Digital Content Development and Management* to ensure the acceptable quality of online resources and OCW to evaluate open digital content and online courses developed under the projects funded by the Ministry of Education, and to provide best practices. There are also official documents such as the *Guidelines for K-MOOC Development and Management* for edX, which help guide KOCW and K-MOOC development.

The actors involved in OER quality are diverse, depending on the country; however, governments, agencies, librarians and other working groups are usually involved. For example, in Spain an *Association for Standardisation* exists, but the working group on repositories of REBIUN and the working group on trends in (O)ER and quality criteria in new learning environments of CRUE (*Conference of Rectors of the Spanish Universities*) are also relevant actors in the quality of (O)ER. On the other hand, the case of the U.S. is unique, since many digital education organisations are involved in defining quality for (O)ER, such as *Quality Matters* or the *Online Learning Consortium, Educause, the Association for the Advancement of Computing in Education and the Association for Educational Communications and Technology*. Alternatively, public agencies are deeply involved in (O)ER quality in South Korea and China.

**Policy**

The third research question explores the influence of country-specific contexts on the development of national/state-wide policies for (O)ER digital infrastructures and their implementation in HE. This issue is strongly influenced by the country’s political structure, which may or may not boost the (O)ER infrastructure development.

In the case of decentralised countries, there are rather non-binding recommendations published by different actors (e.g. U.S. and Germany), whereas in centralised countries (e.g. South Africa and China), laws and regulations define policies regarding (O)ER infrastructure. For example, the current action plans in China, the *Action Plan for Educational Digitalisation 2.0* and the *Education
Modernisation 2035 Initiative, point towards the acceleration of digitalisation in education, including the development of (O)ER, and especially, MOOCs, with digital transformation being one of 10 strategic priorities for education modernisation. On the other hand, an action plan has not been developed or provided the necessary follow-through or funding in Japan. For example, whilst the Grand Plan for Japanese Higher Education 2040 highlights the importance of using ICT to improve teaching and learning in HE, it does not establish follow-up plans or support.

South Korea is highlighted as the first country to implement a digital strategy, as early as 1996, and since then and every five years, the basic plan of education informatisation has been established and implemented (Lim, Lee & Choi, 2019). The digital strategy e-Campus Vision for Higher Education (2002) involved South Korean government support in the establishment and implementation of e-learning support centres in universities across 10 different regions of the country, as well as funded collaborative content development among universities (Centres for Teaching and Learning) since 2000. In Turkey, the Vision 2023 Framework is regarded as the national roadmap with six macro themes, one of which is Education, Science and Technology. One of the actions taken within this Framework was the HE Council’s (HEC) Digital Transformation Project that was intended to support and assist the Turkish HE institutions to complete their digital transformation processes. As the first step in this project, MOOC-like courses that focused on the improvement of digital skills of the faculty members and students were developed and piloted in nine Turkish universities.

In the case of some mid- and all highly decentralised countries, although there are working papers that aim to influence national/province policy, there is no national educational policy. For instance, in Spain, we can highlight ICT 360º, Digital Transformation at the University and UniversiTIC 2017. The Analysis of ICT in Spanish Universities, which outline the trends regarding digital transformation at universities and propose strategic lines of action. In the case of Australia, provinces have the power to legislate on education, but the national government dominates HE policy. Nevertheless, the Australian Government currently has no explicit OER or OEP policies, framework or regulation for use in HE (Bossu & Stagg, 2018; Stagg, Nguyen, Bossu, Partridge, Funk & Judith, 2018).

Given the lack of a central educational agency, the Council of Ministers of Education in Canada (CMEC) serves as an overarching body for the discussion of common interests and provides a forum to discuss policy issues, a means by which to consult and cooperate with national education organisations and the national government. Similarly, in Germany, the Standing Conference of Ministers of Education and Cultural Affairs (KMK) and the German national government make recommendations that aim to develop policies in the field of digital transformation, for instance, the strategy papers Education in the Digital World and Shaping digitalisation. In the first recommendation, the states promulgate a joint understanding on the role, challenges and measures to be taken, in order to ensure appropriate education on all levels in the context of digital transformation, with OER being one of the action and development areas.

The federal government in the U.S. has developed the initiative GoOpen, which supports using OER to transform teaching and learning, but leaves the participation up to individual states and institutions. Decision-makers in the U.S. are not only decentralised by states, but also by markets. On the other hand, the national government of South Africa has developed several policies where OER are referred to, with the most recent being the Call for comments on the open learning policy framework for South African post-school education and training (2017), but there is no overarching national digital infrastructure policy with regard to OER in HE. Interestingly enough, (O)ER are a featured part of the country’s HE strategy for enabling and broadening access to HE in Turkey, where the number...
of university students has been increasing in recent years (TUSIAD, 2017), and in South Africa, where access is a matter of discussion (DHET, 2014a; 2014b; 2017).

**Change**

The last research question of this study is related to the influence of country-specific contexts on the promotion of change at the national level in terms of funding, managing and promoting (O)ER digital infrastructures in HE. Again, countries’ varying political structure is a relevant element, although not prominent.

The most relevant action for the promotion of (O)ER and their infrastructure at the macro level consists of national digital strategies (involving government investment/budget) or national funding initiatives, which all countries in the study have, except Japan. These are not usually just focused on (O)ER and their infrastructure, but digital education aspects are highlighted. In the case of the U.S., the federal government does have funding bodies for special educational funding initiatives, but it does not provide operational funding for education at any level. The Canadian national funding agency SSHRC (the *Social Science and Humanities Research Council*) provides generous funding for projects in national competitions. In Germany, four large-scale tenders were announced between 2016 and 2020 through the national government within the funding line *Research in Digital Higher Education*. The 2016 tender funded 20 projects related to OER (Mayrberger, 2018). South Korea has several funding schemes for HE digital transformation, which is also an evaluation criterion of HEIs, as does China, especially for the creation, development and sharing of MOOCs. In South Africa, the National Treasury dedicates and channels public funding for OER. Another measure includes the *Teaching Development Grants* funded by the South African Department of Higher Education and Training, which will be used to encourage collaborative development and use of OER, and the policy allows for the sharing of OER with other countries, especially when these are released under an open license that permits adaptation (DHET, 2014b).

Some of the countries under investigation also have private funding initiatives, with private institutions particularly involved in (O)ER initiatives in specific countries (see Figure 5). Crucially, private foundations have been an important source of funding for (O)ER initiatives in the U.S. The Hewlett Foundation has provided strong support to open education initiatives, along with others such as the Gates Foundation and the Open Society Foundation. However, individual start-up companies (such as TeacherTube) and organisations (such as Khan Academy) have also initiated what some might consider open education. Also, U.S. companies, such as Google and Microsoft, have also been particularly interested in South African education, providing funding for digital education related projects. In the case of Spain, academic networks and organisations have been offering modest funds for one-year projects, prizes or awards for the creation of (O)ER (in the past, OCW; and now MOOCs). Additionally, the creation (and teaching) of (O)ER/MOOCs is regarded as a complementary merit for university teacher accreditations. Honourable titles and funding in the form of online course subsidies are available for the development of MOOCs in China.

![Figure 5: Spectrum Private funding - Public funding.](image-url)
Agents at this level are mostly national and provincial governments (e.g. Spain, South Korea, Germany and China), national funding agencies (e.g. Canada) and private organisations (e.g. U.S.). However, other bodies could also be involved, depending on the country. In Australia, the macro level agents for change are government, university and industry bodies. In the case of Germany, the Hochschulforum Digitalisierung (HFD) is an important think tank, advisory body and actor that promotes policy-practice-research dialogue. It can be considered as a major driver of change as it has high public visibility and collates expertise from both research and teaching as well as policy making. It operates with national funding. Community-platforms relevant for the promotion of change in the field of OER in Germany are OERinfo and the OER World Map.

Although there are agents for change at the macro level, change has been reported to happen mostly at the other levels in the majority of countries. For instance, change especially occurs at the institutional level in South Africa, Turkey\(^4\), Japan, Australia and Spain; and at the micro level (led by individual faculty members) in the U.S. and Japan, but also in Australia. In the case of Canada and Germany, agents for change are mostly located at the provincial/state level. Exceptions include China\(^5\) and South Korea, where change happens mainly at the national level.

Discussion and conclusions

This study contributes to the field with an international comparative approach to further understand the factors behind (O)ER infrastructure at the national level, some of which were initially covered in the Open and Distance Education volumes (Qayyum & Zawacki-Richter, 2018; Zawacki-Richter & Qayyum, 2019). Overall, and despite the differences among countries, the key value of OER and their repositories of enabling universal education (Caswell et al., 2008) seem to be a work in progress. Although some countries (concretely, Turkey and South Africa) include the goal “broadening or enabling access to HE” in their policies, their real practices show that there is still more to do for its actual realisation. On the other hand, as Archer and Prinsloo (2017, p. 279) note, OER and MOOCs require an ethics of caring that “recognises that the change brought about as technology, not only represents a disruption in access to knowledge, but is also a product of a changing society”. Despite the technological focus of the project in which this study is framed, our perspectives shed light on cultural, social and economic aspects linked to the issue of digital infrastructures of (O)ER that are in dynamic change. These contextual aspects have to be considered as challenges that each country manages its own way.

Therefore, we consider that findings from this study could serve as a wake-up call for national/provincial organisations, to see countries comparatively reviewed and therefore justify their push for the improvement of (O)ER infrastructure. It is vital to acknowledge that it is not possible to understand national (O)ER infrastructure and the associated support elements without analysing and understanding the differences of context and culture, as became clear from the analysis above. Aspects such as the political context and the socioeconomic situation have been shown to be a major influence on how HE (O)ER infrastructures are - or are not - developed and how change takes place. National and provincial legislation and recommendations, as well as measures for promoting change such as the provision of funding or the acknowledgement of merits, influence the development of (O)ER infrastructure in HE. Quality assurance mechanisms, such as the

\(^4\)Although Turkey has a highly centralised system, the change, or initiatives regarding OER, comes from public institutions that have a long history of open education, such as Anadolu, Ataturk and METU.

\(^5\)Change in China also happens at the meso and micro levels, although compared to the Government, the other forces are far less significant.
development of standards and ensuring its compliance, may be in place to ensure not only the interoperability between infrastructures but also the quality of (O)ER content.

The method of this study should be acknowledged as its most important limitation. This report relied heavily on the expertise and knowledge of academic experts from the countries under investigation to conduct desk research and obtain data and general information on the topic. This method could potentially lead to subjective views and a non-exhaustive retrieval of information, since a systematic approach to obtain prior research may not necessarily have been followed. Therefore, some gaps within the results may be present; these can be addressed in a more systematic way in the future. Also, the study has rather a descriptive character than a critical perspective. Such a perspective would be in line with studies, such as the one by Knox (2013), which brings another approach to the topic that could be considered in future work. Next steps will also analyse the meso (institutional level) and the micro levels (teaching and learning level) of the various countries and provide a more holistic overview of the current state of (O)ER dissemination and use.

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Effective Pedagogical Strategies for STEM Education from Instructors’ Perspective: OER for Educators

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Abstract

The Massachusetts Institute of Technology (MIT) OpenCourseWare (OCW) was launched in 2001. It is one of the earliest Open Educational Resources (OER). MIT OCW has published more than 2,400 courses which are available at no cost, the majority of which are STEM related. The purpose of this exploratory study was to examine the pedagogical strategies through reviewing instructor insights of 15 MIT OCW STEM courses using thematic analysis. The most effective pedagogical strategies used found by instructors were active learning, personalizing instruction, engaging learners, providing feedback, building learning community, and clarifying learning objective. Instructors used in-class formative assessment, such as quizzes and oral exams, for just-in-time teaching and online automatic assessment environments for students’ self-assessment. The primary summative assessments were final exams and projects. Instructors encountered challenges such as assessing students’ learning and changing pedagogical beliefs. Implications for practice were discussed as well.

Keywords: OER, MIT open courseware, STEM education, electrical engineering education, computer science education, pedagogical strategies

Introduction

One of the earliest Open Educational Resources (OER) is the Massachusetts Institute of Technology (MIT) OpenCourseWare (OCW) (Bonk, 2009; MIT News, 2001), which was launched in 2001. It was intended to share MIT course materials with the public for free. As of August 2019, more than 2,400 courses were available, with approximately 170 million visitors to their website (MIT OpenCourseWare, 2019b). Nine percent self-reported as educators (MIT OpenCourseWare, 2019a). The majority of the courses are related to science, technology, engineering, and mathematics (STEM) subjects such as Electrical Engineering (EE) and Computer Science (CS).

Open Educational Resources (OER) was previously examined regarding design, development, disseminating methods, and quality by Kimmons (2015), cost-saving by Wiley, Hilton, Ellington, and Hall (2012), and impact by d’Oliveira, Carson, James and Lazarus (2010). However, STEM pedagogical strategies were not yet considered. Thus, the purpose of this study is to examine MIT OCW STEM instructor insights in order to inform other STEM educators regarding effective pedagogical strategies and assessment methods and possible challenges.

The following three research questions guided this study:

1. What are the effective pedagogical strategies for MIT OCW EE and CS courses?
2. What are the commonly used assessment methods of MIT OCW EE and CS courses?
3. What challenges do the instructors perceive they have while teaching MIT OCW EE and CS courses?
Literature Review

OER and MIT OCW

Open Educational Resources (OER) was defined by UNESCO (2002) as, “the open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes” (p. 24). OER dates to the initiative of Massachusetts Institute of Technology (MIT) in 2001, with the intention to share learning materials with the public for free on the Internet (Goldberg, 2001). The OER movement has been gaining attention around the world (Guttenplan, 2010), attracting a huge number of international audiences. Not surprisingly, some institutions translated MIT OCW into their local languages such as Chinese, Spanish, and Portuguese (Abelson, 2008).

