MEASURING DIGITAL LITERACY: DEVELOPMENT AND VALIDATION OF AN INSTRUMENT FOR TEACHERS

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

YUNUS PAŞALI

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
COMPUTER EDUCATION AND INSTRUCTIONAL TECHNOLOGY

JANUARY 2023

Approval of the thesis:

MEASURING DIGITAL LITERACY: DEVELOPMENT AND VALIDATION OF AN INSTRUMENT FOR TEACHERS

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

MEASURING DIGITAL LITERACY: DEVELOPMENT AND VALIDATION OF AN INSTRUMENT FOR TEACHERS

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January 2023, 120 pages

Digital literacy is gaining more attention as digitalization and digital transformation accelerate. Many studies attempt to define it as a concept, glean its components and to assess individuals' digital literacy levels. The field of education, and specifically teachers, as main agents of the field, are no exception. Setting off from this point, this study aims to develop and validate a scale to measure the digital literacy levels of teachers working in primary schools. Pursuing this aim, an extensive literature review is conducted by analyzing and synthesizing various studies. Based on this synthesis and in consideration with Bloom's Taxonomy, a conceptual digital literacy framework was created, consisting of 54 components gathered under three main domains, i.e. cognitive, technical, and social. Utilizing this framework, an item pool of 459 statements were created, and filtered down to a total of 67 five-point Likert-type items after four editing and revision sessions with experts. A total of 432 teachers filled out this draft scale. The collected data were used for exploratory factor analysis (EFA), which yielded to a 12-item scale that was further filled out by 125 teachers. These data were used for confirmatory factor analysis (CFA) to validate and finalize the 12-item scale which measures 11 components from two domains, i.e., cognitive and technical. The responses given to the final scale were also descriptively reported. The findings showed that all of participant teachers perceive themselves as digitally literate. They are aware of fundamental digital concepts and self-learning methods; they can extrapolate the digital innovations and use the technology effectively and efficiently in a secure way.

Keywords: Digital Literacy, Scale Development, Digital Literacy Framework, Digital Literacy Scale, Bloom's Taxonomy

ÖZ

DİJİTAL OKURYAZARLIĞI ÖLÇMEK: ÖĞRETMENLER İÇİN BİR ARACIN GELİŞTİRİLMESİ VE GEÇERLEMESİ

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Ocak 2023, 120 sayfa

Dijitalleşme ve dijital dönüşüm hız kazandıkça dijital okuryazarlık daha fazla ilgi görmektedir. Birçok çalışma, bunu bir kavram olarak tanımlamaya, bileşenlerini belirlemeye ve bireylerin dijital okuryazarlık düzeylerini değerlendirmeye çalışmaktadır. Eğitim alanı ve özellikle de alanın ana temsilcileri olarak öğretmenler de bu konuda bir istisna değildir. Buradan hareketle, bu çalışma, ilköğretim okullarında görev yapan öğretmenlerin dijital okuryazarlık düzeylerini ölçmek için bir ölçek geliştirerek geçerliliğini sağlamayı amaçlamaktadır. Bu amaç doğrultusunda, çeşitli çalışmalar incelenip sentezlenerek kapsamlı bir literatür taraması yapılmıştır. Bu sentezden hareketle ve Bloom Taksonomisi dikkate alınarak; bilişsel, teknik ve sosyal olmak üzere üç ana alan altında toplanan toplam 54 bileşenden oluşan kavramsal bir dijital okuryazarlık çerçevesi oluşturulmuştur. Bu çerçeveden yararlanılarak, 459 maddelik bir madde havuzu oluşturulmuş ve uzmanlarla yapılan dört düzeltme ve gözden geçirme seansından sonra toplam 67 adet beşli Likert tipi maddeye indirgenen bir taslak ölçek oluşturulmuştur. Bu taslak ölçeği toplam 432 öğretmen doldurmuştur. Toplanan verilerle açımlayıcı faktör analizi (AFA) yapılarak sonuçta 12 maddelik bir ölçek elde edilmiş ve bu ölçek 125 öğretmen tarafından doldurulmuştur. Toplanan veriler, ölçeğe nihai halini vermek ve geçerlemesini yapmak üzere doğrulayıcı faktör analizi (DFA) için kullanılmıştır. Elde edilen nihai ölçek, bilişsel ve teknik olmak üzere iki ana alandan 11 bileşeni ölçen 12 maddeden oluşmuştur. Nihai ölçeğe verilen cevaplar da betimsel olarak raporlanmıştır. Bulgular, katılımcı öğretmenlerin tümü kendilerini dijital okuryazar olarak nitelendirdiğini göstermiştir. Öğretmenler, temel dijital kavramların ve kendi kendine öğrenme yöntemlerinin farkında olduklarını, dijital yenilikleri öngörebildiklerini, teknolojiyi etkili, verimli ve güvenli bir şekilde kullanabildiklerini belirtmiştir.

Anahtar Kelimeler: Dijital Okuryazarlık, Ölçek Geliştirme, Dijital Okuryazarlık Çerçevesi, Dijital Okuryazarlık Ölçeği, Bloom Taksonomisi

To my beloved family

ACKNOWLEDGMENTS

To begin with, I would like to express my thanks and regards to the supervisor of the thesis, Assoc. Prof. Dr. Göknur Kaplan for her patience and contributions. I would like to express my thanks and regards to the co-supervisor of the thesis, Dr. Ayşe Gül Kara Aydemir.

I would like to express my regards and gratitude to the committee members, Prof. Dr. Hasan Çakır and Assist. Prof. Dr. Erkan Er for their comments and contributions.

I would like to express my thanks and regards to Prof. Dr. Yavuz Akbulut, Prof. Tayfun Can Onuk and Dr. Mustafa Güleç for their valuable contributions in data analysis process.

I would like to express my deepest gratitude and thanks to my mother for her patience and supports in all parts of my life.

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CHAPTER 1

INTRODUCTION

1.1 Overview

Literacy is defined in Cambridge Dictionary (2004) as having reading and writing capabilities. From different perspectives, literacy is often paired with another concept as in media literacy, financial literacy, computer literacy, information literacy, digital literacy, etc. Despite some communalities and similarities, each literacy has its own characteristics, definition and structure. Especially in case of IT-based literacies, skills and abilities are emphasized more powerfully. From the same perspective, Buckingham (2006) uses a conceptual framework including four elements, namely, Representation, Language, Production and Audience to discriminate and define different types of literacies. According to him, possessing literacy, i.e. being 'literate' in something; individuals need to have specific skills and knowledge about the focus of designated literacy. Thus, to decide whether someone possesses a certain literacy, their knowledge and abilities are questioned. To illustrate, financial literacy is defined as the knowledge and skills leading individuals to significant financial actions (European Commission, n.d). When people need to decide on financial cases, they should choose the appropriate options and use suitable financial instruments with the help of their knowledge base and financial skills. People who can meet such requirements are called 'financially literate.'

Digital literacy is a concept that is frequently used in the digital age. Joint Information System Committee (JISC, 2014) describes digital literacy as prioritizing essential digital-based skills assisting people in living, learning and working in a digital society. The committee emphasizes the importance of practical digital competencies and behaviors shaped by digital literacy skills. Similarly, European

Commission (2018) offers a definition that states ‘digital competencies’ as the key factors of effective technology use for learning and further emphasizes them as a requirement for better integration with society. American Library Association (ALAIR, 2011) also portrays digital literacy as an ability of technology use to reach and process information, where *“information processing”* includes management, consumption, evaluation, and even creation of information. These definitions further imply that digital literacy is an instrument allowing individuals to access and process information. Especially in daily routines and career processes, digital literacy is considered important for self–learning and personal development, which can be boosted with the help of technology. What is more, various institutions and organizations come up with different definitions of digital literacy due to diversity in their perspectives, which might bring about additional elements to the mix, besides certain common characteristics. For instance, while United Nations Educational, Scientific and Cultural Organization (UNESCO, 2018) explains digital literacy as an ability and apparatus for employment and entrepreneurship; London School of Economics (as cited in Nascimbeni & Vosloo, 2019) describes digital literacy as an occasion for individuals who socialize and engage with digital platforms. These descriptions add a social dimension digital literacy and identifies it as a set of skills, which encompasses a range of abilities to use digital devices, communication applications and networks to access, manage and evaluate information, where such expertise can be used for social engagement or personal development.

Broadening the perspectives, Ng (2012) describes digital literacy based on three domains, namely, cognitive, technical and social, along with a specific take on education. In line with the emphasis on *knowledge* within above-mentioned definitions, many components of digital literacy might cluster under the ‘cognitive domain.’ Similar to Ng (2012), Hatlevik et al. (2015) also underlines the importance of “knowledge” for digital literacy. Especially ‘technical knowledge’ is required for interpretation in practice. Knowledge lying behind technical abilities, paves the first step of any digital competency; similar to Bloom’s understanding that knowledge is the necessary precondition for putting any skills and abilities into practice (Bloom et al., 1956). Moreover, essentials of digitalization and knowledge of technology related concepts might also be categorized within cognitive domain according to Ng's (2012) definition.

