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Research Article

The Role of Self-directed Learning, Metacognition, and 21st Century Skills Predicting the Readiness for Online Learning

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Abstract

This study investigated role of the self-directed learning skills, metacognitive awareness, and 21st century skills and competences in predicting readiness for online learning during the COVID-19 pandemic. 21st Century Skills and Competences Scale, Self-Directed Learning Skills Scale, Metacognitive Awareness Inventory, and Readiness for Online Learning Scale were used to collect data from 834 prospective teachers. Structural equation modelling (SEM) results indicated that self-directed learning skills, metacognitive awareness, and 21st century skills and competences positively predict prospective teachers' readiness for online learning. These findings suggested that enhancing prospective teachers' self-directed learning, metacognitive awareness, and 21st century skills and competences may promote their readiness for online learning.

Keywords: self-directed learning, metacognitive awareness, 21st century skills, readiness for online learning, teacher education

INTRODUCTION

COVID-19 pandemic has affected all aspects of human life. One of the aspects where the effect of the pandemic is experienced intensely is education (Akat & Karatas, 2020). From preschool to higher education, all students were negatively affected by the COVID-19 pandemic (Crawford et al., 2020). In particular, the negative effects of the pandemic have been deeply experienced in faculties of education which train prospective teachers (Donitsa-Schmidt & Ramot, 2020). Faculties of education in certain countries could not complete their technological transformation process that is required to provide students with online learning opportunities (Adnan & Anwar, 2020). Further, teacher candidates also have difficulties in planning online courses and adapting learning materials for online environments (Moorhouse, 2020). The pandemic has shown that the structure of education systems needs both technological and pedagogical improvements.

Prospective teachers who live in low socio-economic levels have problems in adapting the online learning during the COVID-19 pandemic since they do not have required facilities such as Internet access (Leacock & Warrican, 2020). On the other hand, having such facilities for online learning is not enough for online learning. In addition, prospective teachers are expected to adapt to the changes caused by COVID-19. Prospective teachers should have computer literacy and digital learning competencies (Kim, 2020), self-directed learning, self-regulation, and metacognition awareness skills for online learning (Bozkurt & Sharma, 2020; Hadar et al.,

2020). In this regard, prospective teachers should have 21st century skills, including information and communication technologies (ICT) literacy, critical thinking, creativity and innovation, self-directed learning skills and metacognitive awareness.

In order to promote participation and engagement in online learning environments, it is important to investigate key factors affecting individuals' online learning readiness during the COVID-19 pandemic. Accordingly, the present study investigated the role of prospective teachers' self-directed learning skills, metacognitive awareness, and 21st century skills and competences in predicting their readiness for online learning.

LITERATURE REVIEW

Readiness for Online Learning

E-learning readiness is the ability of any organization or individual to take advantage of e-learning (Lopes, 2007). Yurdugül and Demir (2017) state that an individual or institution should have the necessary prior knowledge/skills and affective characteristics (such as attitude, motivation) in order to experience e-learning in the most effective way. Warner et al. (1998) states that students should have readiness for online learning, such as student preference in course modality, the students' ability to participate in self-directed learning, as well as student competence and confidence in utilizing computer-mediated communication. Similarly, Hung et al. (2010) state that students should have learner control, self-directed learning, motivation. Maryuningsih et al. (2020) state that prospective teachers must possess ICT skills. Cooper et al. (2020) state that to meet the needs of their future students, teachers must be prepared to integrate technology into their teaching as well as to be prepared to teach online. If this is not the case, it is claimed that teachers who do not have online learning readiness will not be able to support their students sufficiently (Hung et al., 2010). For this reason, it is expected that prospective teachers will graduate with online learning readiness in the teacher training process.

21st Century Skills

In the 21st century, knowledge itself is growing ever more specialized and extending exponentially. Therefore, this increase and spread of information brings along many changes in social, economic, political and technological fields. These changes also affect education systems, and the necessity to make needed changes in the acquisition of knowledge, skills and competencies of individuals (Arpaci, 2018; Cansoy, 2018). We ought to consider the skills people should have in order to adapt to this rapid change and transformation without any problems. At this point, a series of skills conceptualized as "21st century skills" emerges. According to the OECD, the 21st century skills are defined as follows; collaboration, solving complex events, using technological tools, using language, symbols and texts (Ananiadou & Claro, 2009; Senturk, 2020). Schleicher (2012) list 21st century skills as follows: critical thinking, creativity, problem-solving, decision-making and learning in the ways of thinking category; communication and collaboration in the ways of working category; information and communications technology (ICT) and information literacy in the tools for working category; and citizenship, life and career, personal and social responsibility in the category of skills for living in the world. Kereluik et al. (2013) state 'three broad categories are foundational knowledge, meta knowledge, and humanistic knowledge' as 21st century skills. A number of the subcategories connected to the main categories are as follows: Mathematical and scientific competence, advanced knowledge in traditional subjects, creativity and innovation, critical thinking, ethical reasoning, empathy, ethical mind, respectful mind, management of feelings, emotional intelligence.