Subsequently, MIT published 2,466 courses and has hosted 285 million site visits based on MIT OCW report in August 2019 (MIT OpenCourseWare, 2019a). Over 600 tenured or tenure-track faculty from MIT, approximately 60% of them, participated in OCW movement. As a result, MIT OCW influences people world-wide. Forty-four percent of the site visitors were from North America, followed by East Asia (20%), Europe (17%), South Asia (9%), Latin America (4%), and Mid East (4%), and Africa (2%) (MIT OpenCourseWare, 2019a). Based on MIT OCW site statistics, the audience of OCW includes self-directed learners (43%), students (42%), educators (9%), and other (6%). Among educators, their stated aims were to improve personal knowledge (31%), learning about innovative teaching (23%), leveraging OCW materials for their own course (20%), finding reference materials (15%), and developing curriculum for their department (8%) (MIT OpenCourseWare, 2019a).

STEM Education

The National Science Foundation (NSF) and other related professional societies have focused on the basic and applied research in STEM and to improve the quality of STEM education (Fairweather, 2008). The attention to STEM was a response to the decrease of the number of students selecting STEM majors and the needs of STEM related employees (Center for Science Mathematics and Engineering Education, Committee on Undergraduate Science Education, 1999; National Science Foundation, 1996). The Committee of Science, Technology, Engineering, and Math Education (CoSTEM), a branch of the National Science and Technology Council, was formed to reform STEM education from K-12 to the higher education levels in order to build a pipeline of jobs for the development of the economy (CoSTEM, 2013).

Low quality college teaching in STEM courses is a critical issue in higher education (Seymour & Hewett, 1997), promoting the search for effective pedagogical practices. This includes instructors’ professional development programs (Wulff & Austin, 2004) for teaching innovation. Fisher, Zeligman, and Fairweather (2005) indicated that pedagogical reforms and innovations in engineering courses significantly enhanced student learning outcomes, including ill-structured problem-solving skills.

Active Learning

Active learning is potentially more effective than the traditional teacher-centered instruction in terms of enhancing student learning and increasing student retention in STEM education (Freeman et al., 2014; Lund & Stains, 2015; Michael, 2006; Prince, 2004). Active learning could address student learning needs and promote critical thinking (Kim, Sharma, Land, & Furlong, 2012). For example, Freeman et al. (2014) conducted meta-analysis on the effectiveness of
teaching in traditional lecturing vs. active learning approach in STEM courses, and the latter was frequently accompanied by increased student performance.

Interactive lecture increases student attention and motivation by using discussions or questions and answers (Allen & Tanner, 2005; Steinert & Snell, 1999). It also enhances student problem-solving and communication skills (Scott et al., 2018) and improves student learning outcomes (Ernst & Colthorpe, 2007). Molinillo, Aguilar-Illescas, Anaya-Sánchez, and Vallespín-Arán (2018) found social presence and teacher-student interaction positively influences students’ active learning.

Blended learning is another active learning strategy in which both online and face-to-face instruction or learning materials are used (Bonk & Graham, 2012; Güzer & Caner, 2014). It enables students to control the time, location, and paces of their learning to some extent (Güzer & Caner, 2014). The flipped classroom as a type of blended learning model used to promote student-centered learning and active learning (Pierce & Fox, 2012). It was originally used to provide videos or screencast instructions to students who were absent from class (Hamdan, McKnight, McKnight, & Arfstorm, 2013). Class time could be shifted from lecture-centered class to class with enriched activities to promote problem solving skills (Tucker, 2012). Flumerfelt and Green (2013) found using screencast videos in flipped classroom could promote the interaction between students and instructors, further fostering active learning (Leicht, Zappe, Messner, & Litzinger, 2012).

However, active learning strategies are not widely adopted in classroom yet (Hora, Ferrare, & Oleson, 2012). Barriers hinder the instructors’ adoptions of active learning strategies (Finelli, Daly, & Richardson, 2014; Froyd, Borrego, Cutler, Henderson, & Prince, 2013; Lund & Stains, 2015; Shadle, Marker, & Earl, 2017), such as instructors’ concerns about its effectiveness, time consumption to prepare courses, student resistance (Tharayil et al., 2018), and instructors’ understanding of the theoretical background (Borda et al., 2020).

**Personalized Instruction**

Personalized instruction and learning have a theoretical base in learner-centered and constructivist learning (Reigeluth, Myers, & Lee, 2017; Watson & Watson, 2017). It customizes the instruction to individual learners’ needs through providing learning resources, technologies, and activities (Kelly, 2016). Its learner-centered theory perspective can address learners’ diverse backgrounds, competencies, and requirements (Green, Facer, Rudd, Dillon, & Humphreys, 2005). One way of personalizing the instruction is through technologies such as social bookmarking, blogs, and collaborative tools (Haworth, 2016). Besides technology-enabled personalized learning environment, social interaction and participatory learning also support personalization (Haworth, 2016; McLoughlin & Lee, 2010).

**Research Design**

A document analysis, a systematic approach to obtain meaning, understandings, and develop empirical knowledge by examining and analyzing the existing documents (Corbin & Strauss, 2008; Rapley, 2007), was the basis of the research design in this study. Such documents for review could include texts, images, and videos generated without a researcher’s intervention (Bowen, 2009). Document analysis is a social research method and research tool (Bowen, 2009). This study adopted document analysis because the documents on the MIT website presented instructor’s pedagogical strategies.
Data Collection

The documents reviewed were instructor insights of 15 MIT OCW Courses (table 1) from the Department of Electrical Engineering and Computer Science which was published on MITOCW site (https://ocw.mit.edu/courses/instructor-insights/#electrical-engineering-and-computer-science). In general, each instructor insights page included seven sections: (1) Course overview: a general information about the course; (2) course outcomes: course overall goals and learning objectives; (3) instructor insights: Instructors’ thoughts on effective teaching strategies that they used; (4) curriculum information: semester of the course and other related courses; (5) assessment: the detailed assessment methods and percentage of each element; (6) student information: the number of students, their grade levels, and majors; and (7) how student time was spent: estimated time for students to spend on learning the course content in and out of class.

Nine courses were at the undergraduate level courses, and the remaining six courses were graduate level. Six of the courses provided text insights on the website, and eight provides video insights with verbatim transcripts. However, one graduate level course did not include detailed instructor insights. All the courses were taught with a team of educators (instructors, lab staffs, and teaching assistants). However, not all of the educators shared their insights. A majority of the insights are from one or some of the instructors from each course.

Table 1: Course title and level

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Electrical Engineering and Computer Science I (Spring 2011)</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>Computation Structures (Spring 2017)</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>Signals, Systems and Inference (Spring 2018)</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>Computer System Engineering (Spring 2018)</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>Artificial Intelligence (Fall 2010)</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>Design and Analysis of Algorithms (Spring 2015)</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>Creating Video Games (Fall 2014)</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>Principles and Practice of Assistive Technology (Fall 2014)</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>Engineering Innovation and Design (Fall 2012)</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>Cognitive Robotics (Spring 2016)</td>
<td>Graduate</td>
</tr>
<tr>
<td>Geometric Folding Algorithms: Linkages, Origami, Polyhedra (Fall 2012)</td>
<td>Graduate</td>
</tr>
<tr>
<td>Advanced Data Structures (Spring 2012)</td>
<td>Graduate</td>
</tr>
<tr>
<td>Algorithmic Lower Bounds: Fun with Hardness Proofs (Fall 2014)</td>
<td>Graduate</td>
</tr>
<tr>
<td>Teaching College-Level Science and Engineering (Fall 2015)</td>
<td>Graduate</td>
</tr>
<tr>
<td>Electric Machines (Fall 2013)</td>
<td>Graduate</td>
</tr>
</tbody>
</table>

Data Analysis

The data were analyzed using thematic analysis (Braun & Clarke, 2006; Braun, Clarke, & Rance, 2014), following the procedures of Braun and Clarke’s (2006). The steps are: (1) becoming familiar
Effective Pedagogical Strategies for STEM Education from Instructors' Perspective

with the data; (2) inductive open coding; (3) identification of themes; (4) review of themes; (5) refining and defining themes; and (6) report writing. Following a review of the 15 courses' instructor insights, the data for each course was coded. The analysis unit was the meaning unit. Themes were identified across all the courses. To increase the trustworthiness of this study, a debriefing was held with an expert in OER field.

Findings: Research Question 1 (RQ1): What are the Effective Pedagogical Strategies for MIT OCW EE and CS Courses?

A variety of pedagogical strategies were shared by the faculty members regarding teaching EE and CS courses. They included active learning, personalizing instruction, engaging learners, providing feedback, building learning community, clarifying learning objective, and integrating teaching and research.

Active Learning

Active learning is one of the most popular pedagogies used by the MIT OCW instructors. It means that learners should be actively involved in learning through hands on activities and interactions, rather than just passively listening to the lecture. Active learning is an umbrella which covers a variety of strategies such as hands on experience, authentic problems, flipped classrooms, discussions, think-pair-share, debates, and etc. One of the active learning approaches that were shared by MIT OCW instructors was practice-theory-practice, which means that instruction should expose students to practice first, followed by presenting theory and providing practical problems to solve. Dr. Dennis Freeman, an instructor of *Introduction to Electrical Engineering and Computer Science I*, explained that the entire practice-theory-practice process emphasizes hands-on experiences of solving authentic problems. Along the same line, Dr. Erik Demaine, who taught *Design and Analysis of Algorithms*, encouraged his students to solve open problems:

So one of the exciting parts of this class is that we ran an optional session where whoever is interested in doing the research side of the material could solve open problems together. So we call this a problem-solving session. But it’s all the problems [that] are unsolved in the field.

Similarly, Dr. Blade Kotelly, an instructor for *Engineering Innovation and Design* also emphasized hands on experience in his course. As he said:

The lectures are interspersed with activities. So students will do some hands-on activities every, let’s say, half hour. Probably at the limit is about halfway through, about an hour through, they’ll have to do something no matter what. Because you want to keep students’ attention up.

Virtual learning environment was used for hands on activities. Dr. Chris Terman, an instructor of *Computation Structures* shared these thoughts on providing virtual lab for hands-on activities:

These virtual labs actually… takes courses from being a listening experience with maybe some pencil P-sets to your hands are active. So hands-on, brain on, right? And when people’s brains turn on, it’s amazing what they remember.

Another active learning strategies was flipping the classroom. Dr. Sanjoy Mahajan, a visiting professor of MIT, stated “we flip the classroom in the sense that we have students do as much as they can outside of class to climb the active learning hierarchy so that when we’re together in class we can focus on constructive and interactive learning.” A common active learning method used by MITOCW
instructors is discussion, which is also an important element in flipped classroom. Dr. Katrina LaCurts, the instructor of the course, *Computer System Engineering*, said:

> Each recitation focuses around a technical paper that the students have read beforehand. And the goal for those discussion sections, those recitations, is for them to be largely discussion based... A large part of that instruction happens in the recitation, where we’re having these discussions. And they go and apply those skills to their design projects.

The detailed discussion formats vary. One of the commonly used discussion formats as well as an active learning method is think-pair-share. Dr. Janet Rankin, the Interim Director of the Teaching and Learning Lab at MIT at the time of the interview, explained:

> In general, you first give students time to think about a question or a situation or some other scenario that you want them to think about. And you give them time to think actively but alone about that. And often you can ask them to write down their thoughts. But then at the end of that short period of time, whether it’s three minutes or five minutes, you have them pair up. And if it’s a really big class or the numbers of students in your class warrant it, you can have them triple up, it doesn’t have to be a pair.

**Personalized Instruction**

Another important pedagogy was personalizing the instruction, which engages learners with diverse knowledge levels and background. It may be invoked via customized language use, optional learning materials, and offering learning materials online. Also, the use of different languages is productive in this regard. Dr. Dennis Freeman, based on experiences of addressing students with diverse prior knowledge, concluded:

> When I’m talking to a student in lab, I adjust what I’m saying to match the student’s current level of understanding. If the student has never seen programming before, I don’t use advanced programming comments in the way I talk to them. If they’ve never seen a circuit before, I don’t use jargon. I’ve learned how to say things without using jargon.

Personalized instruction requires optional learning materials. For example, Dr. Chris Terman, provided a range of materials to benefit students with different backgrounds and learning preferences:

> So I create a huge— I think of it as a buffet. There’s lots of dishes. And you can start at the beginning of the buffet and sort of pick it up from scratch. Or you can say, I’ll skip the first couple courses, and I’m ready to dive in sort of in the middle of the conversation somewhere.

The short and small asynchronous materials available online offer students an opportunity to study at any time and any place. Dr. Chris Terman noted:

> It’s keeping things short and sweet. So you have a huge-- because now you have a bunch of short bites. Now, the MITx platform lets you organize those with questions that let you sort of continue to test your learning. So it’s actually worked out to be a very nice way of making a fairly organized tour through the material that the students can start, and stop, and come back to. Plus, it’s asynchronous. In other words, they get to choose their time and place.

**Engage Learners**

Another theme was learner engagement. Relevant strategies include storytelling, joking, showing passion, and making class fun. Dr. Chris Terman emphasized the importance of engaging students,
especially, after a long talk on technical topics. Dr. Patrick Winston, who taught *Artificial Intelligence* used stories to provide a big picture and inspire learners:

I think stories are an important element of education, and if you strip them out, you don’t have much left that can possibly be inspiring… I call them powerful ideas. If all you’re teaching is skills, the educational experience you offer students is okay, but if you can accompany the skills with some big-picture, powerful ideas, the educational experience becomes more impactful, more important.

Another way to engage learners is to convey passions, as Dr. Winston said,

There are things people need to know, but you can’t say they’re very exciting. You have to pretend they’re exciting. Somehow. Otherwise, your passion won’t come across and your teaching won’t be inspiring…

One of my colleagues told me that he always ends his lectures with something fun so that people feel like they’ve enjoyed the class the whole time. It could be a joke, or an historical anecdote, or an intriguing demo. I do that now, too. I always try to end with something fun.

Guest speakers provided diverse perspectives and engaged learners. Dr. Joel Schindall, who taught *Engineering Innovation and Design* said:

In some cases, we’ll bring in someone from the Engineering faculty who is particularly gifted at communicating mechanical engineering design skills or electrical or chemical, because we want to give the students—there tend to be some discipline unique ways of thinking, and we want to give the students an idea of what the broad range is.