As for the 'technical domain,' individuals' technical skills that they employ to come up with digital solutions to problems and their technical proficiencies are in focus. Martin (2005) states that the recognition of technology and its use means digital literacy, whereas one can extend this to include various instances of use and implementation of technology, with a special emphasis on its efficient, effective, creative and ethical use. In line with this, White (2015) emphasizes that only people with such use of technology can be considered as digitally literate. Spires and Bartlett (2012) further add 'production of digital content' as a requirement for digital literacy, similar to Hague and Payton (2011), who includes 'creation' in their digital literacy definition.

Finally, the third domain, which is called 'social domain,' is basically about using digital skills for interaction, communication and social collaboration. Joining with the communities in the digital environment (Alexander et al., 2016), contacting and sharing content (Spires & Bartlett, 2012) are the processes that have been frequently emphasized by the authors while defining digital literacy.

To some up, most of the definitions of digital literacy contains elements that correspond to these three domains, whereas some definitions focus on one of two of these domains. For instance, some definitions put their focus on digital abilities and skills, which falls under the 'technical domain,' while some of them present a tripartite structure which includes components that equally cover all three domains.

1.1.2 Digital Literacy in Education

Digitalization and digital integration are the terms frequently used in society and industries. In education, there are models (e.g. ASSURE Model) and frameworks aiming to integrate technology with education. Almost all of the students in current education systems are familiar with digital tools and can be categorized as digital natives (Prensky, 2001). However, teachers can be partially categorized into the same group. Some of them may need better digital skills for daily routines and their instructional design processes. Teachers, working in educational environments, should improve their digital skills to meet the digital age requirements (Zhao et al., 2021).

The Organization for Economic Co-operation and Development (OECD, 2018) states that the close future holds different conditions than today. Their position paper includes some challenges that will influence most people directly. These challenges are grouped under three main headings: environmental challenges within the scope of climate change, economic challenges created and transformed by the enhancements in technology (along with birth and development of new IT fields, and lastly, social challenges. Therefore, education systems need to transform to raise new generations that are equipped with such skills and competences to overcome these obstacles and unforeseen challenges of the close future.

Pursuing this need, OECD has been developing a new learning framework, i.e. 'The OECD Learning Framework 2030,' which provides a vision for the educational practices, environments, etc., where they firstly come up with the key cognitions, practices and behaviors that are respectively examined under three domains, namely, "Knowledge", "Skills" and "Attitudes and Values." These domains are made up of subdomains, and the learner interacts with them throughout "Competencies," which are defined as "*Transformative Competencies,*" where learners are expected to obtain and mobilize the knowledge, skills, attitudes and values with such competencies. Secondly, they put forth an ideal education system, where they recommend radical changes in the curricula by placing students in the center of multiple sequences. Such placement gives students more responsibility and requires connectivity with other components of the educational environment. In other words, the framework allows learners to create their own learning atmosphere, where OECD predicts that the significance of digital literacy will increase.

This learning framework is one of the mainstays of this study because of three reasons:

a. the prediction regarding the radical changes and its transformative, and extensive effect on education
b. the placement given to digital literacy occupying a major part in the framework, along with the importance and significance attributed to akin to a vital phenomenon such as health in their future projection
c. the proposal for a learning framework, where there are responsibilities that teachers should meet to be able to raise new generations with the capability to overcome unforeseen challenges.

As important figures and agents of the education system, teachers should develop such skills and make practical contributions to curriculum changes. Moreover, educators with sufficient digital skills can transfer necessary knowledge, skills, attitudes and values about the digital world to provide a vision for their students.

1.2 Background of the Study

Digitalization is a frequently used term in the digital age like globalization. In this study, the digitalization concept is handled within the scope of technology in education. Especially during the period of coronavirus (COVID-19) pandemic, technology has been widely used in professional environments and education.

The distance education progress was run through digital media and technology was used heavily in the instructional design processes. At this point, teachers' digital skills and background knowledge that qualify them for better technology implementation in the instructional design processes become more important in line with Sulak's (2019) study that points out the need for equipping teachers with digital literacy skills.

Digital literacy is defined from a variety of perspectives, and this brings about the need for more standardization in global understanding. On a global scale, there is disharmony regarding the understanding of what digital literacy stands for and there seems to be hardly any global standard that has consensus around the world. Currently, frameworks are developed to provide a structure for the digital literacy concept to set international standards. Digital Intelligence (DQ) Framework (DQ Institute, 2019) is announced the Global Standards Report, and standardization issues were included in the report. The report states that a universal understanding does not exist, and financially significant investments in digital-based concepts are also pointed out. DQ Framework, containing eight areas and 24 levels is developed to provide a solution.

Despite such attempts to establish a common understanding and create a framework, a second problem arises: Flexibility in such frameworks. Due to the rapid enhancements in digital systems, global understanding may quickly change when it comes to technology. Therefore, the structure of the digital literacy should be easily adaptable to such new conditions.

Moreover, digital literacy is a concept that is nested in educational settings and learning environments as well, so similar to flexibility, there appears the problem of adaptability as underlined in Digital Intelligence (DQ) Framework by the DQ Institute (2019). To clarify this case, Digital Intelligence Framework has been analyzed in the same report in terms of the OECD Learning Framework 2030. On the contrary, though, increasing the compatibility between the digital literacy framework and other learning frameworks will make the digital literacy structure more feasible.

1.3 Statement of Problem Situation

In this study, the problem can be defined four-fold, where measuring teachers' digital literacy lies at the heart of the problem. The first fold is about the lack of a comprehensive digital literacy framework to use for drafting a scale, where the remaining folds are about concerns regarding such framework.

In multiple studies (List, 2019; García-Martín & García-Sanchez, 2017), preservice teachers' or teachers' digital literacy skills, their beliefs about digital literacy and their perceptions are the main focus. Researchers give importance to the teachers' and prospective teachers' digital literacy skills.

Therefore, instrument development to measure teachers' digital literacy became an important research topic. However, abundance of various digital literacy definitions and frameworks combing various behaviors or competences based on various knowledge and skills makes it a serious problem to pinpoint the concept as a whole. Thus, it is important to create an extensive, inclusive framework synthesized from the literature that is usable for educational settings, so that it can be used for development and validation of a 'digital literacy scale' that can be used to measure teachers' digital literacy levels.

What is more, when developing framework, three main concerns emerges: the existence of shared understanding, integrability and flexibility. The digital literacy concept is defined from multiple perspectives. Different perspectives and definitions enrich the digital literacy concept but obstruct a collective view that hinders to arrive at a shared understanding. Secondly, learning frameworks and digital literacy can be used together, especially in the case of digital literacy. In the literature, there is an emphasis on the learning process using technology (Ng, 2012). In this perspective, technology is interpreted as the media of the learning process. There are also digital literacy frameworks (e.g. A European Framework For Digital Literacy [DigEuLit Project]) for educational environments to establish technology-enriched education. Therefore, digital literacy frameworks should be responsively compatible with the learning frameworks, and digital literacy components should be definable in the education content. In other words, the created framework should be compatible with integration into educational contexts. Thirdly, the study provides a broad perspective on the digital literacy structure. In this study, describing the digital literacy concept in detail may supply a comprehensive vision of digital literacy abilities.

Containing current trend technologies with their accompanying skills may increase flexibility of the framework which makes way for updates and edits, whenever it is necessary (i.e. emergence of a new technology, procedure, etc.) However, such flexibility does not guarantee the main actors and agents of digitalization in education, namely, teachers' equipment with such skills. There is a need for an instrument to evaluate such skills and to measure their digital literacy levels.

1.4 The Significance of the Study

Various scales are developed for estimating the digital literacy levels of individuals. In various studies, researchers analyze teacher's technology understanding, perception and attitudes. For instance, there are multiple studies that explore teachers' digital literacy, and technology understanding (List et al., 2020; List, 2019; Lucas et al., 2021). In national literature, there are similar research studies aiming to develop a scale to measure teachers' digital literacy. However, Ng (2012) is widely used as a scale in literature and it has been translated into Turkish many times (Hamutoğlu et al., 2017; Üstündağ et al., 2017). Such studies for scale adaptations show a need for a scale to measure digital competences of teachers, not only pre-service teachers. Furthermore, use of such scale might help researchers to specify the skills needed for emergency cases, such as COVID-19, as well as to read early-on markers of certain warning signs for what is lacking and take precautions. Therefore, while planning learning environments, possible problems can be filtered out early on.

1.5 Purpose of The Study

The purpose of the study is to develop and validate a digital literacy scale to measure teachers' digital literacy levels utilizing a comprehensive digital literacy framework created based on the synthesis of literature review focused on digital literacy definitions and frameworks and in consideration with Bloom's Taxonomy.

For this purpose, the following research questions are pursued:

1. What is digital literacy?

2. What are the main elements of digital literacy?

3. How do these main elements come together to create a digital literacy framework?

4. What should be the structure of a scale that can be used to determine teachers' digital literacy levels?

a. What items should be included to the scale?

b. How valid and reliable is this scale?