This century is a century in which information and communication technologies (ICT) are rapidly developing and becoming widespread. Therefore, it is important to focus on the development of 21st century teachers and the ICT pedagogical skills of prospective teachers (Ananiadou & Claro, 2009). ICT is transforming how we learn and the nature of how work is conducted. Today, much success lies in being able to communicate, share, and use information to solve complex problems, and in being able to command and expand the power of technology to create new knowledge (Ledward & Hirata, 2011). In the context of 21st century skills, it is

considered important to provide prospective teachers with both online learning competence and teaching skills using digital tools in the process of teacher training (Cooper et al., 2020).

Self-Directed Learning

The development of information and communication technologies and the increase in virtual learning opportunities has led to a change in people's understanding of learning. In traditional understanding, 'teacher' was seen as the only source of knowledge. Today, sources of information have become very diverse. Therefore, as information has become easier to access, the nature of learning has also changed. In the past, it was important to memorize information, but nowadays, it has become important to gain skills related to where to information can be accessed and how to learn it (Karatas & Basbay, 2014; Tekkol & Demirel, 2018). To be more precise, people are expected to acquire the skills of learning to learn. Individuals who cannot learn to learn and who cannot organize their own learning processes fall behind in many areas in the globalizing world where technology is rapidly developing (Taskin, 2019). At this point, we come across the concept of 'self-directed learning' regarding the need for people to manage their own learning processes. Self-directed learners make plans by determining their learning goals. They organize how to access learning resources. They are also open to learning, curiosity, autonomy, and taking the initiative to learn in a self-controlled manner (du Toit-Brits & van Zyl, 2017).

One of the most important features of self-directed learners is that they can benefit from "online learning environments" (Chou, 2012). It is important that the individual provides motivation for learning and maintains interest and engagement in the online learning process (Song & Bonk, 2016). In fact, in the online learning process, students may lose their self-control and have a problem focusing on learning (Yustina et al., 2020). On the other hand, it is stated that individuals who have acquired self-directed learning skills will show persistence in learning with increased motivation and engagement with online learning (Sandars et al., 2020). In this context, it is necessary for prospective teachers to acquire self-directed learning skills in order to be ready for online learning.

Metacognition Awareness

Flavell (1979) defined the concept of metacognition as an awareness of how one learns and having knowledge of how to use information in achieving a goal. In general, metacognitive awareness plays an important role in planning the learning process, evaluating the process, and conducting adequate self-assessment (Akben, 2020). Those with a strong level of higher cognitive awareness will have higher levels of learning achievement (Zhang et al., 2019) self-directed learning skills (Karatas, 2017). One of the benefits of this age for people is the spread of online learning environments beyond a specific and limited learning environment. Metacognitive awareness is an important component for online learning (Rapchak, 2018). Metacognition is especially consequential for online learners because completing online courses requires the ability to regulate one's own learning and to stay motivated to end coursework (Lee et al., 2013). At that point, it is stated that students' metacognitive awareness improves when learning environments are supported with digital tools (Raes et al., 2012; Reisoglu et al., 2020).

Theoretical Background and Hypothesis

Distance education has become ubiquitous because of the COVID-19 pandemic during 2020 (Kim, 2020). The OECD makes suggestions to further increase online learning opportunities for students during the COVID-19 pandemic (Reimers & Schleicher, 2020). Therefore, resources should be put to work for comprehensive and intensive online learning during the pandemic process (Bryson & Andres, 2020). The role of the teacher is important in online education as well as in face-to-face education. Tsai et al. (2013) states that in the process of transformation from face-to-face learning to online learning, the roles of teachers and students should be carefully reviewed, and efforts should be made to adequately address the epistemological basis. The critical role of student motivation, self-regulation and positive learning dispositions are highlighted in the online learning process (Chiu & Hew, 2018). In this context, teachers should have the necessary knowledge, competencies and attitudes to be ready for online learning in order to ensure the online learning adaptation of their students, to motivate and to encourage them. If teachers are not ready for online learning, they may

not be in a supportive and facilitating position for their students with regard to online learning. They may have problems in providing motivation and participation. The teacher training process provides an important opportunity for future teachers to be ready for online learning. At this point, prospective teachers are expected to graduate with a high level of online learning readiness. At this point, it is necessary to reveal structures related to the readiness of prospective teachers for online learning.

This study is constructed considering the assumptions of the Self-Determination Theory (SDT). The SDT, developed by Ryan and Deci (2020), is a general theory of motivation that claims to explicate the dynamics of human needs and motivation within the social context. The SDT addresses autonomy, relatedness, and competency as determinants of motivation. In online learning, students will be able to achieve success when they can be autonomous, self-motivated, and understanding of the ways to achieve their learning goals (Moore & Kearsley, 2011). In fact, students with self-directed learning skills and who gain meta-cognitive awareness will provide learner autonomy and improve their intrinsic motivation (Mynard & Stevenson, 2017). In the same way, it is thought that students with 21st century skills, such as learning self-reliance, decision-making and learning, as well as having personnel responsibility, will also support learner autonomy. Based on these theory and assumptions, the relationship between online learning readiness and self-directed learning skills, metacognitive awareness, and 21st-century skills is the following with hypotheses were tested:

H1: Self-directed learning skills would positively predict readiness for online learning.

H2: Metacognitive awareness would positively predict readiness for online learning.