**Provide Feedback**

Providing systematic support and feedback to learners was important. Usually, they have an education team including instructors, lab staffs, and teaching assistants (TAs). Dr. Chris Terman indicated the advantages of having a hierarchy feedback system:

But the students actually prefer the other thing, which is actually asking an TA is not very intimidating. The students, maybe they just took it last semester... And then you sort of work the chain up, work up the hierarchy to get an answer of people below. And that way you’re only asking questions of the more intimidating people when you’re pretty sure that no one else has the answer.

In addition, TAs provided optional tutorials. Students who wanted to join the tutorials can sign up the session. A third of the students of Dr. George Verghese’s, *Signals, Systems and Inference*, attended the weekly tutorials noted:

The teaching assistants go prepared with a small set of basic problems, simpler than those on homework, and illustrating points that have come up in lecture. However, the tutorials are also teaching assistant office hours, and students are encouraged to come with questions they may have.

Serval courses used discussion forum as a platform for questions and answers. The instructors and the TAs provided timely feedback to address students’ questions. When a student asks a question in the forum, other students with similar question benefit from the response. The online discussion
forum scales up the way of providing feedback and enhances the efficiency of providing support to students. Dr. Terman said:

For the first time I'm able to make a thoughtful answer to a question and have 180 people look at the answer instead of one. And then the next person who has the same question, you say, well, I just spent 10 minutes. And with a large class, you can't spend 10 minutes for each of 300 people.

Learning community

Learning communities provide a physical or virtual learning environment to support building learning community. Dr. Verghese created formal learning community through providing a physical learning space and TA support:

We reserve a classroom for the three or four evenings that precede the day homework is due, and guarantee that at least one of the staffs will be present there for 1.5-2 hours; usually we have the lecturer or a recitation instructor, as well as a teaching assistant. We find students working individually as well as collaboratively, and periodically interacting with the staff, either at the board or at their desk—very immersed and engaged in the homework problems, and in sorting out ideas and misconceptions related to these. The staff will typically respond to student questions with other (well chosen!) questions or hints that guide them along, rather than with answers—and that makes for a very fruitful dynamic.

Learning objectives

Some instructors proposed to share learning objectives with learners at the beginning of the class. Dr. Patrick Winston said: "you want to tell them what they'll be able to do at the end of the lecture that they couldn't do in the beginning. I try to start every lecture with a promise, every time." Dr. Philip B. Tan, who taught Creating Video Games, shared similar ideas:

So one thought that I have for educators who are running those classes is be very clear to yourself and then to the students about whether you are running a class about game design, or game programming, or project management. When we started this class, we were trying to be as clear as possible to the students. This is a class project management. You will do all those other things in the process of this class, and many of you are here for that reason.

Integration of Teaching and Research

Integrating research into teaching stimulates instructor motivation and engages learners. Some instructors used the research results in their teaching, and were inspired to pursue related research topics. For instance, Dr. George Verghese, who taught Signals, Systems and Inference, noted regarding integrating teaching and research:

I routinely discuss with my class such examples originating in research. I also bring in application examples from other fields, as opportunity arises. These various examples are motivating for the students, as they illustrate the relevance of the course material. It is also almost invariably the case that each time I lecture the subject, I encounter new questions and ideas to carry back to my research!

Similarly, an instructor of the course Design and Analysis of Algorithms, Dr. Erik Demaine, expressed passion with algorithms in both research and teaching:

And all of my research is also around algorithms. So this is me living the dream, teaching the topic that I love. And it’s an exciting class… I try to add in new topics that I don’t know so well, so I learn them even better. And that, in turn, influences my research.
Findings: RQ 2: What are the Commonly Used Assessment Methods of MIT OCW EE and CS Courses?

Formative assessment included quizzes and oral exams for just-in-time teaching, as well as the creation of an online automatic environment for students’ self-assessment. The summative assessments were primarily final exams and projects.

Formative Assessment

Formative assessments were widely used by MIT OCW instructors. Some instructors used in-class formative assessment to get to know students’ learning levels to adjust their teaching accordingly. For instance, Dr. Blade Kotelly stated, “we administer a quiz, we swap all the quizzes, we review all the answers… So we try to do a diagnostic to see what’s happening.” Similarly, Dr. Dennis Freeman used formative assessment for just-in-time teaching:

Since implementing the practice-theory-practice approach, I’ve become more careful to assess students’ understanding during lectures. I do this by asking a concept question every 15 minutes or so… Students work in pairs to answer the questions. I show them five possible answers, and they raise their hands showing some number of fingers that corresponds with their answer choice. I look at their responses. If everybody gets the question right, I know I don’t need to explain the concept again. I keep going. If some students get the question wrong, I provide more explanation. If everyone gets the question wrong, then I know I didn’t explain the concept well and I start from the beginning.

They also used technology to enhance the efficiency of providing feedback. Dr. Sanjoy Mahajan described noted students in the design lab put their questions in an electronic help queue seen by all the students and TAs. TAs could use their mobile phone to respond, provide check-off points, and record the results online.

One of the methods to check whether student master the learning content was to use oral exams. However, its effectiveness was limited due to the large number of evaluators. Dr. Freeman noted:

We asked very open-ended questions, from which we learned a lot. We would start with an easy question, a question that we expected everybody would get. If the student got it easily, then we would ask a harder question. If the student didn’t get it easily, then we’d ask another easier question. If he or she sailed through the easy question, we went straight to a difficult question. In other words, we adjusted to the student’s level, and it was really quick. In 10 minutes, and sometimes fewer, we had a good feeling for the student’s level of understanding.

Self-assessment was obtained via an online tutorial environment in which students checked their code, and receive feedback. If incorrect, detailed feedback is provided. Dr. Dennis Freeman said: “Checking test cases offers much richer feedback. ‘Your code passes tests 1, 2, 4, and 5 but fails test 3.’ This message contains a wealth of information about not only the problem at hand but also about how to construct effective test cases, which is essential to becoming an expert programmer.”

Summative Assessment

Final exams, projects, and presentations were the basis of summative assessments. Projects were used in Dr. Erik Demaine’s graduate level course Algorithmic Lower Bounds: Fun with Hardness Proofs:

So with every sort of advanced class that I teach there’s a final project. And the goal of the final project is for students to somehow get their feet wet with the material and sort of experience it at
a more researchy level. In general, this can be things like surveying papers that I didn't cover in the class because there's only so much you can fit in one semester. So they'll go and read other material and kind of aim to teach that to the students. So there's a written project part, and then there's also a presentation in class. So this is an opportunity for students to learn more.

Findings: RQ 3: What Challenges do the Instructors Perceive They have While Teaching MIT OCW EE and CS Courses?

Challenges ranged from ways to assess students’ learning to approaching in changing other instructors’ pedagogical beliefs. Dr. Erik Demaine explained the challenge to assess whether students could apply the algorithms creatively:

But it's hard to measure a student's understanding because it's like, did you get the creative trick that we had in mind, or find another one that's just as good? Students may find a different creative trick that doesn't end up with as good an algorithm in the end. So we penalize that someone, but for the most part we are happy when people get correct algorithms.

Regarding colleagues’ pedagogical beliefs, Dr. Freeman stated:

In fact, it's been a process to shift the teaching model toward a hands-on approach, such that most of the learning happens in the lab. It’s been hard to get the faculty on board with this shift. Some of our most effective lecturers have commented, “I don’t want to teach this course because there's no teaching,” which is completely wrong. Usually by the time they've done it a few times, faculty realize that they're actually imparting a lot more knowledge by facilitating hands-on learning than they would solely by lecturing. There’s a misconception on the part of “broadcast” lecturers that if they say it, students will understand it. That's so wrong.

Discussion

The purpose of this study was to examine MIT OCW STEM instructor insights, particularly their pedagogical strategies, assessment methods, and perceived challenges in instruction in order to inform other STEM educators regarding effective pedagogical strategies and assessment methods. Fifteen MIT OCW instructor insights from the department of Electrical Engineering and Computer Science were reviewed. A variety of pedagogical strategies were identified, such as active learning, personalizing instruction, engaging learners, providing feedback, building learning community, clarifying learning objective, and integrating teaching and research. Both formative and informative assessment methods were used. Challenges such as effective way to assess learners and changing instructors’ pedagogical beliefs were identified.

Active learning is one of the primary themes of the instructor insights. Flipped classroom is one of the effective active learning strategies used by instructors, which concurs with previous research (i.e., Freeman et al., 2014; Michael, 2006; Prince, 2004; Lund & Stains, 2015). The flipped classroom manifests the core pedagogical shift from lecture-centered teaching to learner-centered instructions that use activities to engage learners and solve problems (Tucker, 2012). However, the pedagogy shifts also encountered barriers as identified in this study. Instructors doubted the effectiveness of active learning strategies and felt uncomfortable of using it. This finding is in line with the previous research which indicated that barriers hinder the adoption of active learning strategies in classroom (Finelli et al., 2014; Froyd et al., 2013; Lund & Stains, 2015; Prince, Borrego, Henderson, Cutler, & Froyd, 2013; Shadle et al., 2017) and instructors do not believe in the effectiveness of active learning (Tharayil et al., 2018). Thus, one of the possible ways to address this problem is to provide professional development to educate instructors by showing successful examples of using active learning.
Another important pedagogical strategy is personalized instruction reported by MIT OCW instructors. This study found that the common practice of personalization is through providing optional materials to learners. These personalized instructions address needs of individual learners (Kelly, 2016) with diverse backgrounds, competencies and requirements (Green et al., 2005). As more and more blended learning mode is used in higher education, providing optional learning materials online could be one way to provide personalized instruction in higher education.

Limitations and Future Research

There are several limitations in this study. First, the researcher only reviewed MIT OCW instructor insights. If the researcher could also review the learning materials such as videos and quizzes of the course to triangulate the data, it would possibly increase the trustworthiness of the study. Future researchers could combine both instructor insights and MIT OCW course learning materials for data triangulation. In addition, the pedagogical strategies were from educators’ perspective, future research might interview learners who have taken MIT OCW STEM courses regarding their learning perceptions and experiences of effective instructional strategies.

Conclusion

The significance of this study contributes to both research and practice. For research, this study indicated that a variety of pedagogical strategies could be used for STEM education such as active learning, personalizing instruction, and etc. In addition, formative assessments such as quizzes and in class evaluations could be used for just-in-time teaching to improve the teaching quality; and both final exams and projects could be used for summative assessment in STEM education. This study indicated that the majority of the pedagogical strategies and assessment methods were aligned with the pedagogy of student-centered learning. This study could be an initial step of the research on the impact of OER on STEM educators teaching pedagogies.

For practice, STEM instructors and instructional designers could leverage the existing experience of MIT OCW STEM educators to improve teaching and student learning. Given challenges faced on how to effectively and efficiently evaluate learning and changing faculty members’ teaching beliefs, practitioners could keep these challenges in mind while designing and delivering their instructions and figure out strategies to address these issues.

Acknowledgement

This research was completed as a part of the OER Fellowship honored to the first author by the Open Education Group. I thank Dr. John Hilton III for his support with this research. In addition, I would like thank the MIT OCW team for sharing the course resources and instructor insights with the public. Particularly, I truly appreciate the advice from Sarah Hansen, the OCW Educator Project Manager, on the available resources.

References


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Opening World Regional Geography: A Case Study

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Abstract

A growing body of research has demonstrated that open educational resources (OER) provide an opportunity for improvements in learning outcomes compared to traditional texts. This project builds on the Open Education Group’s COUP framework to explore student and faculty use and perceptions of an open education World Regional Geography textbook. World Regional Geography is a lower-level course that is typically taught using traditional methods and with an emphasis on breadth over depth. As this case study explores, however, the creation and use of OER has provided an opportunity to completely reconfigure the course using a flipped classroom approach. Further, this study finds a statistically significant difference in student perception of OER before and after using the open course textbook, a significant difference in how often students read the book, and an overall positive response from students. Shifting to an open textbook has thus transformed and revitalized the class both from a student and an instructor perspective.

Keywords: Open educational resources; geography; open textbooks

Introduction

As the price of traditional college textbooks have increased (Government Accountability Office, 2013; U.S. Bureau of Labor Statistics, 2016), so too has a movement to shift to alternatives that are free, editable, and re-mixable. These open educational resources (also referred to as OER) are defined as “teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions” (Hewlett Foundation, 2020). Further, research has demonstrated that the use of OER has either no impact or a positive impact on learning outcomes when compared to traditional textbooks (Hilton, 2016).

While research into OER has expanded over the past decade, the body of research still remains limited (see Hilton, 2019b). In addition, while there has been a call for more rigorous statistical research on the impacts and efficacy of OER usage (Hilton, 2019b), there is also the need for additional research into the design and implementation of courses using OER. Research on OER, particularly North American studies aligned with the COUP framework (cost, outcomes, usage, and perceptions), have often been positioned as a straight comparison, swapping a traditional textbook for open materials and examining the effects (Hilton, 2019b). While these comparative studies improve statistical measures, it is also useful to explore how these texts can provide a radically different teaching and learning experience for both students and faculty. OER, by their very definition, provide universal access to students and are able to be reconfigured to suit a particular instructor’s needs and objectives which can radically reshape the nature of a course (see Tuomi, 2013; Chikuni, Cox, & Czerniewicz 2019).

This study examines the creation and implementation of an open textbook for an introductory-level World Regional Geography course. While most World Regional Geography textbooks and courses approach the material from a relatively traditional perspective, emphasizing a broad array of facts and figures and utilizing a lecture-based approach, shifting to OER enabled a complete course
redesign and the adoption of a flipped-classroom model. Students have responded positively to these changes and overall the use of OER has revitalized the course.

**Literature Review**

Across the United States, textbook cost increases have outpaced the inflation rate, with prices rising an average of 6 percent per year from 2002 to 2012 (Government Accountability Office, 2013). These high costs can have a significant impact on students in a variety of ways. When exploring the impacts of textbook costs on course outcomes, Jhangiani and Jhangiani (2017) found that students reported taking fewer courses, not registering for a course, or withdrawing from a course as a result of textbook costs. Thirty percent of respondents in the study reported earning a lower grade as a result of the cost of textbooks (Jhangiani & Jhangiani, 2017). While textbooks are central facet of a college course experience, a 2012 survey of students in Florida found that 64% of student respondents reported not purchasing a required textbook due to its cost (Florida Virtual Campus, 2012).