5. What are the primary school teachers' digital literacy levels as measured by the developed digital literacy scale?

1.6 Definition of Terms

Literacy is defined in Cambridge Dictionary (2004) as having reading and writing capabilities. From different perspectives, literacy is often paired with another concept as in media literacy, financial literacy, computer literacy, information literacy, digital literacy, etc. Despite some communalities and similarities, each literacy has its own characteristics, definition and structure. Bawden (2001) states that computer literacy or internet literacy are related concepts to digital literacy. However, using the terminology incorrectly or interchangeably may create flue zones between the terms. This may lead to unclear borders and intricate structures of technology-related literacies. To avoid such vagueness the operational definitions of the relevant terms are given in this section.

Being *digitally literate* will be defined as being competent enough to live, learn and work safely and ethically in a digital world.

In line with above definition, *digital literacy framework* is defined as a dynamic set of competencies that come from cognitive, technical and social domains, which comprises many components ranging from simple and complex and encompass various knowledge and skills. It is a *dynamic* set of competencies, because of its transformative, adaptable, flexible and systematic nature.

Similar to the frequently used terminology in such frameworks, this operational definition also includes domain, knowledge, skill, and competence that needs further clarification. It is also possible to meet other terminology uses.

For instance, Ferrari (2013) mentions dimensions of digital literacy in A Framework for Developing and Understanding Digital Competence in Europe, including components, competence, skill and attitudes, whereas DQ Institute (2019) defines the Digital Intelligence (DQ) framework with eight distinctive areas, three different levels and 24 competence competencies, adding more terminology and new concepts to the mix.

In this study, domain is used to refer to the highest taxonomic rank that are composed of either subdomains containing various components or just one component that makes up the compiled digital literacy framework.

Bloom et al. (1956) define the *knowledge* as the concept that can be remembered. In this study knowledge is defined as the outcome of the assimilation of information through learning, inference, reflection, etc.

Possessing a *skill* is to be able to enact prior knowledge, use information to complete a task, solve a problem, etc.

Bloom et al. (1956) formulate the "*ability*" as the sum (joint) of "skill" and "knowledge." Some of the digital literacy frameworks reviewed in this study, uses the wording 'competency' or define 'competences' based of this operational definition of ability with an added dimension of measurement.

The comprehensive digital literacy framework offered in this study, uses mainly the knowledge and skills, as well as abilities, whenever there is a joint created by both knowledge and skills.

However, it is structured using domains, subdomains and components as its terminology, where components might correspond to either knowledge or skill, or ability at times.

1.7 Limitations

The study has two main limitations. Firstly, the study and the data collection process were conducted post-pandemic. Teachers' digital competencies have been frequently questioned in this period, and different measurement types were used within distance education. Any possible tiredness might affect this study's data collection process, and the self-reporting technique's health could be influenced. Secondly, the sample size can be increased. The digital literacy framework has been designed in detail. Therefore, the number of components led to excessive item number, requiring large sample sizes. Moreover, multiple items may affect the feasibility and applicability negatively. To avoid that, some components were not included in the scale. Regarding the demographic information, there was no homogeneity in the gender and teaching fields, which is expected, since majority of primary school teachers who are working on the field are female. On the other hand, collecting data from the genuine, in-service teachers actively working in schools, rather than teacher candidates or pre-service teachers contributes to the reliability of the study. Furthermore, employing up-to-date validity and reliability techniques in the scale development process, namely, composite reliability, discriminant validity, and convergent validity; the scale has been validated. What is more, the scale is drafted utilizing a comprehensive digital literacy framework based on the literature review, along with a Bloom's taxonomy, which is used to categorize the framework components and scale items. Such features can be considered as strengths of the study.

CHAPTER 2

REVIEW OF THE LITERATURE

2.1 Overview

In the literature review chapter, studies on the research question and the methodologies used to lighten the problem are systematically reviewed. A conceptual review of digital literacy has been presented at the beginning of the review process. Changes in understanding the digital literacy concept and approaches have been included. In the next part, the purpose of the review has been stated and existing studies have been introduced. Studies conducted on teachers' digital literacy skills have been included. At the beginning of the composition process, the research questions leading the literature review have been stated. While organizing the related studies, digital literacy concepts have been examined from two perspectives. Firstly, frameworks and approaches developed by global organizations and governmental institutions have been presented. Secondly, views by authors and researchers have been introduced. The gap in the literature and solutions provided in this study have been submitted. Predictions on the possible consequences of the study are also included. Although the research has been conducted with descriptive principles, the researcher predicts some possible outcomes about the research considering similar studies. Therefore, the expected outcomes about the research question have been stated.

2.2 Conceptual Framework

Some skills that allow the individual to read and write are needed to be literate in any field. In the case of technology-based literacies, definitions may be transformed. Technology use for specific purposes, such as learning and evaluating digital devices, can be included in digital literacy definitions.

At this point, creative, effective and efficient use may become more meaningful. In this part of the study, variety of digital literacy definitions and perspectives have been included.

2.3 Definitions, Perspectives and Frameworks on Digital Literacy

2.3.1 Definitions and Perspectives on Digital Literacy

Digital literacy is handled from different perspectives. Definitions provided by authors and organizations show similarities and differences.

Definitions highlight the multi-structure of the digital literacy concept. Digital literacy is not only examined individually but also by organizations and institutions. Industries and their partners expect some high digital skills from the employees because employees may face tough challenges (van Laar et al., 2017). DQ Institute (2019) states that there are big investments for digital literacy programs and other related concepts. Therefore, a global understanding and framework are needed by the sectors and their related partners. In this study, definitions were divided into two groups. In the first group, perspectives of global organizations, institutions and foundations were introduced. The second group is made up of the definitions made by individuals. In both groups, definitions commonly underline cognitive, technical and social domains. In table 2.1, definitions made by institutions and organizations have been listed.

Table 2.1 Definitions Made by Organizations and Institutions

Organization	Year	Emphasized Domain	Definition
American Library Association Institutional Repository (ALAIR)	2011	Technical	Digital literacy is the ability to access, assess and reach information using information and communication technologies with the help of cognitive and technical skills.
Joint Information Systems Committee (JISC)	2014	Cognitive and Technical	Digital literacy is an ability that makes people available to integrate with the digital environment and is not limited to IT skills.
Council of Europe (Frau-Meigs et al., 2017)	2017	Technical and Social	Interacting with technologies and producing, sharing, implementing, exploring, communicating, and training with the data are included in the meaning of digital citizenship. In addition, taking an active role in the digital communities responsibly by defending human rights and attending the lifelong learning process in formal and informal contexts are also included in the definition.
European Commission (EC)	2018	Technical	Using technology with self-confidence in a liable and critical way to participate the society and learning in business life are included the digital competence. Information, media and data literacy, producing content in digital platforms, digital security, overcoming problems, intellectual property and critical thinking are covered by digital competence.

Table 2.1 (Cont'd)

Organization	Year	Emphasized Domain	Definition
United Nations Educational, Scientific and Cultural Organization (UNESCO)	2018	Technical	Digital literacy is a group of abilities including reaching, assessing, leading, comprehending, communicating and producing information considering security. In the definition, abilities were described for employment, enterprise and adequate jobs. Moreover, according to the definition, competencies included by computer, ICT, information, and media literacies are also included in digital literacy.
United Nations International Children's Emergency Fund (UNESCO) (Nascimbeni & Vosloo, 2019)	2019	Cognitive and Technical	In the definition, digital literacy was defined as the ability to detect and get the positive outcomes of digital interaction and preventing from the negative sides of the same interaction. In this concept, skills that allow getting positive consequences while using the devices and platforms are included.

Organizations define the digital literacy concept by emphasizing different characteristics. American Library Association Institutional Repository (ALAIR, 2011) defines digital literacy as underlining requirements of cognitive and technical skills. In the definition, interpreting information and using some technologies for communication are two main points of the digital literacy concept. Digitally literate individuals are expected to use such technologies for reaching, developing and assessing information. In short, ALAIR requires using some technologies to get, evaluate and even compose new details. United Nations International Children's Emergency Fund (UNESCO, 2018) defines digital literacy through the information concept.

Reaching, leading, comprehending, assessing and developing information are some required skills in the definition. These skills are required to perform with digital technologies for employment and some other business-related activities. According to the perspective of UNESCO, digital literacy contains specific competencies from other literacies, such as computer literacy and information literacy. Likewise, Eshed-Alkalai (2004) places information literacy in the digital literacy framework. From these perspectives, digital literacy and some other technology-based literacies are not used interchangeably but in a hierarchical structure. London School of Economics (LSE) is another institution defining the digital literacy concept. In this definition, requirements abut accessing or evaluating the information become more general. Digitally literate individuals are expected to choose reliable and valid digital platforms (LSE, n.d., as cited in Nascimbeni & Vosloo, 2019). Individuals are expected to have the ability to understand the positive and negative outcomes of digital platforms. This ability is also included as a component in this study. To meet the competency, there should be reasoning ability. In addition, literates are expected to use digital platforms with the necessary related skills. The specific characteristics Included in the definition are preferring high-quality media and using them. The Council of Europe (2017), as an organization for human rights, provides a description based on the data. The capability to interact with digital platforms is one of the requirements of being digitally literate. Participating with digital platforms on small or global scales is included in the definition. Moreover, an individual joining such platforms as a digitally literate has responsibilities regarding behaviors, capabilities, information and some other factors. In parallel with previous definitions, data generation, sharing, contacting, and executing are some other expected skills. From a humanistic perspective defending human honor and human rights is also handled in the scope of being digitally literate. In the definition of the European Commission (2018) technology use is implemented as a way for the learning process. Using technology in a responsible way and digital participation are included in the definition. Like some other definitions presented above, some literacies like media literacy and data literacy are stated as part of the digital literacy structure. In this definition, some advanced skills are also required from the individuals such as programming. Besides the institutional perspectives, there are also individuals' definitions in the literature. In the Table 2.2, definitions and emphasized domains are demonstrated.