H3: 21st century skills would positively predict readiness for online learning.

METHOD

Participants and Procedure

A convenience sample of 834 prospective teachers were recruited from a public university in Turkey. An online surveying system was used to collect data. 73% of them were women (n=609) and 27% of them were men (225) with an average age of 22.16 (SD=3.98, ranged from 16 to 52). By class standing, 15.0% were freshman, 33.6% were sophomore, 35.1% were junior, and 16.3% were senior. Only 38.1% of the participants find the online course videos useful, whereas 38.9% of them of these videos not useful (23% neutral).

Measures

21st Century Skills and Competences Scale: The scale was developed by Aygun et al. (2016) to measure individuals' 21st century skills and competences. Cronbach alpha of the whole scale was reported as .889. The items (42) were collected under three factors: "Learning and Innovation Skills, Life and Career Skills, and Information, Media and Technology Skills." Items were rated on a five-point Likert scale from "Strongly Disagree" to "Strongly Agree." Cronbach's alpha of the total scale was .89.

Self-Directed Learning Skills Scale: The scale was developed by Askin-Tekkol and Demirel (2018) to measure individuals' self-directed learning skills. The scale consisted of four sub-scales (self-control, motivation, self-confidence, and self-monitoring) and 21 items, which were rated on a five-point Likert scale from "Almost Never" to "Almost Always." Cronbach's alpha of the total scale was .90.

Metacognitive Awareness Inventory: The scale developed by Schraw and Dennison (1994) to measure individuals' metacognitive awareness. Akin et al. (2007) adapted the scale into Turkish. The scale consisted of 52 items and two sub-scales (knowledge and regulation of cognition). The items were rated on a five-point Likert-scale ranging from "Never" to "Always." Higher scores indicate higher levels of metacognition. Cronbach's alpha of the total scale was .95.

Readiness for Online Learning Scale: The scale developed by Yurdugül and Demir (2017) to measure individuals' readiness for online learning. The scale consisted of 33 items and six sub-scales (internet self-efficacy, computer self-efficacy, self-directed learning, online communication self-efficacy, motivation

Table 1. Correlations and reliability coefficients

Scale	α	1	2	3	4
1. 21st Century Skills and Competences	.920	1			
2.Self-Directed Learning Skills	.912	.521*	1		
3.Metacognitive Awareness	.935	.509*	.683*	1	
4.Readiness for Online Learning	.918	.596*	.445*	.453*	1

*p<.001

Table 2. Model fit indices

Fit Indices	Measurement Models				Reference Value(s)
	21st Century Skills	Self-Directed Learning	Metacognitive Awareness	Readiness for Online Learning	
χ^2	1851.856	529.707	2328.785	1427.718	
p value	.000	.000	.000	.000	
χ^2/df	2.399	3.730	2.655	3.124	< 3
GFI	.902	.940	.884	.903	≥ .90
AGFI	.886	.903	.863	.880	≥ .80
NFI	.853	.925	.802	.915	≥ .90
TLI	.897	.916	.848	.931	≥ .90
CFI	.908	.943	.865	.941	≥ .90
IFI	.909	.944	.867	.941	≥ .90
RMSEA	.041	.057	.045	.050	≤ .08
SRMR	.045	.045	.047	.054	≤ .08

towards e-learning, and learner control). The items were rated on a seven-point Likert-scale ranging from "very much unlike me" to "very much like me." Higher scores indicate higher levels of readiness. Cronbach's alpha of the total scale was .93.

RESULTS

Preliminary Analysis

SPSS (v.25) was used to conduct initial statistical tests. Kaiser-Meyer-Olkin indices, which ranged from .925 to .936 indicated sampling adequacy for each scale. Significance of the Bartlett's test (p<.001) indicated that data was appropriate for the factorability. Cronbach's alpha coefficients, which ranged from .912 to .935 indicated reliability of the scales. **Table 1** presents Pearson correlations and internal reliability results.

Confirmatory Factor Analysis

SPSS AMOS (ver. 23) was used to conduct a confirmatory-factor-analysis to evaluate validity of the measurement models. Threshold values indicated an adequate model fit for each scale (Hair et al. 2006). The results shown in **Table 2** suggested an adequate evidence for the construct validity of the measures.

Hypothesis Testing

A SEM-based regression analysis in SPSS AMOS (ver. 26) was used to test the hypothesized relationships. Results indicated that self-directed learning skills positively predict readiness for online learning (β =.102, CR = 2.651, p = .008) and therefore, H1 was supported. Further, the results indicated that metacognitive awareness positively predicts readiness for online learning (β = .144, CR = 3.775, p < .001). Therefore, H2 was supported. The results indicated that 21st century skills and competences positively predicts the readiness for online learning (β = .469, CR = 14.326, p < .001). Hence, H3 was supported.