Open educational resources thus provide a way for instructors to mitigate these cost challenges while providing increased access for students. Research shows that this increased access can significantly improve student grades and withdrawal rates (Feldstein et al., 2012). Course pass rates were similarly shown to increase in a study examining a basic bath course (Pawlyshyn, Braddlee, Casper & Miller, 2013). Even if exam scores or grades remained the same as a variety of studies have shown (see Lovett, Meyer, & Thille, 2008; Wiley, Hilton III, Ellington & Hall, 2012; Hendricks, Reinsberg & Rieger, 2017), the cost savings of using OER texts can be substantial. In the Hendricks, Reinsberg and Rieger (2017) study of a physics course in Canada, for example, just one year of OER use saved the students $85,000 (Canadian dollars). This study complements previous research by examining the impact of the use of an open textbook over the course of a semester on student perception and by providing a comprehensive case study on the writing, implementation, and effectiveness of an open textbook. Furthermore, this study presents a statistical analysis of student use and perceptions that is sometimes missing from more anecdotal case studies.

Open educational resources (OER) are characterized as “teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use or re-purposing by others” (Atkins, Brown, & Hammond, 2007, p. 4). While textbooks are perhaps the most commonly cited open educational resource, they also include modules, notes, software, and other course materials (Atkins et al., 2007). Furthermore, although an awareness of open educational materials among instructors has grown considerably over the past few years, it still remains relatively low, with less than half of faculty reporting an awareness of OER materials (Seaman & Seaman, 2018). Peer-reviewed research on OER, while also expanding, remains limited (Hilton, 2019a).

That said, the Open Education Group is seeking to further OER research using its COUP framework, which refers to research into the cost, outcomes, usage, and perceptions of OER materials (Open Education Group, n.d.). Much of the evidence-based research on OER can be grouped into these four areas and this project takes a similar approach, primarily exploring the categories of student usage and perceptions using both quantitative, statistical analysis as well as a qualitative approach.

When comparing the perception of the quality of open textbooks versus traditional textbooks, the literature shows that the vast majority of students report open textbooks to be of the same or better quality than the commercial textbooks they have used. Bliss, Hilton III, Wiley and Thanos
reported that 94% of 490 students said they found open textbooks to be of equal or higher quality than traditional textbooks. Illowsky, Hilton III, Whiting and Ackerman (2016) reported on two surveys of students using an open textbook at a U.S. community college, one in 2013 of 231 students and one in 2015 of 94 students (the students surveyed in 2015 used a significantly-revised version of the textbook the students in 2013 had used). In the 2013 survey, 87% of students rated the quality of the open textbook to be the same or better when compared to traditional textbooks, and in the 2015 survey, 93% of student respondents did so. In a survey of over 300 students in British Columbia, 63% of respondents said the quality of the open textbook used in their course was “above average” or “excellent,” with another 33% rating the quality as “average” (Jhangiani & Jhangiani, 2017). Illowsky et al. (2016) similarly found 87% of students using an open statistics textbook rated it equal or better than a traditional text. Faculty similarly had positive views, with one study finding that 50% of faculty perceived the OER text as the same quality as traditional textbooks and 33% finding that it was better (Hilton et al., 2013). Much of the research on student perceptions focuses on either student feedback after having used open materials, or a more controlled study where students compare and rate a traditional textbook versus an open text (see Hilton, 2019a).

Another limitation of much of the existing research on OER is that traditional textbooks can be more well-suited to traditional learning goals and assessment, such as multiple-choice tests. Open textbooks, however, can be pedagogically freeing for both instructors and students, enabling instructors to reshape learning objectives and assessment metrics around entirely different goals. Research into open pedagogy have more explicitly explored these new educational landscapes, critically examining how open educational resources have enabled what could be termed “open pedagogy” (see Hegarty 2015; Wiley & Hilton, 2018) or open educational practices (OEP) (see Cronin 2017; Cronin & MacLaren 2018). Others like Weller et al. (2015) indicated that instructors are indeed more likely to innovate and experiment with their course instruction as a result of using OER. This study builds upon these foundations to examine how open educational materials could be used to enable a completely redesigned course and explores both the faculty and student perspective on how those changes impacted the teaching and learning experience.

History and Background of World Regional Geography

At most universities, World Regional Geography is an introductory-level general education course typically taken by both Geography majors and a wide array of non-majors. It is famously a challenging course to teach, as a 2019 session at the annual meeting of the American Association of Geographers can attest to: “Teach the World, No problem: Challenges to Teaching World Regional Geography in One Semester.” The breadth of the course, covering in theory the entirety of the world’s people in places in one semester, combined with the vastly different interest and experience levels of students in the course can present a significant obstacle for instructors. Compounding this issue, typical World Regional Geography textbooks emphasize breadth over depth, providing a somewhat repetitive presentation of various facets of each world region, to include its key physical geographic features, political geography, economics, culture, and so on. For instructors, the course can feel a bit like teaching the encyclopedia, conveying a list of facts about the world with little over-arching structure or connections between places.

Further, for students this approach of broad, place-based geographic knowledge closely aligns with how geography is taught at the primary and secondary levels in United States public schools. Map quizzes are common in K-12 settings and are traditionally a feature of World Regional Geography courses at the college level as well. For professional geographers, though, it is the connections
between places and a deeper spatial understanding that is of critical importance. What this amounts to, then, is presenting students with a novice-level approach to geography rather than how experts understand the discipline.

Within the Department of Geography at the University of Mary Washington, individual instructors have significant freedom to design and teach their courses and there is only one instructor, the author of this research paper, who teaches World Regional Geography every semester. Thus, it was the instructor’s decision, in consultation with the department chair, to shift to a team-based learning approach. Team-based learning provided a research-backed foundational structure (see Michaelsen, Knight, & Fink 2002) for shifting from a lecture-based approach to a problem-based approach where students could work in small groups to discuss and solve complex global issues. However, the traditional format of most World Regional Geography textbooks presented an impediment to “flipping” the course since they emphasized facts about specific regions rather than connections between places or larger global problems. Furthermore, students routinely commented that they were overwhelmed by the amount of information in the traditional World Regional text, and thus assigning additional news articles on top of the textbook reading, which students could then use in application activities, would be challenging.

Thus, the open textbook *World Regional Geography* was developed during the summer of 2016 as an alternative to more traditional geography textbooks on the market. Rather than present a broad array of information about specific places, this text emphasizes depth over breadth, focusing on a different key concept in geography for each of the world’s regions. The broad concepts of globalization and inequality are woven through each chapter, providing a more cohesive overall structure. *World Regional Geography* is also more concise than traditional texts, containing ten chapters rather than the more typical fourteen or fifteen, which more closely aligns with the team-based learning format and enables instructors the flexibility to assign additional readings. The text was developed to be openly and freely accessible in support of the American Association of Geographer’s initiative to broaden participation in the discipline of geography (American Association of Geographers, n.d.). If students couldn’t even access the textbook at the introductory undergraduate level, how would they go on to be active participants in the field? Providing an open and free textbook was one way to remove an early barrier to the discipline.

*World Regional Geography* was initially written and compiled using LaTeX, a typesetting programming language which is available for free at https://www.latex-project.org/, and posted online in both PDF and HTML format on the author’s personal domain. In the summer of 2019, the online version was shifted to Pressbooks (at https://worldgeo.pressbooks.com/) in order to make the text more accessible for students with disabilities. Pressbooks (https://pressbooks.com/) is built on Wordpress and shares its accessibility features, such as supporting screen readers and the use of alternative text. It is free to create a Pressbook, though there is a one-time cost to “publish” the book and make it available to others. At the time of this publication, the cost was $19.99 (USD) to publish an eBook or $99 (USD) to create both a eBook and generate a PDF. Again, this was a one-time cost and there are no additional charges to make edits or changes. Pressbooks also supports exporting the text in other formats compatible with print-on-demand services, so *World Regional Geography* is now offered as a color print edition on Amazon and Kindle through Amazon’s Kindle Direct Publishing program (https://kdp.amazon.com). *World Regional Geography* was published under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License (https://creativecommons.org/licenses/by-nc-sa/4.0/). There are a variety of licenses offered by the Creative Commons non-profit organization and this particular one was selected because it allows non-commercial re-use as long as the material is attributed and shared openly. Since its initial
publication, *World Regional Geography* has been downloaded over 18,000 times in over 30 countries. The Pressbooks version of the text has been visited by over 2,800 active users since its posting in summer 2019. It has also been adopted by a number of universities and community colleges. At the University of Mary Washington alone, adopting an open textbook represents a potential cost savings to students of $84,000 over the past four years.

**Methods**

This study was conducted beginning in the Fall 2018 semester and continuing to the Spring 2019 semester in two different sections of a World Regional Geography course at the University of Mary Washington. The University of Mary Washington is public liberal arts university located in Fredericksburg, Virginia. The university has approximately 4,800 students, most of whom are undergraduates (around 4,400) and most of whom are full-time (88%). Of the full-time undergraduate students in academic year 2018–2019, 68% applied for need-based financial aid and 32% received need-based scholarship or grant aid (University of Mary Washington, 2019).

This class used team-based learning, a form of “flipping” the classroom where students come to class having completed the assigned reading, take a quiz to check their knowledge, and then work in groups to discuss and solve complex problems. Each section of the course had the same basic content, assignments, exams, and delivery format and used the same textbook, an open World Regional Geography textbook written by the instructor and implemented in Fall 2016. Each course had approximately 70 students enrolled and met face-to-face three times each week. Students were asked to complete an anonymous pre-semester, mid-semester, and end-of-semester survey to determine their perceptions and use of the textbook and course format.

**Student Survey**

Beginning in Fall 2016, a relatively brief survey was developed by the instructor to gauge initial student interest in the course material, delivery format, and the textbook at the start of the course with additional surveys at the mid-semester point and at the end of the semester. These surveys were anonymous and were disseminated using Canvas, our institutional course management system. In early versions of the survey, the focus was primarily on team-based learning and on whether students preferred a printed or electronic textbook. As this research project evolved, additional questions were added in Fall 2018 specifically examining student use and perceptions of the open textbook in more detail utilizing the examples provided in the open education toolkit (http://openedgroup.org/toolkit) which builds on research by Bliss et al. (2013). For example, students were asked, “How would you rate the quality of free, open access textbooks compared to traditional course texts?” As in the study by Illowsky et al. (2016), students were not provided a definition for what would constitute a “quality” textbook and instead this question was left open to students to interpret. These additional questions regarding specific issues related to student perception and textbook use are the focus of this study. The core questions regarding team-based learning and interest in the course material were also used in the later version of the survey. A total of 136 students responded to the pre-semester surveys during the Fall 2018 and Spring 2019 semesters and 116 responded to the end-of-semester survey. These results were analyzed using SPSS Statistics 24, a statistical analysis software package. Since these surveys were anonymous, independent t-tests rather than paired t-tests were utilized, a limitation with this type of anonymous research (Warne, 2018).
Results

Student Access

As discussed, this textbook was provided freely and openly online. In addition, a black-and-white printed, spiral-bound version was offered at the University of Mary Washington campus bookstore for $15. Perhaps surprisingly, most students (N=79, 69%) responded that they purchased a printed textbook (see Table 1).

<table>
<thead>
<tr>
<th>Access Method</th>
<th>N</th>
<th>Percentage of all respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDF or HTML Viewed Online</td>
<td>40</td>
<td>35%</td>
</tr>
<tr>
<td>Downloaded PDF or HTML</td>
<td>35</td>
<td>30%</td>
</tr>
<tr>
<td>Purchased a printed textbook</td>
<td>79</td>
<td>69%</td>
</tr>
<tr>
<td><strong>Total Respondents</strong></td>
<td><strong>115</strong></td>
<td></td>
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</tbody>
</table>

This speaks to research from the National Association of College Stores which found that most college students prefer printed textbooks over digital versions (NACS, 2014). In addition, the high percentage of students downloading or viewing a web version connects to the importance of ensuring accessibility to all learners, which can sometimes be a problem with OER materials (see Navarrete & Luján-Mora, 2018).

Student Perception of Quality

Several questions were developed to determine student perceptions of the quality of the open textbook. Since the textbook was developed specifically with the intention of having an accessible and conversational writing style, students were asked to rate the statement, “The writing style of the textbook and its approach has enhanced my understanding of the course material,” using a five-point Likert scale ranging from Strongly Disagree to Strongly Agree. Students overwhelmingly agreed with this statement, with 92% reporting either “Agree” or “Strongly Agree” (see Table 2). Instructors considering authoring OER texts might feel they would be unable to match a traditional textbook’s stately writing style, but it would seem that a more accessible and conversational tone is valued by students and perhaps an instructor’s goal could simply be to allow their own voice to shine through.

<table>
<thead>
<tr>
<th>Rating</th>
<th>N</th>
<th>Percentage of all respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Disagree</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Neutral</td>
<td>8</td>
<td>7%</td>
</tr>
<tr>
<td>Agree</td>
<td>52</td>
<td>45%</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>55</td>
<td>47%</td>
</tr>
<tr>
<td><strong>Total Respondents</strong></td>
<td><strong>116</strong></td>
<td></td>
</tr>
</tbody>
</table>

A more general concern was overall student perception of open educational resources and how using these resources impacted their perception. At the beginning of the semester, students were asked, “How would you rate the quality of free, open access textbooks compared to traditional course texts?” and this question was repeated at the end of the semester. Students could select whether open textbooks were worse than, about the same as, or better than traditional textbooks.

At the beginning of the semester, about half of students rated open textbooks as about the same as traditional textbooks (see Table 3). By the end of the semester, over 80% of students rated open textbooks as better than traditional textbooks.

Table 3: How would you rate the quality of free, open access textbooks compared to traditional course texts?