Table 2.2 Definitions Made by Individuals

Author(S) and Year	Emphasized Domain	Definitions
Gilster (1997)	Cognitive	Comprehending and using the information from different resources with different forms in the case of accessing throughout the computer are the abilities of digital literacy.
Martin (2005)	Cognitive and Technical	In this definition digital literacy is defined as the ability, attitude, and consciousness to use digital devices properly to lead, connect, define, assess, analyze, and synthesize digital sources and develop new knowledge. Creating new media statements and connecting with other people for positive social practice are the points also included in the definition.
Hague and Payton (2011)	Technical and Social	Creating and sharing information in kinds of forms to develop, contact and collaborate in effective way are stated for being digitally literate. Comprehending the correct case to use digital devices to enhance the process is also included in the definition.
Ng (2012)	Cognitive, Technical and Social	Digital literacy covers cognitive, technical, and social-emotional approaches in terms of learning with technology in the case of online and offline.
Spires and Bartlett (2012)	Technical and Social	Digital literacy can be defined with three points. These are reaching and using digital contents, developing digital contents, and connecting and sharing digital contents.

Table 2.2 (Cont'd)

Author(S) and Year	Emphasized Domain	Definitions
Hatlevik et al (2015)	Cognitive and Technical	Digital literacy has common points with digital competence and digital skills. There is an aspect of knowledge with skill or literacy.
White (2015)	Technical	Digital literates can use digital technologies in secure, ethical, efficient, and creative ways.
Alexander et al (2016)	Technical and Social	Digital literacy is a generic term contains abilities for using digital devices, using and developing digital contents to attend the digital environments.

Although digital literacy is mostly a technology-dependent concept, there are other factors that influence digital literacy abilities. In the current definitions, such factors have been included, and Gilster (1997) points out this situation. According to his perspective, a connection between digital literacy and ideas has been established. People who can comprehend and use information with the computer can be classified as digitally literate. Martin (2005) provides a set of competencies for digital literacy. The definition is mainly associated with technical abilities and interacting with digital devices. Using digital tools and having digital capabilities for the technology are the requirements for being digitally literate. Some of these skills, attitudes and abilities are ordered in the definition. Abilities can be categorized in analysis, synthesis and evaluation categories of Bloom's Taxonomy. In addition, social interaction is also included in the definition. Hague and Payton (2011) also provide a perspective on the digital literacy concept. Having technical abilities and interpreting the culture to digital tools are indicated to be digitally literate. Spires and Bartlett (2012) explain digital literacy with three factors. In this explanation, people are expected to form digital content. Moreover, the authors include accessing, using and sharing such content as digital literacy abilities. Digital content consumption is one of the other points emphasized by Alexander (2016). In this description, digital content consumption and creation are two practices that assist people in participating in digital society. In parallel with some other definitions, the social domain is included by Ng (2012), with cognitive and technical abilities. Learning with digital devices is frequently emphasized in digital literacy definitions. Individuals are expected to reach the information and learn with the technology. In addition, the learning process is defined not only for online platforms but also for offline platforms. White (2015) focuses on the technology use in the definition of digital literacy and prioritizes the technology with various methods. Using the technology effectively, efficiently and within the scope of digital security procedures, are the points emphasized by the author.

2.3.2 Existing Frameworks

Definitions and frameworks are the instruments helping the researcher to establish a comprehensive structure of the digital literacy concept. In this part, existing digital literacy frameworks are introduced. As inferred from the approaches and definitions, stated in the Literature Review chapter, digital literacy is established in three domains.

While some explanations emphasize the technical domain of digital literacy (American Library Association Institutional Repository [ALAIR], 2011; European Commission [EC], 2018) some of them highlight the technical domain with others (Council of Europe, 2017; Nascimbeni & Vosloo, 2019). Eshed-Alkalai (2004) points out this situation and provides a conceptual framework. In this framework, digital literacy has been analyzed with five other literacies. Photo and visual literacy is one of them. In this type of literacy, literates are required to interpret visuals. Especially while interacting with graphical interfaces, photo - visual literacy is used as the element of digital literacy; hence, digitally literate individuals can perceive the visual text or message. Independently, this concept was also included by the digital literacy framework of this study as a component with the title of *"Knowledge of Digital Symbols"*. Another type of literacy covered by Eshed-Alkalai (2004) is reproduction literacy requiring revision and multiplication of knowledge with digital materials in the scope of multiple criteria and rules. Information literacy is included in the framework associated with digital literacy. In the paper, information literacy is defined as judging and criticizing knowledge in terms and the validity. Moreover, individuals with information literacy should be able to filter information. Branching literacy, and social-emotional literacies are other type of literacies in the digital literacy framework.

Defining a universal framework for digital literacy is the research topic that researchers frequently focus on. DigEuLit is a project designed and executed to create European Digital Literacy Framework (EFDL). The project is developed in the conditions of European Commission's' online learning program (Martin, 2005). In the project, an educational perspective and elements of the digital literacy concept have been identified for the education system in Europe. In other words, the framework has been developed to provide a definition and framework that can be used in education. The project has been conducted in four stages. In the first part, the literature is reviewed. The specific definitions and key elements of the construct are specified in the first stage. Secondly, the construct of digital literacy is established. In this stage, instruments are also developed to integrate the educational progress. Practices and materials are designed to integrate digital literacy and education systems. Thirdly, the success of the framework on the target group is tested. Lastly, the framework is intended to extend globally with different methods, such as online environments. The framework is developed with four key elements. A storage unit made up of materials and contents is one of them. Students' needs or digital competence have been defined, and teachers prepare suitable materials or development programs. The Digital Competence Framework for Citizens (DIGCOMP) (Ferrari, 2013) is another project for the definition of digital competence. In the project, five dimensions have been defined and each one includes explanations of competencies. Competences are elaborated for each dimension with more specific forms. In the first dimension, the areas for digital competence are defined. In the next dimension, the competencies are stated in detail and handled more specifically. In the third dimension, proficiencies are levelized. The fourth dimension analyses some examples of related competence. In the fifth dimension, the concept is handled in terms of practical issues and implementations. The DigComp 2.0 digital literacy framework has been used as the primary material in another framework development study, A Global Framework Reference on Digital Literacy Skill for Indicator 4.4.2 (Law et al., 2018). DQ Institute (2019) has revealed a new framework for digital competence with related skills. The study underlies some futures of the framework and needs for the global understanding of digital literacy. The framework covers 24 competencies, and each competency is explained with the components of the OECD Learning Framework 2030. In this framework, digital literacy is represented by three literacies.

2.4 The Suggested Framework

The suggested digital literacy framework of the study was designed considering flexibility, comprehensiveness and adaptability. The framework provides three domains and multiple components for each domains. Components were categorized from the knowledge technical and social perspectives. In the literature review, it was figured out that digital literacy skills and abilities have been ordered in terms of complexity in some definitions (Martin, 2005; American Library Association Institutional Repository [ALAIR], 2011). In other words, digital literacy requirements can be categorized in terms of complexities. Therefore, Bloom’s taxonomy was employed to determine the components of the digital literacy framework. The primary difficulties of the research are inclusiveness and flexibility. In this study, the components have been defined for each category of Bloom’s Taxonomy within the digital literacy concept. The framework’s structure should also provide flexibility for possible updates in the digital literacy definitions. Frameworks with strict structures may become outdated. Current perspectives have been included to provide a sustainable framework. The study differs from the parallel studies at two points. Firstly, at the beginning of the research, 54 components were defined under the cognitive, technical and social domains. Each component has been described in detail to increase the flexibility of the digital literacy framework. Thus, possible technological inventions or enhancements can be placed or substituted in the proper domain of the framework. Moreover, the structure can comprehensively include digital skills in a more encompassing way.

2.5 Theoretical Framework

The theoretical structure of this study is examined at two points.

Firstly, the theory of the digital literacy concept, framework and related perspectives are included. At the second point, the hierarchical structure of the framework is handled. In this study, using a taxonomy while stating the digital literacy components is a distinctive factor. In this categorization model, required knowledge and abilities have been identified.

Instead of using a taxonomy a categorization model might be preferred. Bloom et al. (1956) state the difference between classification and taxonomy. Taxonomy is associated with a theoretical framework, while a classification model is interpreted with other metrics such as usability or transmission mechanism.