Table 3. Hypotheses testing results

Path	Estimate (β)	Std. β	Std. Error (SE)	Critical Ratio (*t*)	*P*
Self-Directed Learning Skills → Readiness for Online Learning	.125	.102	.047	2.651	.008**
Metacognitive Awareness → Readiness for Online Learning	.060	.144	.016	3.775	***
21st Century Skills and Competences → Readiness for Online Learning	.367	.469	.026	14.326	***

**p< .01, ***p< .001

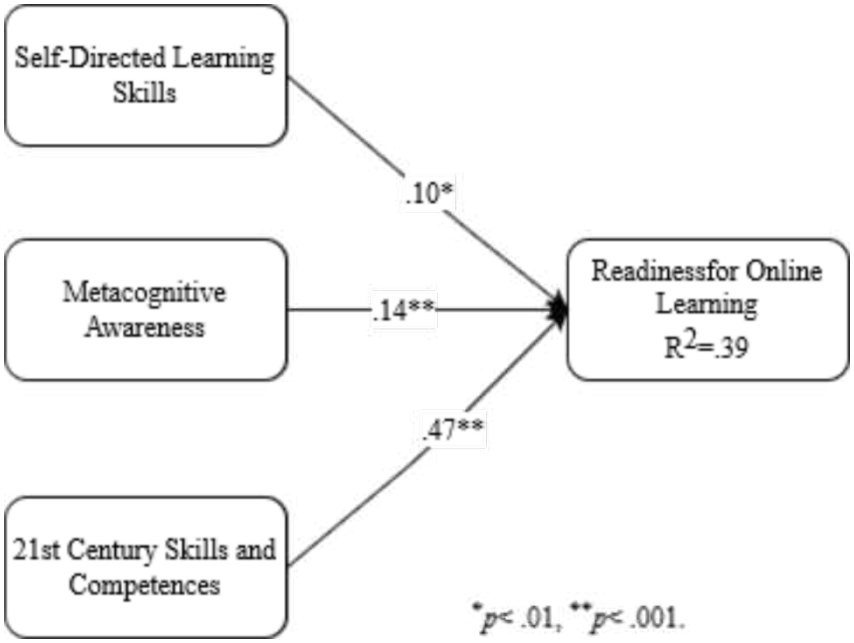

Figure 1. The structural model

R^2 value shown in **Figure 1** indicated that self-directed learning skills, metacognitive awareness, and 21st century skills and competences together explained 39% of the variance in the readiness for online learning.

DISCUSSION AND CONCLUSION

This study investigates the role of self-directed learning skills, metacognitive awareness, and 21st century skills in predicting readiness for online learning. According to the findings, it can be concluded that the assumptions of the SDT theory are confirmed. In other words, that there is a meaningful relationship among the structures that will improve and support the 'learner autonomy' of prospective teachers. More clearly, a significant relationship is found between 'readiness for online learning and metacognitive awareness, self-directed learning skills, and 21st century skills competency'. At the same time, metacognitive awareness, self-directed learning skills, and 21st century skills competency are found to be predictors of readiness for online learning. Therefore, in this research, it is believed that important findings have been obtained on how student motivation can be built and sustained in online learning.

One of the findings of the research is that 21st century skills and competences are a strong predictor of students' readiness for online learning. 21st century skills are an umbrella concept that covers life and career, learning and innovation, ICT skills. In the context of modern skills, it is important for individuals to use digital tools and to gain digital competence. Pappas et al. (2019) state in their research that today's learning systems need to become more flexible, thoughtful, and adaptive, in order that 21st century individuals should understand online learning. Students who develop 21st skills are more prone to learning and development (Liesa-Orús et al., 2020). According to van Laar et al. (2019) having up-to-date skills means having digital literacy, digital competence, digital skills, and e-skills. In this sense, individuals with 21st century skills are expected to have high levels of readiness for online learning. Actually, it is stated that those with the required skills benefit more from online learning opportunities (Martin et al. 2020). In this context, this research

finding is consistent with the literature. Similarly, an individual's ability to use technological tools, digital literacy, digital competence, technical experience and competency in using computers are also essential skills (Dwikoranto et al., 2020; Soulé & Warrick, 2015). Therefore, it can be inferred that the higher the individual perception of 21st century skills, the greater the level of predicting readiness for online learning.

Another finding obtained in the study is that the level of metacognitive awareness is a predictor of readiness for online learning. This finding is consistent with previous research findings in the literature (Margottini & Rossi, 2020; Rapchak, 2018). Pellas (2014) found a positive relationship between the metacognitive awareness levels of students registered in online learning at a university and their attitudes towards online learning. Metacognitive awareness is critical to achieve in the online learning process (Cervin-Ellqvist et al., 2020; Rohloff et al., 2019). Metacognitive skills are the key and are mostly-used by achieving online learners (Liu & Feng, 2011; Reisoglu et al., 2020). In the online learning process, the student should conduct a series of metacognitive activities, such as monitoring, evaluating and making appropriate decisions by comparing with existing information (Karakelle, 2012). While individuals acquire information and eliminate sources of information in the online learning process, they need to think deeply and critically. In this sense, the online environment offers learners a wide area of freedom in terms of information resources.