<table>
<thead>
<tr>
<th>Rating</th>
<th>Pre-Semester</th>
<th>End-of-Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Open textbooks are WORSE than traditional textbooks</td>
<td>4</td>
<td>3%</td>
</tr>
<tr>
<td>Open textbooks are ABOUT THE SAME as traditional textbooks</td>
<td>68</td>
<td>50%</td>
</tr>
<tr>
<td>Open textbooks are BETTER than traditional textbooks</td>
<td>64</td>
<td>47%</td>
</tr>
<tr>
<td>Total</td>
<td>136</td>
<td>100%</td>
</tr>
</tbody>
</table>

A t-test for independent samples can be utilized to determine whether or not this difference in the perception of quality is statistically significant. Before conducting the t-test, the homogeneity of variance was tested to determine if the variance within the two groups was equal. The result of Levene’s test for equality of variances was significant ($p<.01$) and thus the variances are not equal. A t-test was calculated based on unequal variances and the result was highly significant ($t=5.594$, $p<.001$). The practical significance of the difference was then analyzed using Cohen’s $d$ yielding a value of .696, which is considered to be a medium effect size. In general, an effect size of .2 is considered small, .5 is considered medium, and .8 is considered large (Cohen, 1988). In other words, there is both a statistically significant and practically significant difference between student perception of open textbook quality before and after using an open textbook.

Students were given an opportunity to provide general comments at the end of both the pre- and post-semester surveys. This course utilized a team-based learning format which was unfamiliar to many students, so much of the comments expressed concern about the particular course structure. Of the pre-semester comments, few discussed perceptions of the textbook’s quality. Only one, for example, directly compared the text to another OER text used previously:

“The course textbook seems to be of much better quality than the open textbook I used for a math class last semester.”

Others based their perception of quality on the instructor’s in-class framing of the textbook and how it was developed:

“I love that we are going to learn out of a textbook that gives you exactly what you need to know and does not give you unneeded super detailed material to mess you up.”

“I really like how instead of using a traditional textbook with lots of information we won’t use, you created your own book to concentrate on the information you deem important.”

The in-class discussion of how the textbook differed from traditional World Regional Geography texts, taking a concise approach rather than presenting a broad survey of geographic information, was clearly reflected in how students approached the text. At the end of the semester, students were overwhelmingly positive about the textbook, with only one negative comment:

“I think the textbook was somewhat dry at times but there isn’t really anything that can be done about that.”

All of the other comments on the textbook were positive, for example:

“I really enjoyed the textbook. The language is easy to comprehend, not so much that it’s like ‘easy,’ but I understood what was being said even though I’ve never taken a geography class before this. It was also an extremely interesting textbook!”

“The textbook was absolutely wonderful compared to some other textbooks that I’ve had to use.”

“This was the best class textbook I have ever used. Information was well-written and easy to read. Unlike traditional textbooks that are unrelated to a specific class, this textbook did not include extraneous information. Therefore, I read each chapter to completion, rather than skimming or skipping reading altogether.”

“The textbook is well written and much more intriguing than a traditional book.”

Before authoring and adopting the open text, previous university-wide course evaluation comments rarely included mentions of the textbook, and when the textbook was discussed, it was generally negative. Overall, student perception of the quality of the textbook was positive, particularly after using the book throughout the semester and understanding more about its development and approach.

**Student Use and Frequency**

At the beginning of each semester, students were asked how often they use the required course texts in a typical course. Consistent with previous research (see Burchfield & Sappington, 2000; Clump, Bauer, & Bradley, 2004), students are not using required textbooks as much as instructors might think and this can have significant impacts on learning outcomes. Around two-thirds of respondents reported using the required texts frequently, two to three times each week or more (see Table 4). Ten percent of respondents reported only using the required texts two to three times each semester, and four respondents never used the required texts at all.

<table>
<thead>
<tr>
<th>Frequency of Use</th>
<th>N</th>
<th>Percentage of all respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>4</td>
<td>3%</td>
</tr>
<tr>
<td>2-3 Times a Semester</td>
<td>13</td>
<td>10%</td>
</tr>
<tr>
<td>2-3 Times a Month</td>
<td>28</td>
<td>21%</td>
</tr>
<tr>
<td>2-3 Times a Week</td>
<td>79</td>
<td>58%</td>
</tr>
<tr>
<td>Daily</td>
<td>12</td>
<td>9%</td>
</tr>
<tr>
<td><strong>Total Respondents</strong></td>
<td>136</td>
<td>100%</td>
</tr>
</tbody>
</table>
At the end of the semester, students were asked the same question but about the World Regional Geography textbook, and results were noticeably different. 85% of respondents reported using the World Regional text two to three times each week or more, with no respondents reporting that they never used it (see Table 5).

**Table 5: For this course, how often did you use the required text?**

<table>
<thead>
<tr>
<th>Frequency of Use</th>
<th>N</th>
<th>Percentage of all respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>2-3 Times a Semester</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>2-3 Times a Month</td>
<td>16</td>
<td>14%</td>
</tr>
<tr>
<td>2-3 Times a Week</td>
<td>91</td>
<td>78%</td>
</tr>
<tr>
<td>Daily</td>
<td>8</td>
<td>7%</td>
</tr>
<tr>
<td><strong>Total Respondents</strong></td>
<td>116</td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

These differences were then tested using an independent-samples t-test. The results of Levene’s test for homogeneity of variance was significant ($p<.01$), meaning that the variance between the groups was not equal, so a $t$-test was calculated based on the assumption of unequal variance. There was a significant difference between how often students used the required texts in a typical course compared to how often used the required text in World Regional Geography ($t=3.511$, $p<.01$). This difference further analyzed using Cohen’s $d$, yielding a value of .433, or a small to medium effect size.

Student comments pre-semester expressed a general appreciation for the free online textbook:

“... really appreciate that it is available online for free, as textbook costs can add up quick.”

“The times that I’ve used a textbook written by the professor of the course, the textbook seemed much more relevant and I enjoyed (and used) the textbook way more.”

Other students appreciated having access to a low-cost printed version:

“I’m very excited that the textbook is not expensive in the bookstore and there is an online version for free!”

Another expressed frustration that the textbook was not available at online retailers:

“It would be been more convenient if the textbook was available on Amazon.”

As a result of the high percentage of students who purchased a printed version of the textbook, and the generally low quality of the black-and-white spiral version, a full color print edition was developed over the summer of 2019 and is now for sale through Amazon’s Kindle Direct Publishing platform for less than $35 (US).
At the conclusion of the semester, students again expressed appreciation for the use of an open textbook:

“I think it is great for the textbook to be available for free online or for a low cost in print, as it makes it more accessible for students struggling financially and already having to pay for many other expenses at school.”

“It was a breath of fresh air that the class did not have to buy an expensive textbook.”

“It’s also the only college class I’ve taken in which I’ve read the textbook in its entirety!”

Research indicates that students do not read textbooks as often as instructors would like to believe (see Clump et al., 2004), and thus one way to tackle this issue is to ensure access for all students. Furthermore, several students specifically mentioned the desire to highlight and underline texts, which is not possible if a student is renting the book or needs to resell it in pristine condition. Overall, open textbooks allow for a valuable combination of instructor customization and universal access which, for this case study, clearly impacted the frequency with which students engaged with the course text.

**Discussion and Conclusion**

Implementing an open textbook in a course can be a daunting task. Rarely do open educational resources come with as robust an array of ancillary materials as a traditionally published textbook. However, OER provides an opportunity for instructors to dramatically redesign and rethink their courses. Even if they do not embark on authoring an entirely new open text, existing open material can be freely remixed, edited, and reconfigured to suit an instructor’s particular needs and objectives. For World Regional Geography at the University of Mary Washington, authoring and utilizing an open textbook allowed a shift from a more traditional, lecture-based course that emphasized a novice-level understanding of global geography to a much more in-depth and nuanced discussion of critical global issues. This course redesign would not have been possible with a traditional textbook. Certainly from an instructor perspective, this course has become much more enjoyable to teach and student feedback is consistently positive. Furthermore, this research has enabled additional revisions to the course textbook. As a result of the high number of students purchasing the printed text, and the printing limitations of other institutions, a printed, full-color edition was developed during the summer of 2019 and is now available for purchase on Amazon for under $35.

It is clear from both the quantitative and qualitative data collected as part of this study that actually using an open textbook significantly improves a student’s perception of OER. Students also used the open textbook significantly more frequently than they would in a typical course. Furthermore, if an instructor can frame why OER is being used, and explain to students how instructor-authored or remixed content fits within the course goals and objectives, students will likely respond positively as numerous comments in this study demonstrate. This study did not have a control group or pre-OER adoption data to compare to, since everything in the course changed as a result of OER adoption, and this represents a limitation to the study. However, what this research does demonstrate is that using OER can have a significant impact on both the teaching and learning experience and can help an instructor create and meet complex and dynamic learning objectives.
References


The Usability of Augmented Reality in Open and Distance Learning Systems: A Qualitative Delphi Study

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Abstract

The main purpose of this research is to determine the usability of augmented reality in open and distance learning environments in accordance with universal design principles, and to make predictions for the future by gathering expert opinions on this subject using the Delphi technique. The Delphi technique was applied to 14 expert participants for 3 rounds as the primary data collection tool with open ended questions based on the theoretical framework. Structured interview questions were used as a secondary data collection tool and were applied during an academic exchange in China. In the Delphi technique used as the primary data collection tool, 92 themes were evaluated by experts and accepted as usability principles by end of this research. Therefore, 92 themes under 21 titles were presented for the use of augmented reality within the framework of universal design principles in open and distance learning. This research may be the first unique study on the usability of augmented reality not just as the convergence of this technology with open and distance learning environments but also incorporating the learning and communication dimensions of this convergence, thereby contributing to the literature of the field. It is imperative to determine the usability of augmented reality in open and distance learning, along with the “how” of this use in application. In this regard, the findings of this study are significant in shedding light to the enrichment, diversification and increased interaction of open and distance learning environments in accordance with universal design principles, bringing a new perspective to how a different technology convergence may be conducted, providing further accessibility.

Keywords: Augmented reality, open and distance learning, universal design principles, Delphi

Introduction

Open and distance learning is something that should not be reduced to the combination of advanced technologies in learning activities (Eby, 2013), yet it is also a field that is directly or indirectly influenced by developments and advances in technology. From correspondence education –the first generation of distance learning– to the advanced computer and internet technologies encompassing smart and flexible learning environments today –the latest generation of distance learning– distance learning applications differentiate in various ways. As such, it is apparent that information and communication technologies had great influence in the development and shaping of this discipline throughout its generations. While the generations of open and distance learning applications differ, the tools and approaches of previous generations do not disappear but rather continue to exist through their enrichment by innovative tools (Gündoğan, 2012). In this interconnected process, developments in information and communication technologies are the greatest determinants on what innovative tools will be.

The school system lasting from the 15th and 16th centuries that require learner attendance, note-taking and examinations, has evolved into a more experimental and interactive state in this century with the emergence of new technologies, allowing more effective learning by learners (Núñez et al., 2008). Traditional activities with low interaction classroom environments and materials are making way for unique, interesting, stimulating, realistic and accessible learning environments that provide the opportunity for more interactive collaborative work. In this regard,
institutions providing open and distance learning products and services are aiming to provide more interesting and stimulating learning opportunities to learners (Pérez-López & Contero, 2013). It is of great importance that open and distance learning environments are equipped with new communication technologies and designed to provide learners with highly interactive environments and seamless information (Topa-Çiftçi, 2011). One of the most interesting of these new technologies is augmented reality.

Craig (2013) stated that considering augmented reality to be merely a technological innovation would be unfair in that augmented reality encompasses its own philosophy and artistic value within itself. Augmented reality presents new experiences by layering data on three dimensional spaces, increasing access to information and bringing new opportunities to learning environments (Johnson et al., 2016). Augmented reality is the enrichment of the real world with virtual additions rather than a fully artificial environment; technologies that enable the opportunity to present interactive experience (Höllerer & Feiner, 2004). The following section elaborates on the research problem, purpose, and significance regarding how augmented reality may be used in open and distance education based on a qualitative Delphi study.

Research Problem

Augmented reality has many applications in many fields, from medicine to engineering, military to architecture. One of the fields in which augmented reality is most utilized is learning environments. The proliferation of augmented reality in traditional learning environments may not necessarily be true for open and distance learning environments. In open and distance learning environments, which differ from traditional face to face learning activities in philosophy, design, theory and application (Eby, 2013), the usability of augmented reality must be questioned and exactly how this technology may be applied to and enrich open and distance learning environments must be determined. However, a review of the literature in the field revealed that the studies directly relating augmented reality with open and distance learning are limited and insufficient.

While the usability of augmented reality widely utilized in traditional face to face learning environments for learners at distance locations is debatable, the number of studies regarding the distance access of augmented reality is limited (Alsina-Jurnet & Guardia-Ortiz, 2015; Altinpulluk & Eby, 2016; Harr, 2015; Pejsa et al., 2016; Scavo, Wild, & Scott, 2015; Yoon et al., 2019). This study, which aims to determine the usability of augmented reality in open and distance learning, establishes a theoretical framework in which only the “technology” aspect of open and distance learning environments are explored, while the relationships with “learning” and “communication” are also taken into consideration. In this regard, in the preparation of a theoretical matrix, the horizontal axis is comprised of the “learning”, “technology”, and “communication” components of open and distance learning (Eby, 2013; Moore & Kearsley, 2011). The second approach of the theoretical framework established are universal design principles.

Universal design principles may be used in various disciplines as an approach to optimize the functional capacity of all individuals through increasing awareness. While the roots of these principles lie in architecture, they have been widely adapted for various studies in the field of education and generally serve to establish meaningful learning environments that may be presented for use to all individuals in an equally accessible manner by removing obstacles. The literature review conducted did not reveal any studies in which augmented reality, universal design principles, and open and distance learning were correlated. This study aims to present the usability of augmented reality in open and distance learning environments from the perspective of universal design principles.