It is decided to use a valid and common taxonomy for a durable structure, and Bloom's Taxonomy has been used as the base of the digital literacy structure. In the taxonomy, the categories are sequential from basic to complex. In other words, there are basic and conceptual abilities at the ground level of the taxonomy. In the knowledge category, the first category of the taxonomy, the process has been specified from concrete to abstract. At the basic level, knowledge in the elementary type is called "Knowledge of Specifics". At the advanced level knowledge of specifics are transformed to the "Knowledge of Theories". The subcategories of knowledge category have been adapted to basic components of the cognitive domain within the scope of technology phenomena.

Digital Literacy is a technology-related term that also underlies learning with technology. Learning concept is included in the digital literacy definitions and explanations (Ng, 2012; White, 2015). The technology is interpreted as the device of the learning process. Being digitally literate may help the teachers in the technology interpretation. While integrating technology into the instructional design process, some digital literacy skills may be needed. The digital literacy framework includes an educational perspective with components for education.

In this study, a structure with a triple domain has been identified for digital literacy. These are cognitive, technical and social domains. Domains are made up of specific components that describe a piece of the digital literacy concept. In other words, groups of components under three domains are called digital literacy. In Figure 2.1, the digital literacy domains and components were visualized.

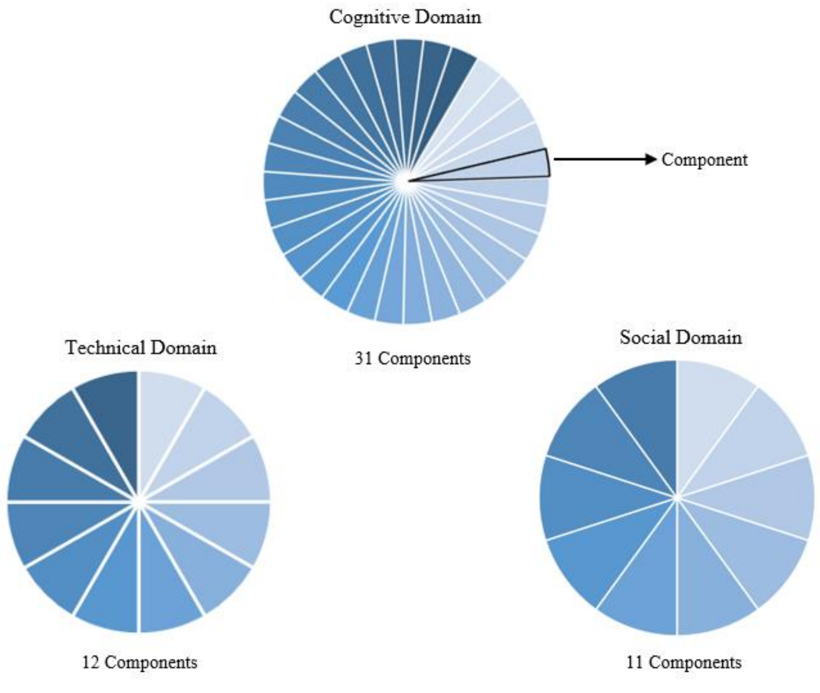

Figure 2.1 Digital Literacy Domains and Components

The comprehensive digital literacy framework offered in this study, uses mainly the knowledge and skills, as well as abilities, whenever there is a joint created by both knowledge and skills. However, it is structured using domains, subdomains and components as its terminology, where components might correspond to either knowledge or skill, or ability at times.

2.6 Components of The Digital Literacy Domains

The framework is structed around three domains which are cognitive, technical and social domains. Under these triple structure there are a total of 54 components. Specifically, there are 31 components that fall under cognitive domain, whereas technical domain comprises 12 components and social domain has 11 components. Components with common or similar characteristics were grouped under a subdomain that falls under the main domains. Names of the components and their distribution in the domains can be examined in Table 2.3, Table 2.4, and Table 2.5, that is followed by detailed explanations of each component.

2.6.1 Cognitive Domain

In this domain, individuals’ awareness and knowledge about the basics of technology, abilities for critical thinking and the analysis of digital structures were mainly covered. The cognitive domain comprises the components about the individuals' philosophical background and represents their knowledge of technology and digitalization. In the table 2.3, cognitive domain and its components are listed.

Table 2.3 Cognitive Domain of the Framework and Related Components

Cognitive Domain (Digital Concept Knowledge and Philosophical Background)
1. Awareness And Knowledge of Digital Innovation
1. Knowledge of Main Digital Terminology
2. Knowledge of Key Concepts in the Digital World
3. Knowledge About Digital Jargon Used in Journals or Other Media Technology Columns
4. Knowledge of Digital Symbols
5. Knowledge of Trend Technologies
6. Convention of Technology
7. Knowledge About the Category of Technology
8. Knowledge on Techniques and Required Skills About Technology Use
9. Knowledge of Innovative Idea Lying Background of the Technology
10. Knowledge of Choosing Correct Technology in A Variety of Cases
11. Recalling the Prior Knowledge During the Process of Learning New Technology
12. Summarizing A Digital Tool with Its Necessary Functions
13. Interpretation of Existing Technical Knowledge for The Specific Cases
2. Learning About New Technology
2.1. Being Aware of How to Learn New Technology (Metacognition)
2.2. Being Aware of Personal Effective Methods About How to Learn Using New Technology (Metacognition)
2.3. Extrapolating Specific Functions of New Technology
2.4. Comparing the Technology with The Previous One or Other Equivalents
3. Analysis of the Digital Structures
3.1. Analyzing a Technology with Pieces or Parts That Build It
3.2. Explaining The Relations Between the Parts of a Technology
3.3. Modelling The Relations Between Technologies
3.4. Analyzing The Principles of Technologies from The Pieces of Digital Structures
4. Critical Thinking
4.1. Critical Thinking About Grounded Idea of a Technology
4.2. Critical Thinking on the Technology Development Process
4.3. Critical thinking on Technology Efficiency and Usability
4.4. Producing Advice to Strengthen the Week Points of the Technology

Table 2.3 (Cont'd)

Cognitive Domain **(Digital Concept Knowledge and Philosophical Background)**
5. Formulating the Ideal Technology with Its Strong Sides
6. Learning New Instructional Media
7. Creating New Instructional Media **7.1.** Designing a Project to Develop New Instructional Media **7.2.** Creating New Platforms to Use in Education by Using Online Generator Tools
8. Integrating the New Media into The Education and Instructional Design Process
9. Digital Literacy in the Curriculum

2.6.1.1 Components Cognitive Domain. Components in the cognitive domain contains knowledge of digitals concepts and philosophical roots of technology, skills related with digital concepts. In this domain, components are categorized using most of categories of Bloom's Taxonomy. The majority of components are under the knowledge and comprehension categories and there are also some other components categorized under the higher levels of taxonomies.

Awareness and Knowledge of Digital Innovation: In this domain, individual's knowledge base is examined. Their awareness of technology, digitalization, and new technical innovations is questioned. Furthermore, knowledge about basic terms of digital environments, key concepts, and perspectives for new technologies are the topics to analyze.

Knowledge of Main Digital Terminology: Individuals define the basic and frequently used terms in the digital environment. They can clearly understand the terms in news, magazines and even articles on technology.

Knowledge of Key Concepts in The Digital World: Individuals can define main digital concepts. Using basic technical terms, they can explain the main idea of the concepts.

Knowledge about Digital Jargon Used in Journals or other Media Technology Columns: Individuals follow some trend journals about technology and innovation. They can talk about the basic and popular resources about the technology, and they can clearly understand the articles published on such media.

Knowledge of Digital Symbols: Individuals identify the symbols pressed on the digital products. They clearly explain the meaning of each symbol.

Knowledge of Trend Technologies: Individuals have a vision of digitalization concepts and the future of digital innovations. They can define upcoming technologies, their functions and potentials.

Convention of Technology: Individuals can interpret the prior knowledge base to use an unknown function of a different technology (software or hardware). At this point, individuals are expected to make some connections with similar technologies (previous versions of the technology) and produce an idea about how to run the new function. In this component, individuals get initial help from their experiences instead of the Internet. To illustrate, using the longest key for giving a blank space while using a keyboard which has not been used before.

Knowledge about the Category of Technology: Individuals have information about the categorization of digital tools in terms of their functions, software and hardware. Moreover, they can realize uncategorized technology products. For example, while learning about a new processor model, it can be placed under the "Computer Hardware" main title and "Central Processing Units" subtitles.

Knowledge of Techniques and Required Skills about Technology Use: Individuals have basic knowledge about the skills needed to use technology. They can assume the basic skills and essential techniques of the related technology. Furthermore, they can categorize the difficulty of such digital skills.

For example, Big Data is one of the trend and promising fields in the digital world. Individuals should have software and programming skills to identify, categorize and interpret the data stored in the database. Moreover, individuals should be capable of database platforms and network systems.

Knowledge of Innovative Idea Lying Background of the Technology: Individuals with basic information about new technology detail the innovative idea that inspires the developers. Starting from the background idea, they can define the development process of the related technology. In an advanced step of the component, individuals explain the background of the technology within the relation between the natural sciences. For example, individuals explain the working principles of the navigation tools with Einstein's relativity theory. The critical point is that individuals underline the scientific reasons that inspire the developers. More detailed and scientific approaches are not needed at this level.