According to another finding of the research, there is a positive and significant relationship between readiness for online learning and self-directed learning. In addition, self-directed learning skills significantly predict readiness for online learning. The findings of previous studies are consistent with the findings of this study (Buzdar et al., 2016; Durnali, 2020; Wei & Chou, 2020). Theorists express that learners should be autonomous and have self-directed skills for online learning activities (Abdelaziz, 2012; Hung et al., 2010). Students' ability to direct themselves in learning and to utilize learning technologies can affect student learning effectiveness (Geng et al., 2019). Similarly, Chou (2012) reports that individuals with high self-directed learning skills have an effect on online learning performance. Self-directed learning skills, the use of technologies, and the ability to obtain and evaluate information are critical skills for online learning. Individuals with self-directed learning skills can manage themselves to acquire knowledge and comprehend how to resolve problems. Self-directed learning is a fundamental competence for individuals living in our modern world, where social contextual conditions are changing rapidly, especially in a digital age (Karatas & Zeybek, 2020; Morris, 2019). Self-directed learners are often more actively involved in learning tasks, such as reading online learning materials, planning and evaluating learning milestones (Geng et al. 2019). In the online learning process, students should determine their goals with intrinsic motivation and make efforts to achieve their learning goals. Moreover, by evaluating the learning process, they are expected to eliminate any learning deficiencies. In this sense, students with self-directed learning skills will make the online learning process both easier and more efficient. In this context, it is necessary to gain self-directed learning skills for readiness for online learning.

As a result, online learning environments have become more common as a result of COVID-19. However, in this process, there are many difficulties related to students, teachers, institutions, internet network access and so on. Despite all these difficulties, students have tried to become educated in online learning environments with distance education tools during the COVID-19 pandemic. One of the biggest problems in online learning is intrinsic and extrinsic motivational difficulties that students will experience with regard to online learning, even if all other problems are resolved (Ryan & Deci, 2020). Therefore, it is important to anticipate these motivational problems and to take precautions. It is known that the success of online learning depends on students not having motivational problems, having resistance to overcoming difficulties and having "readiness for online learning" (Wei & Chou, 2020). Therefore, it is necessary to be prepared for global disasters that may arise later, by learning from the education problems experienced during the COVID-19 pandemic period. In this respect, it is important to ensure that all students, especially prospective teachers, are ready for online learning in a way that will support their autonomy and improve their motivation. Therefore, when the teacher becomes stronger pedagogically, this efficiency will be reflected on the student. As a result, in the process of training prospective teachers, a policy should be followed to raise 21st century skills, metacognitive awareness, and self-directed skills in order to increase levels of "readiness for online learning". Today's teacher must be competent in information and communication technologies

and have a high online learning capacity (Grande-de-Prado et al., 2020; Senturk, 2020; Reimers & Schleicher, 2020). Teachers must overcome all the problems that occur in online learning and teaching (Aliyyah et al., 2020). If this is not the case, teachers with low readiness for online learning will not be able to ensure that their students are ready and prepared for online learning. In the same way, teachers who have not gained 21st century skills, metacognitive awareness, and self-directed skills will be unable to pass on these skills to their students. In this context, prospective teachers should be provided with competencies to raise and improve their level of readiness for online learning in the teacher training process.

Independent variables discussed in this study predict 39% readiness for online learning. Within this context, it is suggested that other structures which predict readiness for online learning could be revealed. Another limitation is related to the fact that the cross-sectional, self-reporting and sample size nature of the data precludes a deeper investigation of the research problems. Future research could be conducted on larger samples, and in-depth studies could be carried out using both qualitative and mixed method research designs. In the same way, in future research, even by collecting data from prospective teachers studying in different countries, readiness for online learning levels may be examined. Findings from these studies could support faculties of education in developing online learning and teaching to educate prospective teachers who can fully meet the challenges of COVID-19.

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REFERENCES

Abdelaziz, H. A. (2012). The effect of computer-mediated instruction and WebQuest on pre-service business education teachers' self-directed learning readiness and teaching performance. *The Journal of Research in Business Education*, *54*(1), 1-15. https://search.proquest.com/scholarly-journals/effect-computer-mediated-instruction-webquest-on/docview/1326249101/se-2?accountid=201395

Adnan, M., & Anwar, K. (2020). Online Learning amid the COVID-19 Pandemic: Students' perspectives. *Online Submission*, *2*(1), 45-51. http://doi.org/10.33902/JPSP. 2020261309

Akat, M., & Karatas, K. (2020). Psychological effects of COVID-19 pandemic on society and its reflections on education. *Electronic Turkish Studies*, *15*(4). 1-13. https://dx.doi.org/10.7827/TurkishStudies.44336

Akben, N. (2020). Effects of the problem-posing approach on students' problem solving skills and metacognitive awareness in science education. *Research in Science Education*, *50*(3), 1143-1165. https://doi.org/10.1007/s11165-018-9726-7

Akin, A., Abaci, R., & Cetin, B. (2007). The validity and reliability of the Turkish version of the metacognitive awareness inventory. *Educational Sciences: Theory & Practice, 7*(2), 671-678. https://psycnet.apa.org/record/2008-10552-001

Aliyyah, R. R., Rachmadtullah, R., Samsudin, A., Syaodih, E., Nurtanto, M., & Tambunan, A. R. S. (2020). The perceptions of primary school teachers of online learning during the COVID-19 pandemic period: A case study in Indonesia. *Journal of Ethnic and Cultural Studies*, *7*(2), 90-109. https://doi.org/10.29333/ejecs/388