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Purpose of the Study

The fundamental goal of this study is to determine the usability of augmented reality in open and distance learning environments in accordance with universal design principles. As such, the research aims to collect the opinions of various experts in the field using Delphi, and provide predictions for the future of this field. Based on the goal of the study, the following research goals in accordance with universal design principles have been established:

• To establish an approach that will aid in the design of interactive, efficient, enriched and innovative open and distance learning experiences using augmented reality,
• To establish a roadmap that combines augmented reality with the established structure of open and distance learning environments and,
• To draw the outline and analyze the processes involved in the establishment of the required infrastructure for the future use of augmented reality in open and distance learning environments.

Importance of the Study

This research may be the first unique study on the usability of augmented reality not just as the convergence of this technology with open and distance learning environments but also incorporating the learning and communication dimensions of this convergence, thereby contributing to the literature of the field. It is imperative to determine the usability of augmented reality in open and distance learning, along with the “how” of this use in application. In this regard, the findings of this study are significant in shedding light to the enrichment, diversification and increased interaction of open and distance learning environments in accordance with universal design principles, bringing a new perspective to how a different technology convergence may be conducted, providing further accessibility.

This is the first study in the field determining the sub components required for the effective, efficient and satisfactory use of augmented reality applications designed based on universal design principles by users in open and distance learning environments.

Literature Review: Augmented Reality Studies in Education and Open and Distance Learning

With the development of web based computer technologies, the design of learning environments has become more realistic, unique, entertaining, and intriguing. With great potential for establishing learning environments with these characteristics, augmented reality—with the interactions it provides—is tending to proliferate in traditional learning environments. It may be seen from content analysis and systematic literature review studies that the number of academic studies conducted on the use of augmented reality in education is increasing yearly (Akcayir & Akcayir, 2017; Altinpulluk, 2019; Arici et al., 2019). With many uses in different fields, augmented reality is also being used in various ways in traditional learning processes (Chang & Hwang, 2018; Ibañez et al., 2020; Redondo et al., 2020; Ruiz-Ariza et al., 2018; Sahin & Yilmaz, 2020).

While augmented reality may be a technology intensively used in traditional face-to-face classroom environments, it also has fields of use in open and distance learning environments. When studies using augmented reality in open and distance learning are analyzed, the majority of research was found to be covering augmented reality with concepts such as “e-learning” and “online learning” used augmented reality as a technology applied in traditional, face-to-face classrooms rather than remotely.
accessible augmented reality based systems. Just as it is used in face-to-face learning environments, augmented reality may be used in environments requiring distance collaboration or shared learning experiences (Billinghurst & Duenser, 2012). Alsina-Jurnet and Guardia Ortiz (2015) state that despite the proliferation of augmented reality applications in traditional learning environments, the usability is not yet at a mature level regarding e-learning. They continue, indicating that more research is needed to better understand when and under what circumstances augmented reality technologies may be integrated into e-learning environments, stating that the number of examples of augmented reality use in a fully online Open University are insufficient. Alsina-Jurnet and Guardia-Ortiz (2015) found that regarding the applicability of augmented reality in fully online-based Open Universities, location-based augmented reality applications are appropriate, while marker-based augmented reality applications may be less effective. Additionally, they suggest that the combined use of game-based learning and discovery-based learning applications in augmented reality for Open University learners may be effective.

There are few studies in the field in which augmented reality is used in the open and distance learning systems of Open Universities through remote access by learners and instructors. The most prominent study is an augmented reality based tele-monitoring application named “Ghost Hands”, conducted by The Open University Knowledge and Environment Institute in England. The remote instructor utilizes a 3D virtual hand model, along with hand motion and audio support to ensure learners successfully complete their own motions and learning processes (Scavo et al., 2015).

Regarding physical presence, Dede (2005) states that while being at that location is necessary, mirroring may provide a copy of remote physical locations in virtual three dimensions. This prediction by Dede came to fruition with the “Room2Room” project by Microsoft Research. This project used Kinect depth of field cameras and digital projectors to capture the image of a remote individual and provided a telepresence experience based on the immersive imaging ensuring the feeling of actually being there (Pejsa et al., 2016). The virtual person silhouettes of people are projected to scale into physical spaces. Each participant sees their virtual counterpart in the correct perspective, can communicate naturally and non-verbally (Metz, 2016). The Room2Room project has the potential to provide an effective learning environment for distance learners if combined with open and distance learning environments.

There are several studies regarding augmented reality based distance laboratory systems (Andujar et al., 2011; Frank & Kapila, 2017; Maiti et al., 2018; Onime & Abiona, 2016; Vargas et al., 2013). Vargas et al. (2013) see AR as an innovative path to enriching visualization in distance laboratories for engineering education. Andujar et al.’s (2011) augmented remote laboratory (ARL) system stands out when research on virtual and distance laboratories and augmented reality is parsed. The ARL system was developed as a new augmented distance laboratory using virtualization. In addition to providing richer sensory experiences to learners compared to traditional laboratories, positive results were obtained regarding learning outcomes. The reduction in sensory and physical interaction of distance laboratories was minimized in augmented reality using stereoscopic vision and virtual models connected to the laboratory. In this study, a comparison and evaluation of ARL with traditional distance laboratories was conducted, emphasizing that ARL was found to be superior as it (1) enriched the feeling of reality, (2) could reuse the same system for different experiments, and (3) provided the opportunity to more easily conduct experiments. Laboratory systems enriched with augmented reality also have the potential to provide experiment and practice in online learning processes, especially in the applied sciences.

Penn State University compared the use of mouse and keyboard with smart glasses and haptic feedback gloves from Oculus Rift through 54 engineering students. Their finding was that haptic
feedback support in virtual reality based online environments were more effective. Despite the vast possibilities for online learning, the premise has been that the three dimensionality and haptic feedback interactivities of these environments were limited and insufficient. With its remote access, Oculus Rift allows learners from different countries to connect, enabling collaborative work and joint projects (Harr, 2015).

The simulation-based campus application for geographically distant learners co-developed by Stanford University and MIT enabled students’ use of virtual reality in group projects, discussions, and networking with other individuals (Essany, 2015).

Beyond all these examples, augmented television, social networks with integrated augmented reality applications, augmented teleconference systems, sensor-based applications such as Kinect, and 3D holographic projectors also carry great potential for remotely accessible augmented reality applications. Despite all these studies, no studies on how augmented reality can achieve universal access in open and distance learning environments have been found in the literature. In this context, the theoretical framework of this study was created by using universal design principles.

**Universal Design Principles and Theoretical Framework**

A group of architects, designers and engineers from the North Carolina State University established a broad scope of design principles that cover environmental organization, production and communication processes, determining the seven principles of universal design. These principles are fundamental approaches to creating environments accessible to everyone regardless of characteristics such as age, skill, or disability. The following are the seven principles of universal design (Connell et al., 1997):

1. Equitable Use: The design is useful and marketable to people with diverse abilities.
2. Flexibility in Use: The design accommodates a wide range of individual preferences and abilities.
3. Simple and Intuitive Use: Use of the design is easy to understand, regardless of the user’s experience, knowledge, language skills, or current concentration level.
4. Perceptible Information: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user’s sensory abilities.
5. Tolerance for Error: The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. Low Physical Effort: The design can be used efficiently and comfortably and with a minimum of fatigue.
7. Size and Space for Approach and Use: Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user’s body size, posture, or mobility.

While universal design may be rooted in architecture, these principles have been reinterpreted in learning environments to other concepts such as Human Centered Design, Universal Design for Learning, Universal Design for Instruction and the broader approach of Universal Design for Education (Smith & Buchanan, 2012). These models are closely related and carry complementary characteristics (Higbee & Goff, 2008).

Moore and Kearsley (2011) indicate that open and distance learning comprises of the elements of learning, instruction, communication, and design when approached from a system perspective. In the same study, they indicate “technology” to be the most important determinant of the communication element within the conceptual model and framework of open and distance learning.
systems. Eby (2013), however, adapted these elements to their own study and determined the elements of open and distance learning to be administration, communication, learning, technology, and evaluation.

For this study, the open and distance learning elements determined by Moore and Kearsley (2011) and Eby (2013) were adapted in accordance with the nature of the study, resulting in “learning”, “communication” and “technology” being determined as the primary elements of open and distance learning. In the usability of advanced technology applications such as augmented reality, it is imperative that not only the technology aspect, but also the communication and learning aspects of open and distance learning environments are taken under consideration. In this regard, the horizontal axis of the theoretical matrix of this study comprises of the (1) Learning, (2) Communication, and (3) Technology elements of open and distance learning environments.

In accordance with the purpose of this study, a cross stitch between the seven principles of universal design and the learning, communication, and technology elements of open and distance learning was established in a theoretical framework (Altinpulluk & Eby, 2016), providing the basis for the research questions and interview questions. The combination of these two approaches establishes the theoretical foundation of this study, determining the research purpose and goals, and largely provides a basis for the development of the data gathering tool in this study.

The authors of the study prepared the theoretical matrix by taking into consideration both universal design principles, and the elements of open and distance learning. The 21 fields in the matrix were finalized based on universal design principles, all the characteristics of open and distance learning, and the suggestions and corrections of two experts in qualitative research.

**Method**

*Research Model*

This study was conducted as a qualitative case study, as it attempts to determine the “why”, “how”, and “in which way” regarding the use of augmented reality in open and distance learning systems in accordance with the theoretical basis of the 7 universal design principles and 3 elements of distance learning.

As such, the justification for the qualitative case study design of the research is as follows:

- The study deeply explores a problem or subject (Creswell, 2013)
- The details of an event are defined (Gall, Borg, & Gall, 1996)
- “How” and “why” are primary concerns, and the study focusses on a current phenomenon (Yin, 2003).

The data gathering for this study was conducted with both local and international experts, with open ended questions emerging from the theoretical matrix. As the primary data gathering tool, the Delphi technique was applied for 3 rounds. Additionally, data from structured interview forms from international participants and observations supported this research.

This study was conducted with a holistic single case (Type 1) design. In this research design:

- The inconclusiveness of the usability of augmented reality in open and distance learning environments,
- The unique characteristics of determining usability in accordance with universal design principles,
- The gap in the literature regarding similar studies resulting in unique value for this research justify the use of a holistic single case design.

The primary data gathering tool for this study was 3 rounds of questionnaires conducted using the Delphi technique.

- In the first round, a qualitative questionnaire with 21 open ended questions based on the theoretical matrix,
- In the second and third rounds a questionnaire with a six point grade of importance was applied to the participants.

As a secondary data gathering tool, structured interview questions developed from the first round of Delphi was applied to international experts.

**Research Scope and Participants**

There are two separate communities of participants within this study. Purposive sampling was used in the first stage of the study to determine participants. The participants in the primary data gathering Delphi technique have certain characteristics. The following were considered to be important measures in participants:

1. The knowledge and experience regarding the subject,
2. The willingness and capacity to participate,
3. Having sufficient time to participate,

In this regard, the selection of the most competent participants in the fields of “augmented reality”, “universal design”, and “open and distance learning” was a highly important factor in the study. As such, experts living in Turkey with a doctorate degree and at least 5 years of academic experience in primarily augmented reality, but also in open and distance learning and universal design were selected as participants for the study.

The Delphi technique as a primary data gathering tool was applied in three rounds for this study. As a secondary data gathering tool, an interview form with four pre-structured questions was applied to experts during an academic exchange program –Asian Association of Open Universities (AAOU) Inter-university Staff Exchange Fellowship– with the Shanghai Open University in China.

There are varying opinions regarding the number of participants for Delphi studies. Williams and Webb (1994) state that there is no set rule regarding the sample size of participants in the Delphi panels. For example, Reid (1988) states that the panel size may vary from 10 to 1685 participants. Okoli and Pawlowski (2004), however, state that the number of expert participants may vary between 10 and 18. In this study, an initial number of 16 experts were selected for participation in the Delphi rounds.

Prior to conducting the study, the data gathering tool was analyzed and corrected with two experts in qualitative research. These two research experts were also individuals who met the criteria for participation in the list of experts of the study. At this point, these two participants evaluated the 21 open ended questions obtained from the theoretical matrix until they reached a consensus regarding language, ambiguity or necessary corrections for each item. Additionally, a pilot study was conducted with three experts who work at the Open and Distance Education Faculty of Anadolu University who were not participants in the study. The feedback from these experts regarding the 21 open ended questions of the first round of the Delphi study ensured certain corrections which resulted in the final state of the data gathering tool.
The Delphi round 1 open ended questionnaire was distributed to 16 expert participants along with the call to participate and a link to the form via e-mail. 14 of the 16 participants selected completed the questionnaire at the end of round 1, while 2 participants did not respond. Table 1 portrays the participation of all three rounds of the study.

<table>
<thead>
<tr>
<th>Delphi rounds</th>
<th>No. of selected participants</th>
<th>Responding participants</th>
<th>Response ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>First round</td>
<td>16</td>
<td>14</td>
<td>87.5%</td>
</tr>
<tr>
<td>Second round</td>
<td>14</td>
<td>14</td>
<td>100%</td>
</tr>
<tr>
<td>Third round</td>
<td>14</td>
<td>14</td>
<td>100%</td>
</tr>
</tbody>
</table>

As can be seen from Table 1, following the participation of 14 of the 16 selected experts in the first round of the study, e-mails were not sent to the unresponsive participants for the following rounds. While the response ratio for the first round was 87.5%, the response rate for all subsequent rounds was 100%. Sumison (1998) suggests that the successful application of a Delphi technique requires a response rate above 70%. Additionally, the researcher must keep track of who responds and who does not (Hasson, Keeney, & McKenna, 2000). In this regard, regular e-mail reminders were sent for this study to keep the response process under control throughout the Delphi rounds.

Yıldırım and Şimşek (2013, p. 52) state that depending on the opportunity to gather data, new situations that emerge during the qualitative research process may re-shape various aspects of the study. In essence, the direction of the research may change when necessary, and new data gathering tools may be developed, and the new data gathering tools may be re-shaped based on newly emerging circumstances. In this study, one of the qualitative researchers was assigned to an unforeseen and unplanned assignment through an academic exchange program to the Shanghai Open University in China. During the second round of the Delphi data analysis, the researcher conducted the data gathering during an 11-day period. Participants comprised of experts working on augmented reality at the Digital Laboratory of the Open University, and academics from around the world (USA, United Kingdom, China, Bangladesh, Spain, Netherlands) participating in the academic exchange program. Participation in this study was based on voluntary participation.