Knowledge of Choosing Correct Technology in a Variety of Cases: Individuals can decide the most proper technology to cope with problems and use the technology-based method under different circumstances. They can integrate the right digital tools with processes that need digital solutions.

Recalling the Prior Knowledge during the Process of Learning New Technology: In the process of learning new technology, individuals can recall the prior knowledge that has been previously gained. In this component, individuals parallelize the digital concepts that have formerly been known and will be learned. Having recalled the prior knowledge, they use specific information to create a chain with a new one.

Summarizing a Digital Tool with Its Necessary Functions: Individuals have detailed information about technology. They describe them with essential characteristics. By using detailed information, individuals make effective summarizations including significant and descriptive properties of the technology.

Interpretation of Existing Technical Knowledge for The Specific Cases: Individuals interpret their technical knowledge to produce digital solutions. They can transform their knowledge for a variety of cases.

Learning About New Technology - Being Aware of How to Learn New Technology – Being Aware of Personal Effective Methods about How to Learn Using New Technology: Individuals have experience with their learning processes of modern technology or digital device. Using the experience, they estimate a learning path including effective methodologies for the learning process. Individuals have metacognitive awareness about their best learning methods.

Extrapolating Specific Functions of New Technology: With the help of previous experiences, and existing knowledge about a digital tool, individuals can estimate the characteristics of new versions. They guess possible patches that can be applied to the new versions of the digital tool. Individuals can estimate the working principles of new futures developed based on the previous versions. In this component, individuals are also expected to estimate the working principles of familiar technologies working with a similar innovative idea. They are familiar with the new technologies thanks to their knowledge base.

Comparing the Technology with the Previous One or Other Equivalents: Individuals compare the innovative idea and main functions of the technologies. They expose the differences and similarities. Furthermore, they can match the identical functions between the technologies.

Analysis of Digital Structures - Analyzing a Technology with Pieces or Parts That Build It: Individuals deconstruct the technology into its smaller pieces. They can identify the future and digital configuration of each part. Moreover, individuals have detailed information about the constructs of the digital product.

Explaining the Relations between the Parts of a Technology: Individuals explain the interrelations and connections between digital devices' parts (hardware or software). They categorize the components in terms of their importance and technical missions.

Moreover, peripherals and their integration with the basic elements are classified. To illustrate, individuals deconstruct mobile phone technology. They categorize its components into software and hardware titles. They can list the essential software and hardware components. In an example of a camera application, they exemplify the relation between the hardware and the software that uses the camera.

Modelling the Relations between Technologies: Individuals explain the working principles of massive digital platforms including several technologies and innovations. In the digital world, they interpret the connections between different technologies. For example, they know the basics of the Internet of Things (IoT) and explain the connection structure between software, the Internet, and connected device that has been managed remotely.

Analyzing the Principles of Technologies from the Pieces of Digital Structures: Individuals can detect unclear messages or main principles of digital products. Moving on the detailed information about any element of the digital device they reach the production purpose of the technology.

Critical Thinking: Individuals evaluate technologies based on internal and external factors. They use global criteria in evaluation processes. Furthermore, individuals make comparisons between the technology and previous ones.

Critical Thinking about Grounded Idea of a Technology: Individuals criticize the innovative idea that brings about digital innovation. They differentiate the digital tools in terms of their functionality. They examine the positive and negative sides of the technology and detect the insufficient properties. They can compare the functions of technology with its counterparts. Furthermore, individuals provide practical suggestions about new abilities or enhancements to upgrade the technology.

Critical Thinking on the Technology Development Process: Individuals criticize the stage of technology development. They can suggest new ideas that increase the efficiency of the development process. At this point, individuals also recommend omitting some steps based on scientific approaches and global standards.

Critical Thinking on Technology Efficiency and Usability: Individuals check whether the properties and functionalities of a digital tool meet global standards and needs. By comparing similar technologies, they describe the efficiency of technology. Based on the common usability definitions, individuals assess the usability factors of the technology.

Producing Advice to Strengthen the Week Points of the Technology: Individuals produce innovative ideas that improve digital tools. They can detect the inefficient functions of the technologies and provide some advice to increase their functionality.

Formulating the Ideal Technology with Its Strong Sides: Individuals create personal formulation that describes the ideal technology with its strong sides and error tolerances. Having designed a new technology or innovative idea, they detect the weak points and produce solutions to make them stronger.

Learning New Instructional Media: Educators follow the latest digital developments in instructional media. With the help of prior knowledge about digital learning tools, they enhance their knowledge base and enrich their media integration methodologies for the instructional design process.

Creating New Instructional Media-Designing a Project to Develop New Instructional Media: Using their experiences and knowledge about instructional media, teachers plan progress for effective and efficient instructional tool development. They can design a new type of media, unique or get rid of weaknesses.

Creating New Platforms to Use in Education by Using Online Generator Tools: With the direction of specific data, that shows the need for digital equipment in the learning process, teachers design new instructional materials that enhance the efficiency of the lectures. For example, an instructional designer develops a course web page using web-based website generators.

Integrating the New Media into the Education and Instructional Design Process: Educators effectively integrate the new digital media into the instructional design process. They produce ideas about using technology-based instructional tools in the lectures and implementing digital tools for information transfer. The component not only requires media integration but also interpreting the new media in an efficient way that reduces the time conception or increases the efficiency of information transfer.

Digital Literacy in The Curriculum: This component examines the slice of digital literacy in the curriculum. The adaptation of main factors that create digital literacy abilities and awareness of educators is explored.

2.6.2. Technical Domain

In the technical domain, the ways of technology use and knowledge interpretation are basically covered. The technical domain components represent the application of digital literacy knowledge. Individuals are expected to perform using their cognitive background in this domain. They implement the information to the technology. Technical dimension also contains some forms of technology use, and people are expected to use the technology effectively, efficiently, ethically and safely. In Table 2.4, technical domain and related components were covered.

Table 2.4 Technical Domain of the Framework and Related Components

Technical Domain	
1.	**Applying the Knowledge to the Technology** **1.1.** Accessing the Technology (Using Correct Devices to Access the Technology **1.2.** Digital Security 1.2.1. Safe Use 1.2.2. Information Security 1.2.3. Verifying the Information
2.	Using the Correct Technology in the Variety of Cases - Interpreting the Knowledge to The Current and New Technology
3.	Creative Use
4.	Ethical Use
5.	Effective Use
6.	Efficient Use
7.	Problem Solving Skills in Digital Cases
8.	Digital Content Design
9.	Instructional Material Design

2.6.2.1 Components of Technical Domain. Components in the technical domain contain skills and abilities that can be perform in daily routines. In this domain, individuals are expected to interpret the knowledge in variety of cases. Most of components of the technical domain are categorized under the application level.

Applying the Knowledge to The Technology: Individuals implement their knowledge of the technology while using it.

They execute the information about the digital tools and perform with the light of the knowledge base. At this point, individuals' experience and attitude while interacting with technology are the determinants.

Accessing the Technology - Using Correct Devices to Access the Technology: Individuals choose the proper devices to use a digital platform with high efficiency. They overcome compatibility issues and reach the technology securely.

Digital Security-Safe Use: Individuals have sufficient information about digital security and its importance. They identify the security concepts, network security phenomena and main principles to keep the systems secure and they act to meet digital security requirements. Individuals also know the processes for protecting the hardware. They use the most proper peripherals and components to keep the device healthy at an optimum rate.

Information Security: Individuals describe the information security, digital identification process and critical information concepts. They are aware of the types of personal data that should be protected. Furthermore, individuals apply security measures to provide the privacy of personal information.

Verifying the Information: Individuals describes the information verification processes. They, elaborate the characteristics of reliable sources and the references that can verify the information. They use the verification methodologies and execute the confirmation process to verify the information.

Using the Correct Technology in The Variety of Cases (Interpreting the Knowledge to The Current and New Technology): Individuals, who have detailed information about the types, properties and working principles of the technologies, apply their knowledge and use the proper technology in a variety of cases. They act on the strength of a personal knowledge base and can overcome the issues with correct technology selection.

Creative Use: For complex purposes, individuals combine different technologies and digital tools. They produce ideas about using technology for meaningful purposes. In such cases, a new functionality about the related technology is defined. While providing a new idea about creative technology use, individuals should avoid potential conflicts with the other functions and repetitions.

Ethical Use: Individuals use the technology with the direction of its purposes. By using related information, they avoid unethical actions such as unpermitted reverse engineering processes, digital bullying, fake digital identities, providing wrong information on digital platforms, and using software engines that make the same action irregularly in a short time. Individuals, moreover, give some basic examples of unethical issues.