Ananiadou, K., & M. Claro (2009). 21st century skills and competences for New Millennium Learners in OECD Countries. *OECD Publishing.* https://doi.org/10.1787/218525261154

Arpaci, I. (2018). An investigation of the relationship between university students' innovativeness profile and their academic success in the project development course. *Journal of Entrepreneurship and Innovation Management, 7*(2), 79-95. https://dergipark.org.tr/tr/pub/jeim/issue/52607/692543

Askin-Tekkol, I., & Demirel, M. (2018). Self-directed learning skills scale: Validity and reliability Study. *Journal of Measurement and Evaluation in Education and Psychology*, *9*(2), 85-100. https://doi.org/10.3389/fpsyg.2018.02324

Aygun, Ş. S., Atalay, N., Kilic, Z., & Yasar, S. (2016). The development of a 21st century skills and competences scale directed at teaching candidates: Validity and reliability study. *Pamukkale University Journal of Education, 40*(40), 160-175. https://doi.org/10.9779/puje768

Bozkurt, A., & Sharma, R. C. (2020). Emergency remote teaching in a time of global crisis due to Coronavirus pandemic. *Asian Journal of Distance Education*, *15*(1), i-vi. https://www.asianjde.org/ojs/index.php/AsianJDE/article/view/447

Bryson, J. R., & Andres, L. (2020). COVID-19 and rapid adoption and improvisation of online teaching: curating resources for extensive versus intensive online learning experiences. *Journal of Geography in Higher Education*, 1-16. https://doi.org/10.1080/03098265.2020.1807478

Buzdar, M., Ali, A., & Tariq, R. (2016). Emotional intelligence as a determinant of readiness for online learning. *International Review of Research in Open and Distributed Learning, 17*(1), 148-158. https://doi.org/10.19173/irrodl.v17i1.2149

Cansoy, R. (2018). 21st Century Skills according to international frameworks and building them in the education system. *Journal of the Human and Social Science Researches, 7*(4), 3112-3134. https://doi.org/10.15869/itobiad.494286

Cervin-Ellqvist, M., Larsson, D., Adawi, T., Stöhr, C., & Negretti, R. (2020). Metacognitive illusion or self-regulated learning? Assessing engineering students' learning strategies against the backdrop of recent advances in cognitive science. *Higher Education*, 1-22. https://doi.org/10.1007/s10734-020-00635-x

Chiu, T. K., & Hew, T. K. (2018). Factors influencing peer learning and performance in MOOC asynchronous online discussion forum. *Australasian Journal of Educational Technology*, *34*(4). https://doi.org/10.14742/ajet.3240

Chou, P. N. (2012). The relationship between engineering students self-directed learning abilities and online learning performances: A pilot study. *Contemporary Issues in Education Research (CIER)*, *5*(1), 33-38. https://doi.org/10.19030/cier.v5i1.6784

Cooper, R., Farah, A., & Mrstik, S. (2020). Preparing teacher candidates to teach online: A case study of one college's design and implementation plan. *International Journal on E-Learning*, *19*(2), 125-137. https://www.learntechlib.org/primary/p/209810/

Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., ... Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, *3*(1), 1-20. https://doi.org/10.37074/jalt.2020.3.1.7

Donitsa-Schmidt, S., & Ramot, R. (2020). Opportunities and challenges: teacher education in Israel in the COVID-19 pandemic. *Journal of Education for Teaching*, 1-10. https://doi.org/10.1080/02607476.2020.1799708

du Toit-Brits, C., & van Zyl, C. M. (2017). Self-directed learning characteristics: making learning personal, empowering and successful. *Africa Education Review*, *14*(3-4), 122-141. https://doi.org/10.1080/18146627.2016.1267576

Durnali, M. (2020). The effect of Self-Directed Learning on the relationship between Self-Leadership and Online Learning among university students in Turkey. *Tuning Journal for Higher Education*, *8*(1), 129-165. https://doi.org/10.18543/tjhe-8(1)-2020pp129-165

Dwikoranto, D., Setiani, R., Prahani, B. K., & Mubarok, H. (2020). Mobile Learning to Improve Student Collaborative Skills: An Alternative to Online Learning in the Era of Covid-19 Pandemic. *Jurnal Penelitian dan Pengkajian Ilmu Pendidikan: e-Saintika*, *4*(3), 259-271. https://doi.org/10.36312/e-saintika.v4i3.314

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34*(10), 906-911. https://doi.org/10.1037/0003-066X.34.10.906

Geng, S., Law, K. M., & Niu, B. (2019). Investigating self-directed learning and technology readiness in blending learning environment. *International Journal of Educational Technology in Higher Education*, *16*(1), 17. https://doi.org/10.1186/s41239-019-0147-0

Grande-de-Prado, M., Cañón, R., García-Martín, S., & Cantón, I. (2020). Digital Competence and Gender: Teachers in Training. A Case Study. *Future Internet*, *12*(11), 204. https://doi.org/10.3390/fi12110204

Hadar, L. L., Ergas, O., Alpert, B., & Ariav, T. (2020). Rethinking teacher education in a VUCA world: student teachers' social-emotional competencies during the COVID-19 crisis. *European Journal of Teacher Education*, 1-14. https://doi.org/10.1080/02619768.2020.1807513