Thus, the limitation of experts and academics for the Delphi panelists comprising only of participants from Turkey was overcome, and with the inclusion of international expert opinions, new perspectives and opinions enriched the study.

Data Gathering Tools

The Delphi technique gets its name from the “Oracle of Delphi”, a figure from Greek mythology with supernatural gifts who prophesied about the future (Thangaratinam & Redman, 2005). Since this study also requires certain predictions and projections regarding determining the future of use tendencies of “augmented reality” – a relatively new technology – in open and distance learning environments, the Delphi technique was applied. Delphi is a frequently utilized research technique for studies in technological inclinations and predictions, especially in Horizon Reports.

In this study which presents technological predictions, the Delphi technique was utilized because:

- There is ambiguity or lack of information on the subject in the literature (Hung, Altschuld & Lee, 2008; Skulmoski et al., 2007)
The Usability of Augmented Reality in Open and Distance Learning Systems

- It requires studying and revealing currently absent situations (Skulmoski et al., 2007)
- There is a lack of certainty on the subject and leaves it open to interpretation (Okoli & Pawlowski, 2004)
- It approaches issues with “what could be” or “what should be” rather than simply “what” (Hsu & Sandford, 2007).

Traditionally, the first round of the Delphi technique is conducted with open ended questions. Open ended questions are important in presenting deep and specialized content on the subject being studied (Custer, Scarcella, & Stewart, 1999). The first round of questions prepared for this study were prepared based on the theoretical matrix of the study in accordance with the purpose and research questions of this study.

A theoretical matrix assists the researcher in defining the dimensions of their research problem, determining the relationships between these dimensions, determining the scope of the data gathering tools, and selecting the themes to utilize during the analysis of data (Yıldırım & Şimşek, 2013). Answers to the 21 open ended questions about the usability of augmented reality in open and distance learning environments, along with predictions are sought within this study. The 21 items in the theoretical matrix were finalized following universal design principles, the elements of open and distance learning, and the suggestions and corrections of two experts in qualitative research.

The 21 questions of the 1st round was presented to participants in a questionnaire form prepared in Google Forms. Following the 1st round, a Likert scale is frequently used to grade panelist opinions based on importance (Thangaratinam & Redman, 2005). In this study, the results of the data analysis from the responses to the first round were utilized in a six point Likert scale that graded between 0 (Unimportant) to 5 (Very Important) in the 2nd and 3rd rounds.

In summary,

The primary data gathering tools were questionnaires conducted in 3 rounds using the Delphi technique and prepared in an online environment.

- In the 1st round, a qualitative questionnaire comprising of 21 open ended questions prepared from the theoretical matrix was applied.
- In the 2nd round, the data gathered was analyzed and the findings were used to apply a six point Likert scale developed to determine the degree of importance of this data.
- In the 3rd round, data from the 2nd round was analyzed and based on the findings, another six point Likert scale was applied to grade the findings based on their importance.

As a secondary data gathering tool, a structured interview form was applied on international expert participants other than the participants of the Delphi rounds.

Due on the preparation of the first round of Delphi questions being prepared in accordance with universal design principles, the researcher developed a different data gathering tool based on the other axis of the theoretical matrix –elements of open and distance learning– based on “Learning”, “Communication”, “Technology”, and “Universal Access”, to gather differing viewpoints. How may augmented reality be used in open and distance learning systems regarding;

1. Learning?
2. Communication?
3. Technology?
4. **Universal Access?**

Additionally, to take advantage of the opinions of participants beyond these elements, a section in the form labeled “other opinions (if applicable)” was presented.

**Data Analysis**

There are various differing viewpoints regarding data analysis in the Delphi technique. Data analysis may be conducted with both qualitative and quantitative methods. In classical Delphi studies, qualitative analyses are used especially in the analysis of the open-ended questions at the beginning of the study (Hsu & Sandford, 2007). The first round of questions in Delphi studies are usually open ended, and analyzed qualitatively to be separated into themes. Based on these analyses, the second round questionnaire questions may be prepared in a more specialized manner. During this stage, grading importance is usually done using quantitative analysis (Thangaratinam & Redman, 2005).

In the first round of this Delphi study, the open ended questions derived from the theoretical matrix of universal design principles and the elements of open and distance learning aimed to gather deeper information regarding the usability of augmented reality in open and distance learning environments. Responses to the open ended questions in the first round are usually evaluated using content analysis (Neuendorf, 2002; Seuring & Müller, 2008). As such, the data from the online form and the dictations of voice recordings were analyzed using content analysis, revealing 103 themes for 21 main subjects in the first round, with two qualitative researchers conducting the coding of the data. During the analysis process of the first round, the reliability between the coding of the two qualitative research experts was determined to be 93%.

During the second round of the Delphi technique, the data gathered in the first round was graded based on their degree of importance. During this grading which was conducted based on the importance degree determined by the panelists, Likert scales are frequently utilized (Thangaratinam & Redman, 2005). To determine the degree of importance regarding the usability themes, a six point Likert scale running between 0 (Unimportant) to 5 (Very Important) was used. Themes with degrees of importance higher than the arithmetic average of 4 were accepted (\( \bar{x} \geq 4 \)) while themes between 3 and 4 were determined for evaluation in the 3rd round, and themes with an arithmetic average below 3 (\( \bar{x} < 3 \)) were eliminated.

The data analysis conducted following the 2nd round with these measures did not eliminate any themes. The number of themes with arithmetic averages between 3 and 4 to be re-evaluated for degree of importance in the 3rd round was 27, while the number of themes with arithmetic averages between 4 and 5 reaching a consensus among experts was 76. The results of the second round are portrayed in Table 2.

<table>
<thead>
<tr>
<th>Table 2: 2nd Delphi Round Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2nd round results</strong></td>
</tr>
<tr>
<td>Eliminated themes</td>
</tr>
<tr>
<td>Themes to be re-evaluated in round 3</td>
</tr>
<tr>
<td>Accepted themes</td>
</tr>
</tbody>
</table>

Based on the responses provided in the 2nd round, 27 of the 103 usability themes were uploaded to the online form along with their average values in the 3rd round to once again determine their degree of importance. The same six point Likert scale ranging from degrees between 0 (Unimportant) to 5 (Very Important) was used.

For the 3rd round, themes with an arithmetic average of 4 and higher ($\bar{x} \geq 4$) were accepted while themes with arithmetic averages below 4 ($\bar{x} < 4$) were eliminated.

In the 3rd round, other than one theme, the arithmetic average of all 26 other themes was found to be higher than in the 2nd round. With these measures in place, the data analysis conducted following the 3rd round eliminated 11 themes and accepted 16 themes. Thus, 11 of the total 103 usability themes were eliminated throughout the 3rd round while a consensus was reached regarding 92 themes. It was also agreed that regarding the themes eliminated following round 3, a consensus could not be reached in round 4, so the Delphi rounds were concluded. The final status obtained following round 3 is portrayed in Table 3.

<table>
<thead>
<tr>
<th>Table 3: Total Eliminated and Accepted Themes in Round 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3rd round results</strong></td>
</tr>
<tr>
<td>Eliminated themes</td>
</tr>
<tr>
<td>Accepted themes</td>
</tr>
</tbody>
</table>

The data analysis for the interviews comprised of four structured questions conducted as a secondary data gathering tool was executed similarly to the data analysis of the first round of the Delphi technique, with qualitative content analysis.

**Findings**

This study, which aims to determine the usability of augmented reality in open and distance learning environments in accordance with universal design principles, took into account seven universal design principles and revealed 92 usability themes under 21 headings. The research questions, Delphi round 1 interview questions, findings and results of the research were all prepared based on the fundamental goal of the study.

Of the 103 themes emerging at the end of the first round, 27 were transferred from the 2nd round to the 3rd round for re-evaluation. Within this round, 11 themes were eliminated, 16 were accepted and a total of 92 themes were evaluated as principles of usability as a result of this study. During the data analysis, data from both the opinions obtained from the Delphi panels from experts in Turkey, and data obtained from structured interview forms obtained from 6 different countries were utilized. The 92 themes that emerged are portrayed in Table 4. This study, which aims to determine the usability of augmented reality in open and distance learning environments in accordance with universal design principles, took into account seven universal design principles and revealed 92 usability themes under 21 headings. The research questions, Delphi round 1 interview questions, findings and results of the research were all prepared based on the fundamental goal of the study.
Table 4: General Findings Regarding the Usability of Augmented Reality in Open and Distance Learning Based on Universal Design Principles

<table>
<thead>
<tr>
<th>Universal design principles</th>
<th>Element of open and distance learning</th>
<th>Headings</th>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equitable use</td>
<td>Learning</td>
<td>Equal opportunities for everyone in the learning process regardless of individual differences</td>
<td>• Financial ease through open access, open source code software solution</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Shaping design while collaborating with distance learners as the end users during all processes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Developing suitable augmented reality applications by retaining learner characteristics in a database and recognizing learner characteristics through analysis using advanced statistical techniques</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Providing equal conditions in the same environment for education requiring augmented reality based application</td>
</tr>
<tr>
<td></td>
<td>Communication</td>
<td>“Accessible” environments for all learners independent of time and space</td>
<td>• Ensuring equitable learning opportunities to disadvantaged individuals and groups</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Agreements with institutions for expensive or difficult to access augmented reality hardware and software</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>Interaction in the design that draws the attention of learners</td>
<td>• Augmented reality integration with game based learning environments within the scope of edutainment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Aggregation of augmented reality with a gamification approach</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Adding augmented reality elements to printed materials and books</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Resolving the stagnation of text based learning with augmented reality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Combining barcodes, QR codes and special symbols with course materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Adding augmented reality elements to electronic books</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Combining the use of digital storytelling with augmented reality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Presenting classes in interesting forms such as augmented reality based flash cards, puzzles and brain teasers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Distance learners observing augmented reality based class materials with web cams.</td>
</tr>
</tbody>
</table>

(Continued)
### Table 4: (Continued) General Findings Regarding the Usability of Augmented Reality in Open and Distance Learning Based on Universal Design Principles

<table>
<thead>
<tr>
<th>Universal design principles</th>
<th>Element of open and distance learning</th>
<th>Headings</th>
<th>Themes</th>
</tr>
</thead>
</table>
| Flexibility in use          | Learning                              | Preparing courses in accordance with the individual characteristics, skills, and speed of the learn | • Preparing classes directed at individual learning speeds through modular instructional design  
• Minimizing individual differences through applications adaptable to different living spaces |
|                             | Communication                         | Providing the opportunity for collaborative work                         | • Use of augmented reality based video conference systems  
• Combining open and distance learning systems with current worldwide augmented reality applications in accordance with technological equipment  
• Resolving interpersonal communication problems in teamwork with augmented reality  
• Use of wearable technology able to communicate at distant locations in project groups  
• Augmented reality applications integrated with web technologies enhancing collaborative learning  
• Enriching sharing environments by supporting social networks with augmented reality applications  
• Establishing glocal (global+local) collaborations and partnerships between global technology firms, project offices, NPOs and laboratories conducting studies on augmented reality  
• Conducting content and application production and evaluation in project groups using collaborative approaches and augmented reality  
• Use between distance learner and instructors for courses with potential communication problems |
|                             | Technology                            | Preparing flexible learning environments that can immediately adapt to different knowledge and skills, providing users with a broad range of choices | • Supporting augmented reality applications with artificial intelligence  
• Designing environments that can adapt based on personal information by combining augmented reality with learning management systems (LMS)  
• Developing smart augmented reality applications delicately adaptable based on user interaction |

(Continued)
Table 4: (Continued) General Findings Regarding the Usability of Augmented Reality in Open and Distance Learning Based on Universal Design Principles

<table>
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<tr>
<th>Universal design principles</th>
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<th>Headings</th>
<th>Themes</th>
</tr>
</thead>
</table>
| Simple and intuitive use    | Learning                              | Enriching the creative thinking skills and imagination of the learners | • Enriching imagination by augmented reality making abstract concepts tangible  
• Directed towards learners with low three dimensional thinking and spatial skills  
• Using coloring and three dimensional imaging techniques |
|                             | Communication                         | Ease of comprehension and use | • Augmented reality based explanatory notes assuming a guiding role  
• Easier use of open and distance learning environments through augmented reality based instructions and notes  
• Realizing maximum mental activity with the simplest interface design  
• Developing simple and functional augmented reality add-ons  
• Fluent use of applications through augmented reality literacy  
• Orientation through applications such as awareness raising, advertising, and technology introduction regarding augmented reality to open and distance learners  
• Using augmented reality based multimedia functions and notifications integrated with daily life |
| Technology                  | Motivational for the sustainability of learning | • Establishing augmented reality environments with current, up to date content  
• Purposeful rather than trendy applications ensuring sustainability  
• Augmented reality presenting interesting, interactive and impressive environments for the sustainability of open and distance learning environments  
• Augmented reality providing motivation and incentive especially for low participation or unsuccessful learners due to it being a new technology |
| Perceptible information     | Learning                              | Activating sensory stimuli containing qualities for all senses | • Contrary to the notion that augmented reality only involves the sense of sight, designing interfaces directed towards the other senses  
• Activating all senses with personalizable augmented reality environments  
• Working with experts in fields such as medicine, psychology and physiology to better understand sensory stimuli |

(Continued)
### Table 4: (Continued) General Findings Regarding the Usability of Augmented Reality in Open and Distance Learning Based on Universal Design Principles