Effective Use: Individuals integrate technology into their daily routines for specific purposes. They, use technology to upgrade their routine process and cope with problems. In a particular case, they describe the problems and their solutions. Individuals decide to use proper technology with their purposeful functions to overcome these issues. They use the related technology with all its functionality. Then, they integrate the tool into the process and get satisfactory outcomes in a predictable time. Furthermore, individuals eliminate the negative side effects of the related technology if it exists, and they focus on the relation between the reasons and results of using the technology. For example, an instructor wants to communicate with hundreds of students as soon as possible. S/he researches online communication tools and their multiple functions that allow the instructor to send messages in their unique form. Then, the instructor decides to use a mail service and communicates with students, quickly.

Efficient Use: Individuals implement the technology to increase the productivity of the process. After the correct technology integration into the process, the quality and quantity of outcomes or consequences rise and, in some cases, the effort or time spent is diminished. Individuals conserve their energy and reduce their workloads with the help of technology.

Problem-Solving Skills in Digital Cases: Individuals produce multiple solutions to technology-based problems. They analyze the progress and detect the symptomatic issues. Using the personal knowledge base, they patch or redefine the progresses to solve the issues completely. At this point, two significant indicators prove the quality of the problem-solving strategy. Firstly, having coped with the problems, the productivity of the progress should be maintained. The second important indicator is that the produced problem-solving method should not bring about new problems.

Digital Content Design: Teachers identify the technology-enriched instructional content design and its differences with a standard understanding of content development. They create new contents that improve the learning process. They decide the bite sizes, information complexity and efficient cognitive load. Moreover, teachers design new materials that ideally fit in the different kinds of medias and devices (Mobile platforms and different screen sizes)

Instructional Material Design: Teachers merge their academic knowledge background and digital skills. They develop new materials that provide an efficient learning environment for the students. This component requires the teachers to use online and offline digital tools and create digital products with the integration of course context.

2.6.3. Social Domain

Communication and content sharing are two main future of digital literacy (Spires & Bartlett, 2012) from the social perspective. Social domain underlies the digital interaction and engagement between individuals. In this part, the social requirements expected from individuals for digital literacy are described. In table 2.5, social domain and related components were covered.

Table 2.5 Social Domain of the Framework and Related Components

Social Domain
1. Using the Technology for Social Benefits
2. Digital Behaviors
3. Attitude Against a New Technology
4. Social Engagement and Social Interaction while Learning a New Technology
5. Integrating the Technology into the Social Life
6. Producing and Sharing Content in Digital Platform
7. Self-Confidence in Digital Environment and Society
8. Approaches to New Technologies **8.1.** Acceptance of New Technology or Digital Innovative Idea
9. Learning the Technology within the Social Environment
10. Applying Social Structure to The Digital Tools - Designing Responsive Digital Tools in Terms of Social and Cultural Structure

2.6.3.1 Components of Social Domain. In social domain, individuals' attitudes against the technology and integrating the technology into the social life were covered. In this domain, individuals' social behaviors were analyzed within the scope of digital literacy. In social domain, specific social behaviors and attitudes were specified. Moreover, human-computer interaction and technology integration into social life were included. At this point, technology acceptance was also contained by the social domain.

Using Technology for Social Benefits: Individuals can produce and share digital content, safely and ethically. They can communicate via digital platforms and protect themselves against cyberbullying. Individuals can engage with different cultures and enrich their sociocultural understandings.

Digital Behaviors: Individuals describe the standard behaviors while interacting with the technology online or offline. They internalize the essential virtues and show them in a variety of cases. They behave responsibly on online platforms. Individuals define the cyber ethics concept and standards. They have an awareness of cybercrimes and the existence of legislation that defines cybercrime.

With the rapid digital developments, they make radical changes in their digital behaviors and use digital tools for different purposes like digital transactions and shopping.

Attitude against a New Technology: Individuals show open-minded characteristics that allow them to learn more and behave creatively. They follow new digital enhancements without bias and hesitation and apply some of them. They describe the required innovations of legacy technologies and estimate the functionality of new versions.

Social Engagement and Social Interaction While Learning a New Technology: In the learning process, individuals benefit from social environments. They interact with friends, mates, family members and other related co-partners to share and exchange information. Moreover, individuals use reliable online platforms, forms and media hosting websites. They get information by using verification methods.

Integrating Technology into the Social Life: Individuals, who don't use any digital solution and digital tool in a specific art of life, explore alternative digital methods. They analyze the proper technology that provides digital solutions and effectively integrate it into routine life. Moreover, individuals who cannot use digital tools because of poor digital skills improve their related skills and use the technologies efficiently.

Producing and Sharing Content for Digital Platform: Individuals specialize the needs of digital platforms. They identify the characteristics of digital content and develop visual and audio-based products. Individuals also define the target group of the created product and share it with the target group members.

Self-Confidence in Digital Environment and Society: Individuals perform with high confidence boosted by their experiences and knowledge base. They identify the problems and produce efficient solutions without any bias. Moreover, individuals participate the social communities that aim to provide digital solutions and declare their opinions with the community members. They can criticize others' views and make effective corrections.

Approaches to New Technologies: Individuals conduct detailed searches about new digital innovations from multiple perspectives. Firstly, they understand the innovative idea causing the development of new technology. By using related information, they explore the available social fields that allow applying the technology and how to integrate the new technology into such fields. In the case of ineffective use, they analyze the reasons and produce new progress that effectively integrate technology with social life. In addition, like space technologies, individuals are curious about other technologies and digital inventions which is impossible to use in daily life.

Acceptance of New Technology or Digital Innovative Idea: Individuals enrich the parts of life with digitalization. They reduce time consumption and increase the efficiency of processes by using proper digital tools. They also substitute the current technologies with new ones that provide enhanced functions and purposeful tools. In other words, they can update their digital attitudes. To illustrate, a teacher proficiently uses an online tool to generate learning materials. S/he can make worthwhile materials designs. However, there is a new version of the online generator tool and compared with the previous version, the new one has multiple additional functions. Under these circumstances, the teacher analyses the feasibility of new technology with pros and cons. Then s/he transforms the current knowledge and technical skills to adapt to the new technology and produce the instructional materials using new ones.

Learning the Technology within the Social Environment: Individuals use the social environment in the learning process. They benefit the experiences and understandings of people in the social environment. Individuals differentiate the information based on their scientific background and use the verified information.

Applying Social Structure to Digital Tools - Designing Responsive Digital Tools in Terms of Social and Cultural Structure: Individuals define the characteristics of the social fabric of their community. They identify the cultural behaviors and attitudes. In the technology design process, they consider such information and construct the technology with respect to the cultural structure.

In this chapter, digital literacy concept has been analyzed in detail. Definitions of the digital literacy were reviewed, and the emphasized domain were listed. Developed frameworks, exiting studies and the theoretical background of the offered framework were covered. Moreover, the structure of suggested framework has been introduced and each component have been explained. As a result of the framework development process, the framework has been handled in terms of the flexibility, comprehensiveness and integrability concepts.

CHAPTER 3

METHODOLOGY

This chapter explicate the overall research design, sample, data collection and analysis procedures as well as postulates, predictions and types of variables as part of scale development process. Additionally, validity and reliability concerns and possible measures taken were covered.

3.1 Research Design

The goal of this study is to measure teachers' digital literacy levels based on components of the developed digital literacy framework. For this purpose, a new digital literacy scale has been developed. The data were collected quantitatively, analyzed using exploratory and confirmatory factor analyses and presented descriptively. Before the scale development process, three digital literacy domains were specified with 54 components based on literature review. Literature review implicated use of a scientific categorization process that fits with the Bloom's Taxonomy specifically its Cognitive Domain (Bloom et al., 1956), and Affective Domain (Bloom et al., 1964). To avoid excessive number of items, researcher turned to expert reviews to determine the components to be included in the scale.

In line with the purpose of the study, which is to develop and validate a digital literacy scale to measure teachers' digital literacy levels, the following research questions are investigated:

1. What is digital literacy?

2. What are the main elements of digital literacy?

3. How do these main elements come together to create a digital literacy framework?

4. What should be the structure of a scale that can be used to determine teachers' digital literacy levels?

a. What items should be included to the scale?

b. How valid and reliable is this scale?

5. What are the primary school teachers' digital literacy levels as measured by the developed digital literacy scale?

3.2 Scale Development Process

The preparation of the scale development process was divided into three parts. The first part contains the steps of framework development process. Using digital literacy definitions and existing frameworks, domains and components of the digital literacy have been defined. The components are categorized based on the Bloom's Taxonomy (Bloom et al, 1956). In the second part, scale item pool was prepared and items are stated considering the taxonomy categories. In the third part, digital the item pool was reviewed by the experts.