Ho, L. A., Kuo, T. H., & Lin, B. (2010). Influence of online learning skills in cyberspace. *Internet Research, 20*(1), 55-71. https://doi.org/10.1108/10662241011020833

Hung, M. L., Chou, C., Chen, C. H., & Own, Z. Y. (2010). Learner readiness for online learning: Scale development and student perceptions. *Computers & Education*, *55*(3), 1080-1090. https://doi.org/10.1016/j.compedu.2010.05.004

Karakelle, S. (2012). Interrelations between metacognitive awareness, perceived problem solving, intelligence and need for cognition. *Education and Science, 37*(164), 237-250. http://egitimvebilim.ted.org.tr/index.php/EB/article/view/779

Karatas, K. & Zeybek, G. (2020). The role of the academic field in the relationship between self-directed learning and 21st century skills. *Bulletin of Education & Research, 42*(2), 33-52. http://pu.edu.pk/images/journal/ier/PDF-FILES/3_42_2_20.pdf

Karatas, K. (2017). Predicting teacher candidates' self-directed learning in readiness levels for terms of metacognitive awareness levels. *Hacettepe University Journal of Education, 32*(2), 451-465. https://doi.org/10.16986/HUJE.2016017218

Karatas, K., & Basbay, M. (2014). Predicting self-directed learning readiness level in terms of critical thinking disposition, general self-efficacy and academic achievement. *Elementary Education Online,13*(3), 916-933. https://hdl.handle.net/11492/4010

Kereluik, K., Mishra, P., Fahnoe, C., & Terry, L. (2013). What knowledge is of most worth: Teacher knowledge for 21st century learning. *Journal of Digital Learning in Teacher Education*, *29*(4), 127-140. https://doi.org/10.1080/21532974.2013.10784716

Kim, J. (2020). Learning and teaching online during COVID-19: Experiences of student teachers in an early childhood education practicum. *International Journal of Early Childhood*, *52*(2), 145-158. https://doi.org/10.1007/s13158-020-00272-6

Leacock, C. J., & Warrican, S. J. (2020). Helping teachers to respond to COVID-19 in the Eastern Caribbean: issues of readiness, equity and care. *Journal of Education for Teaching*, 1-10. https://doi.org/10.1080/02607476.2020.1803733

Ledward, B. C., & Hirata, D. (2011). *An overview of 21st century skills. Summary of 21st century skills for students and teachers.* Pacific Policy Research Center. Honolulu: Kamehameha Scholls- Research & Evolution.

Lee, Y., Choi, J., & Kim, T. (2013). Discriminating factors between completers of and dropouts from online learning courses. *British Journal of Educational Technology*, *44*(2), 328-337. https://doi.org/10.1111/j.1467-8535.2012.01306.x

Liesa-Orús, M., Latorre-Cosculluela, C., Vázquez-Toledo, S., & Sierra-Sánchez, V. (2020). The technological challenge facing higher education professors: Perceptions of ICT tools for developing 21st century skills. *Sustainability*, *12*(13), 5339. https://doi.org/10.3390/su12135339

Liu, Y., & Feng, H. (2011). An empirical study on the relationship between metacognitive strategies and online-learning behavior & test achievements. *Journal of Language Teaching and Research, 2*(1), 183-187. https://doi.org/10.4304/jltr.2.1.183-187

Lopes, C. T. (2007). *Evaluating e-learning readiness in a health sciences higher education institution.* Proceedings of IADIS International Conference of E-learning.

Margottini, M., & Rossi, F. (2020). Processi autoregolativi e feedback nell'apprendimento online. *Journal of Educational, Cultural and Psychological Studies (ECPS Journal)*, (21), 193-209. https://doi.org/10.7358/ecps-2020-021-marg

Martin, F., Stamper, B., & Flowers, C. (2020). Examining student perception of their readiness for online learning: Importance and confidence. *Online Learning, 24*(2), 38-58. https://doi.org/10.24059/olj.v24i2.2053

Maryuningsih, Y., Hidayat, T., Riandi, R., & Rustaman, N. Y. (2020). *Profile of information and communication technologies (ICT) skills of prospective teachers.* IOP Publishing. https://doi.org/10.1088/1742-6596/1521/4/042009

Moore, M. G., & Kearsley, G. (2011). *Distance education: A systems view of online learning*. Cengage Learning.