<table>
<thead>
<tr>
<th>Universal Design Principles</th>
<th>Themes</th>
<th>Element of open and distance learning</th>
<th>Perceptible Information</th>
<th>Technology</th>
<th>Tolerance for Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceptible information</td>
<td>Communication</td>
<td>The process of information transfer independent of medium or environment</td>
<td>Utilizing techniques or interfaces that provide compatibility, encompassing users with sensory limitations/disabilities</td>
<td>Isolating the learning environment from threats</td>
<td>Clearing stating behaviors and design elements that may cause errors and accidents</td>
</tr>
<tr>
<td></td>
<td>Learning</td>
<td>Augmented reality based learning environments which cannot be experienced in the physical world</td>
<td>Providing feedback for errors through audio analysis software</td>
<td>Developing early warning systems against accidents and errors possible in learning environments</td>
<td>Preventing danger before it can happen by conducting designs with virtual markers and warning</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>The use of special augmented reality components for preparing embassies or signage/language, similar as precautions against sensory limitations</td>
<td>Developing augmented realities adaptable to the type and severity of sensory obstacles</td>
<td>Minimizing institutional errors through circular/cyclical design</td>
<td>Tolerance for error</td>
</tr>
<tr>
<td></td>
<td>Tolerance</td>
<td>Setting natural events or experiences which cannot be experienced in the physical world</td>
<td>Accessing inaccessible geographic spaces and locations</td>
<td>Determining definitions of danger and degrees of importance, and developing augmented reality applications appropriately</td>
<td>Tolerance for error</td>
</tr>
<tr>
<td></td>
<td>Headings</td>
<td>Presenting natural events or experiences which cannot be experienced in the physical world</td>
<td>Accessing inaccessible geographic spaces and locations</td>
<td>Determining definitions of danger and degrees of importance, and developing augmented reality applications appropriately</td>
<td>Tolerance for error</td>
</tr>
<tr>
<td></td>
<td>General findings of the usability of augmented reality in open and distance learning based on universal design principles</td>
<td>The necessity for augmented reality applications to work independent of device</td>
<td>Making augmented reality based learning environments compatible based on the disability, personal preference, or sensory requirement</td>
<td>Designing systems that can automatically sense based on the disability, personal preference, or sensory requirement</td>
<td>Tolerance for error</td>
</tr>
<tr>
<td></td>
<td>Perceptible information</td>
<td>• Learners at distant locations connecting to each other</td>
<td>• Equipping university campuses appropriately for augmented reality</td>
<td>• Making augmented reality based learning environments compatible based on the disability, personal preference, or sensory requirement</td>
<td>Tolerance for error</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>• The ability for augmented reality applications to work both online and offline</td>
<td>• Developing augmented realities adaptable to the type and severity of sensory obstacles</td>
<td>• Designing systems that can automatically sense based on the disability, personal preference, or sensory requirement</td>
<td>Tolerance for error</td>
</tr>
<tr>
<td></td>
<td>Tolerance</td>
<td>• Creating designs that are minimally influenced by external factors</td>
<td>• Developing augmented realities adaptable to the type and severity of sensory obstacles</td>
<td>• Designing systems that can automatically sense based on the disability, personal preference, or sensory requirement</td>
<td>Tolerance for error</td>
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<td></td>
<td>Headings</td>
<td>• The necessity for augmented reality applications to work independent of device</td>
<td>• Making augmented reality based learning environments compatible based on the disability, personal preference, or sensory requirement</td>
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<tr>
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<th>Element of open and distance learning</th>
<th>Headings</th>
<th>Themes</th>
</tr>
</thead>
</table>
| Tolerance for error         | Technology                            | Correction and feedback for simple user errors | • Providing multiple options through augmented reality depending on the source and characteristic of the error  
• Recording erroneous processes in a database during augmented reality activities and providing immediate feedback |
|                             | Learning                              | Increasing attention levels by providing ease of use | • Determining subjects proving difficult in learning and presenting them using augmented reality  
• Augmented reality being interesting as a new and different experience  
• Determining subjects with low page viewing durations and presenting them using augmented reality |
| Low physical effort         | Communication                         | Effectiveness and efficiency | • Producing ecological designs that use low energy and resources  
• The complete convergence/integration of augmented reality applications with learning environments  
• Designing a strong backend system with a simple interface  
• The employment and training of professional technical staff and designers in the field of augmented reality |
|                             | Technology                            | Easily making hard to experience abstract and difficult concepts tangible | • Supporting simulation applications with augmented reality  
• Using augmented reality based animations and three dimensional videos  
• Using smart glasses in distance access  
• Accessing distant locations virtually using holograms  
• Creating unique learning environments through wearable technologies  
• Presenting distance learning course materials with contact lenses |

(Continued)
Table 4: (Continued) General Findings Regarding the Usability of Augmented Reality in Open and Distance Learning Based on Universal Design Principles

<table>
<thead>
<tr>
<th>Universal design principles</th>
<th>Element of open and distance learning</th>
<th>Headings</th>
<th>Themes</th>
</tr>
</thead>
</table>
| Size and space for approach and use | Learning                              | Ensuring appropriate conditions for the creation of unique learning environments regardless of the individual characteristics (body, communication needs, physical skills, mobility) of the learner | • Presenting personal authorization to digital content using augmented reality supported digital recognition and identification technologies  
• Structuring augmented reality based designs based on an individual deprived of many senses |
| Learning                     | Communication                          | Increasing the level of commitment                                       | • Preparing web based three dimensional virtual environments that use various imaging technologies  
• Integrating augmented reality with web conference based virtual course software |
| Technology                   | Providing the opportunity for the individual to create their own unique learning environment | • Free and voluntary access  
• Using semantic technologies from web 3.0 and beyond  
• Personalizable augmented reality applications provide the opportunity to present unique environments  
• The individual may create their own unique learning environment based on augmented reality with a constructivist approach  
• The learner may create their own augmented reality based learning environment by scripting and producing the content themselves |
Discussion and Conclusion

Within the scope of this study, which aims to determining the usage possibilities of augmented reality in open and distance learning environments based on universal design principles, a total of 92 usability themes under 21 headings were presented under seven universal design principles. This study was not limited to a certain group of participants for Delphi rounds, but data was also gathered from participants in other countries and observations were made regarding studies on augmented reality. Throughout the Delphi rounds, data triangulation was conducted using online forms with open ended questionnaires, online forms with quantitative based Likert scales, and structured qualitative interview forms presented to foreign experts as a secondary data gathering tool. Space triangulation is used to resolve the limitations of conducting a study within a single culture and society (Cohen, Manion, & Morrison, 2013). In this regard, one of the researchers observed the perceptions regarding augmented reality within a different culture in China, conducted informal interviews with programmers developing augmented reality applications, and also gathered data with structured interview questions presented to a team and participating academics developing and studying augmented reality at a “Digital Laboratory”.

The most fundamental characteristic of the flexibility in use universal design principle refers to offering broad options to users by adapting to different knowledge and skills. In this regard, one of the findings of this heading was the significance of artificial intelligence (AI), smart, and personalizable systems for the development of adaptive systems. The combination of AI and augmented reality applications is gaining prominence not only in open and distance learning, but in all educational environments. The literature in the field also provides examples of smart applications offering augmented reality based education and exercise services (Westerfield et al., 2015). This research finding is also supported by Tim Cook, CEO of Apple. Apple predicts that the most significant core technologies in the near future will arrive through the combination of AI and augmented reality (Fingas, 2016). In short, new augmented reality systems in which AI is used may provide an impressive use opportunity in open and distance learning systems.

Regarding enriching imagination through augmented reality, the foremost finding was the power augmented reality has to actualize abstract concepts. Learners in open and distance learning systems consist of masses from various geographies, various age groups, and various personality traits. The level of three-dimensional thinking skills and spatial intelligence also vary by individual. There is a strong relationship between spatial skills and augmented reality. The difference of spatial augmented reality compared to other definitions lies in how it prevents the hardware from converging with the user through the use of mirrored rays, transparent screens, holograms or video projectors rather than hardware implemented on the head or body, glasses, or mobile devices (Lee et al., 2019). While this approach has it’s strengths and limitations, the development of three dimensional thinking and spatial intelligence by spatial augmented reality is supported by many studies (Benko et al., 2015; Laviole et al., 2018; Rossi, 2018), indicating that augmented reality may also be used by distance learners to enrich creative thinking and imagination in this regard.

There is a misconception that augmented reality is only related to our visual senses. Augmented reality, starting with our sense of hearing, is also capable of encompassing other methods of sensory interaction such as touch (tangible augmented reality), taste, and smell (Azuma et al., 2001). While augmented reality studies covering the enrichment of auditory (Chatzidimitris et al., 2016; Härmä vd., 2004; Heller et al., 2016; Jot & Lee, 2016; Tashev, 2019) and tactile (Bach et al., 2017; Bau & Poupyrev, 2012; Choi, 2019) reality are prevalent, studies on taste and smell also exist (The New Economy, 2014). As such, another finding of this study is that contrary to the notion that augmented reality is only related to sight, interfaces may be designed for other senses as well. While some
simulators encompassing all five sensory apparatus have been developed, especially in the context of virtual reality, their adaptation to augmented reality and development in both virtual and actual reality rather than merely virtual reality may be possible.

Another conclusion of this study was the development of augmented reality applications of individuals with disabilities in open and distance learning systems, wherein the augmented reality would adapt depending on the type and severity of the disability. Rather than offer vision based augmented reality applications to a learner with visual impairment, providing aural, oral and olfactory stimulus would be more effective. As such, adaptive designs based on disability type must be conducted. Many studies on augmented reality regarding people with disabilities support this conclusion. VA-ST, an English technology company, designed a set of prototype augmented reality glasses named Smart Specs aiming to improve the vision of people with partial visual impairment, glaucoma, night blindness, and other impairments such as macular degeneration (Metz, 2015). The further development of such applications towards disabilities may be foreseeable. An important aspect of this would be the feedback obtained from learners with disabilities. As the end user, it is important that people with disabilities provide opinions and determine the strengths and weaknesses of augmented reality applications developed for them. This feedback would ensure more robust applications and the addressing of shortcomings. In summary, it is important to work with disabled individuals throughout the whole development process. Another conclusion that was drawn was the design of systems capable of automatically sensing based on the disability, personal preference, or sensory requirements. One example would be the sensing of a visually impaired individual, and their subsequent direction toward augmented reality applications that present stimuli other than visual stimulus. Currently, the use of sensors may be an approach for the determination of the sensory impairment. The data gathered from sensors regarding the sensory impairment type may allow the system to automatically adapt appropriately.

As a branch of wearable technologies, smart glasses are frequently used in the field of augmented reality (Rauschnabel et al., 2015; Rauschnabel & Ro, 2016; Ro et al., 2018; Sun & Lan, 2019) and their influence on learning processes have been previously studied. Many large technology companies have produced and released their own augmented reality and virtual reality glasses, enabling a competitive market. With the interactions they provide, these glasses provide virtual and digital supplements to the physical world of the user and may thereby create unique learning environments. The remote access feature of smart glasses, enabling learners to connect with other learners, instructors, and learning resources in their learning environments suggests that this technology may be used more effectively in the future.

There is a direct correlation between wearable computers and augmented reality technologies (Barfield, 2015; Tussyadiah et al., 2018). In this section of the study, the foundation established was the creation of unique environments regardless of the physical characteristics of the learner, therefore the focus of participants tended to be wearable technologies as the most commonly known subset of augmented reality applications. Wearable technologies allow the creation of unique open and distance learning environments. The wearable computers used by learners may be utilized for various functions such as connecting with each other, remote access, or imaging augmented reality elements. Just as with smart glasses, contact lenses also fall into the same wearable technology category and may be enriched with augmented reality. Studies in this field are continuing (Parviz, 2009; Perry, 2020; Takahashi, 2020) and it is stated that more advanced augmented reality based contact lenses will be designed in the future. While optical health and ethical considerations are continuing debates on this subject, the studies conducted indicate the leniency towards the development of augmented reality based contact lenses.
Recommendations

Despite being extensively used in traditional face to face learning environments, various differing approaches emerged regarding augmented reality and the indeterminate ways it may be used in distant locations. A total of 92 themes presented under 21 headings determined based on 3 dimensions of distance learning and 7 universal design principles are portrayed as a table in the findings section. Based on the findings and conclusions of this study, the following suggestions are presented based on recommendations for “institutions” and “researchers”:

Recommendations for Institutions

• The usability principles that emerged from this study may be applicable for institutions such as open education faculties, distance education centers, and open universities that provide open and distance learning services.
• Face to face educational institutions at primary and secondary levels along with universities may conduct further studies regarding the most effective and efficient use of augmented reality in addition to open and distance learning institutions.

Recommendations for Researchers

• The usability of augmented reality is presented under a broad scope within this study. In this regard, the usability of more specialized applications and environments such as mobile augmented reality, holograms, or wearable technologies may be studied under are more focused scope.
• Different theoretical approaches to the universal design principles used in this study may be utilized, studying different aspects of the usability of augmented reality in open and distance learning.
• Studies with a broader scope may be conducted by including elements of open and distance learning beyond “learning”, communication”, and “technology”.
• There is a lack of research regarding the use of virtual reality in open and distance learning environments, despite being related to but significantly different than augmented reality. Various studies that focus solely on virtual reality may be conducted.
• Other studies may utilize the Delphi technique with quantitative analyses, rather than the qualitative based Delphi technique utilized in this study.
• The effectiveness of remotely accessible augmented reality applications may be determined using experimental studies.
• In depth research over longer durations may be conducted using a design-based research method.
• Research may be conducted regarding the influence of augmented reality applications in open and distance learning on the academic achievement, interest and motivation levels of learners.
• The 92 usability themes that emerged from this study may be considered as separate subjects of inquiry in various regards by different researchers.
• Differing from studies that prioritize the sense of sight in augmented reality, emphasis in future research may be placed on the augmentation of reality for the other senses.
• Augmented reality applications may be developed specifically for open and distance learners with disabilities and their effectiveness may be determined.
• The current status of augmented reality applications may be followed in accordance with developments and the pace of advances in technology, allowing for innovative new research.
Acknowledgements

This study was supported by project number 115K627 which was accepted by the TÜBİTAK 3001 Initial Research and Development Support Program.

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Authors’ Note

The theoretical framework of this study was presented and published at the EdMedia conference in Vancouver in 2016, and the execution of the study was conducted in accordance with the feedback provided (Altinpulluk & Eby, 2016).

This study is derived from the doctorate thesis titled “Usability of Augmented Reality within the Framework of Universal Design Principles in Open and Distance Learning” conducted at the Anadolu University Institute of Social Sciences, Department of Distance Education.

References


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