Moorhouse, B. L. (2020). Adaptations to a face-to-face initial teacher education course 'forced' online due to the COVID-19 pandemic. *Journal of Education for Teaching*, 1-3. https://doi.org/10.1080/02607476.2020.1755205

Morris, T. H. (2019). Self-directed learning: A fundamental competence in a rapidly changing world. *International Review of Education*, *65*(4), 633-653. https://doi.org/10.1007/s11159-019-09793-2

Mynard, J., & Stevenson, R. (2017). Promoting learner autonomy and self-directed learning: The evolution of a SALC curriculum. *Studies in Self-Access Learning Journal, 8(*2), 169-182. https://doi.org/10.37237/080209

Pappas, I. O., Giannakos, M. N., & Sampson, D. G. (2019). Fuzzy set analysis as a means to understand users of 21st century learning systems: The case of mobile learning and reflections on learning analytics research. *Computers in Human Behavior*, *92*, 646-659. https://doi.org/10.1016/j.chb.2017.10.010

Pellas, N. (2014). The influence of computer self-efficacy, metacognitive self-regulation and self-esteem on student engagement in online learning programs: Evidence from the virtual world of Second Life. *Computers in Human Behavior, 35,* 157-170. https://doi.org/10.1016/j.chb.2014.02.048

Raes, A., Schellens, T., De Wever, B., & Vanderhoven, E. (2012). Scaffolding information problem solving in web-based collaborative inquiry learning. *Computers & Education*, *59*(1), 82-94. https://doi.org/10.1016/j.compedu.2011.11.010

Rapchak, M. E. (2018). Collaborative learning in an information literacy course: The impact of online versus face-to-face instruction on social metacognitive awareness. *The Journal of Academic Librarianship*, *44*(3), 383-390. https://doi.org/10.1016/j.acalib.2018.03.003

Reimers, F. M., & Schleicher, A. (2020). A framework to guide an education response to the COVID-19 Pandemic of 2020. *OECD.*

Reisoglu, İ., Toksoy, S. E., & Erenler, S. (2020). An analysis of the online information searching strategies and metacognitive skills exhibited by university students during argumentation activities. *Library & Information Science Research*, *42*(3), 101019. https://doi.org/10.1016/j.lisr.2020.101019

Rohloff, T., Sauer, D., & Meinel, C. (2019, December). Student Perception of a Learner Dashboard in MOOCs to Encourage Self-Regulated Learning. In *2019 IEEE International Conference on Engineering, Technology and Education (TALE)* (pp. 1-8). IEEE. https://doi.org/10.1109/TALE48000.2019.9225939

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

Sandars, J., Correia, R., Dankbaar, M., de Jong, P., Goh, P. S., Hege, I., ... & Webb, A. (2020). Twelve tips for rapidly migrating to online learning during the COVID-19 pandemic. *MedEdPublish*, *9*(1), 82. https://doi.org/10.15694/mep.2020.000082.1

Schleicher, A. (2012). *Preparing teachers and developing school leaders for the 21st century: Lessons from around the world*. OECD Publishing. https://doi.org/10.1787/9789264174559-en

Schraw, G., & Sperling-Dennison, R. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology, 19,* 460-470. https://doi.org/10.1006/ceps.1994.1033

Senturk, C. (2020). Effects of the blended learning model on preservice teachers' academic achievements and twenty-first century skills. *Education and Information Technologies*, 1-14. https://doi.org/10.1007/s10639-020-10340-y

Song, D., & Bonk, C. J. (2016). Motivational factors in self-directed informal learning from online learning resources. *Cogent Education*, *3*(1), 1205838. https://doi.org/10.1080/2331186X.2016.1205838

Soulé, H., & Warrick, T. (2015). Defining 21st century readiness for all students: What we know and how to get there. *Psychology of Aesthetics, Creativity, and the Arts, 9*(2), 178-186. https://doi.org/10.1037/aca0000017

Taskin, B. (2019). *Analysis of computer literacy in terms of self-directed learning: A cognitive ethnographic study* [Ph.D. Thesis]. Hacettepe University.

Tsai, C. C., Chai, C. S., Wong, B. K. S., Hong, H. Y., & Tan, S. C. (2013). Positioning design epistemology and its applications in education technology. *Journal of Educational Technology & Society*, *16*(2), 81-90.

van Laar, E., Van Deursen, A. J., Van Dijk, J. A., & De Haan, J. (2019). The sequential and conditional nature of 21st-century digital skills. *International Journal of Communication*, *13*, 3462-3487. https://doi.org/10.1037/t73734-000

Veenman, M. V., Van Hout-Wolters, B. H., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and learning*, *1*(1), 3-14. https://doi.org/10.1007/s11409-006-6893-0

Wei, H. C., & Chou, C. (2020). Online learning performance and satisfaction: do perceptions and readiness matter? *Distance Education*, *41*(1), 48-69. https://doi.org/10.1080/01587919.2020.1724768

Yurdugül, H., & Demir, Ö. (2017). An investigation of pre-service teachers' readiness for e-learning at undergraduate level teacher training programs: The case of Hacettepe University *Hacettepe University Journal of Education*, *32*(4), 896-915. https://doi.org/10.16986/HUJE.2016022763

Yustina, Y., Halim, L., & Mahadi, I. (2020). The Effect of 'Fish Diversity' Book in Kampar District on the Learning Motivation and Obstacles of Kampar High School Students through Online Learning during the COVID-19 Period. *Journal of Innovation in Educational and Cultural Research*, *1*(1), 7-14. https://doi.org/10.46843/JIECR.V1I1.2

Zhang, Y., Chen, B. L., Ge, J., Hung, C. Y., & Mei, L. (2019). When is the best time to use rubrics in flipped learning? A study on students' learning achievement, metacognitive awareness, and cognitive load. *Interactive Learning Environments*, *27*(8), 1207-1221. https://doi.org/10.1080/10494820.2018.1553187

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