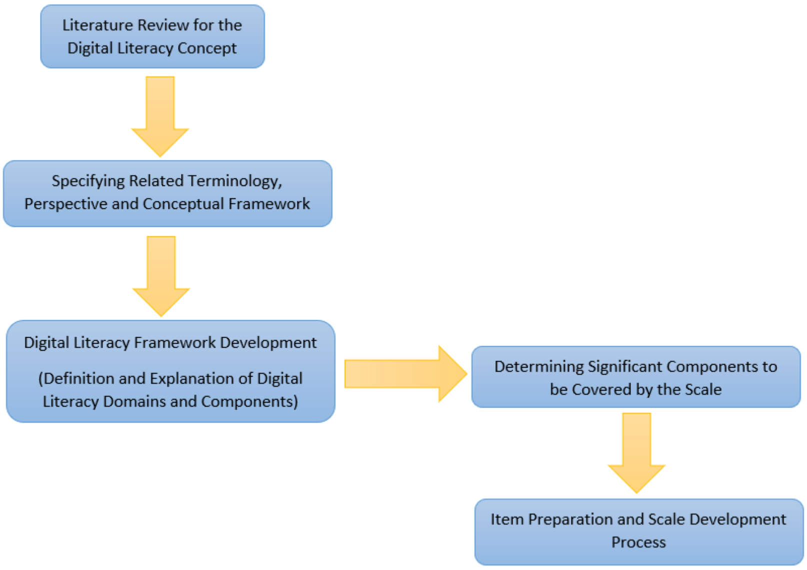

Figure 3.1 Diagram for the Preparation Process of Digital Literacy Scale

3.2.1 Methodological Assumption of the Scale Development Process

Digital Literacy scale has been developed with multiple steps. DeVellis (2003) has been used as the primary resource in scale development in this study. The path of the scale development process has been created with this resource. Moreover, additional resources (Tavşancıl, 2018; Şeker & Gençdoğan, 2020) were preferred for the scale development concept and fundamentals of scaling.

After the data collection, exploratory factor analysis and confirmatory factor analysis were conducted with reference to multiple resources (Fabrigar & Wegener, 2012; Özdamar 2017; Brown, 2006; Thompson, 2004). These resources were used for detailed information about the factor analysis concept and the steps of factor analysis. Moreover, various studies (Yurdugül & Sarıkaya, 2013; Farrell, 2008; Al-Qeisi & Hegazy, 2015) including scale development steps, factor analysis and validity and reliability tests were also reviewed. Calculations and preferred methods were analyzed and consequently, the following steps have been followed in the scale development process as recommended in these studies:

- Having developed the digital literacy framework, an item pool was prepared.
- Expert reviews were conducted and scale items were determined.
- Exploratory factor analysis and confirmatory factor analysis were performed, respectively.
- The scale was tested regarding reliability and validity.

The scale development process is visualized in the Figure 3.2, the framework development process is also detailed in the same figure.

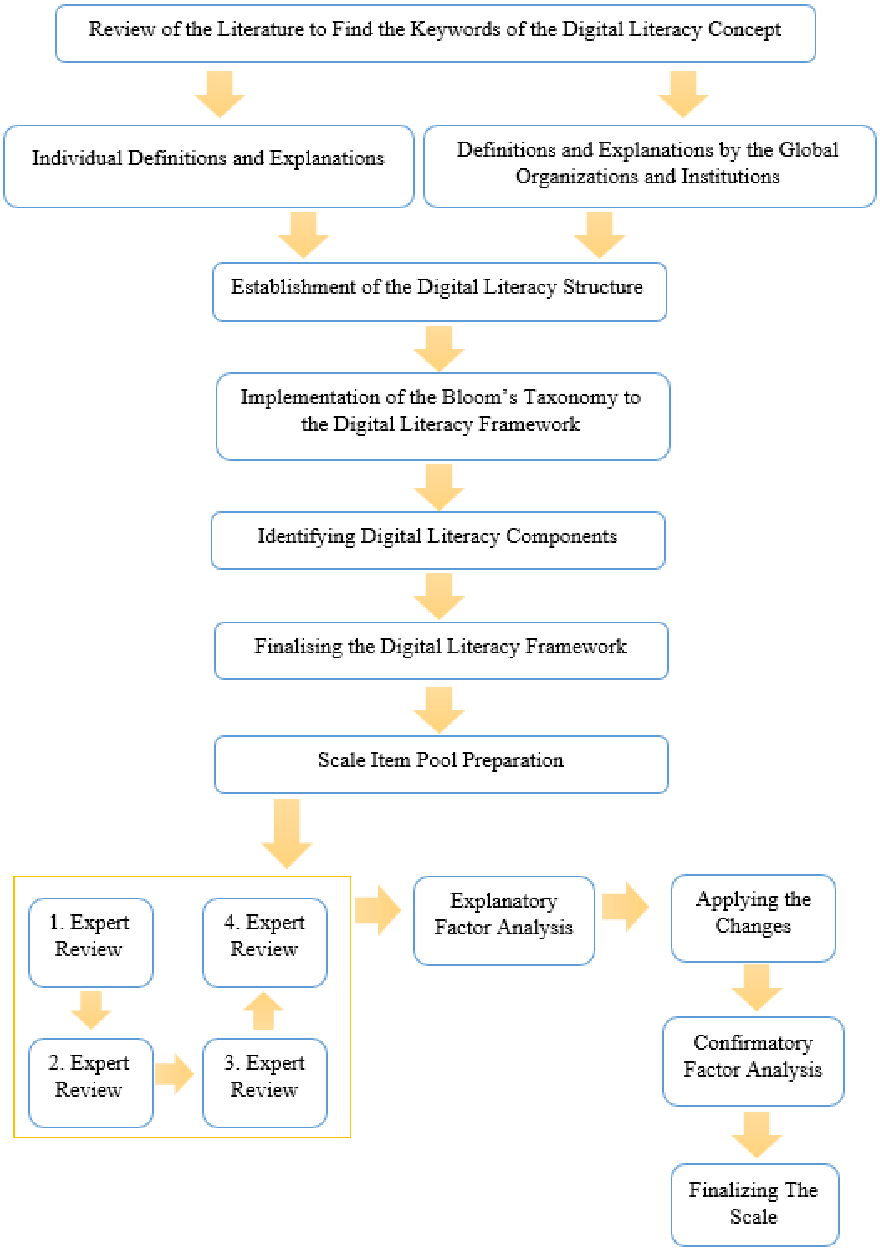

Figure 3.2 Scale Development Process

3.2.2 Preparation of the Scale Item Pool

The digital literacy framework contains 54 components. Multiple items have been prepared for each component from different aspects and wording. A total of 459 items have been stated for the item pool. Table 3.1 lists item distribution with respect to the domains and components, whereas Table 3.2 shows the distribution regarding the taxonomy categories.

Table 3.1 Item Distribution with Respect to the Domains and Components

Domain	Sub-Domain	Component	Number Of Items in Item Pool
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Main Digital Terminology	6
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Key Concepts in the Digital World	7
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge About Digital Jargon Used in Journals or Other Media Technology Columns	8
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Digital Symbols	4
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Trend Technologies	3
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Convention of Technology	4
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge About the Category of Technology	3
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge on Techniques and Required Skills About Technology Use	8
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Innovative Idea Lying Background of the Technology	7
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Choosing Correct Technology in A Variety of Cases	8

Table 3.1 (cont'd)

Domain	Sub-Domain	Component	Number Of Items in Item Pool
Cognitive Domain	Awareness And Knowledge of Digital Innovation	Recalling the Prior Knowledge During the Process of Learning New Technology	4
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Summarizing a Digital Tool with Its Necessary Functions	6
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Interpretation of Existing Technical Knowledge for The Specific Cases	3
Cognitive Domain	Learning About New Technology	Being Aware of How to Learn New Technology – Being Aware of Personal Effective Methods About How to Learn Using New Technology	5
Cognitive Domain	Learning About New Technology	Extrapolating Specific Functions of New Technology	7
Cognitive Domain	Learning About New Technology	Comparing the Technology with The Previous One or Other Equivalents	6
Cognitive Domain	Analysis of the Digital Structures	Analyzing a Technology with Pieces or Parts That Build It	9
Cognitive Domain	Analysis of the Digital Structures	Explaining The Relations Between the Parts of a Technology	10
Cognitive Domain	Analysis of the Digital Structures	Modelling The Relations Between Technologies	5
Cognitive Domain	Analysis of the Digital Structures	Analyzing The Principles of Technologies from The Pieces of Digital Structures	5
Cognitive Domain	Critical Thinking	Critical Thinking About Grounded Idea of a Technology	12

Table 3.1 (cont’d)

Domain	Sub-Domain	Component	Number Of Items in Item Pool
Cognitive Domain	Critical Thinking	Critical Thinking on the Technology Development Process	5
Cognitive Domain	Critical Thinking	Critical Thinking on Technology Efficiency and Usability	16
Cognitive Domain	Critical Thinking	Producing Advice to Strengthen the Week Points of the Technology	4
Cognitive Domain	Formulating the Ideal Technology with Its Strong Sides	Formulating the Ideal Technology with its Strong Sides	3
Cognitive Domain (Educational Perspective)	Learning New Instructional Media	Learning New Instructional Media	6
Cognitive Domain (Educational Perspective)	Creating New Instructional Media	Designing a Project to Develop New Instructional Media	9
Cognitive Domain (Educational Perspective)	Creating New Instructional Media	Creating New Platforms to Use in Education by Using Online Generator Tools	4
Cognitive Domain (Educational Perspective)	Integrating the New Media into The Education and Instructional Design Process	Integrating the New Media into The Education and Instructional Design Process	6
Cognitive Domain (Educational Perspective)	Digital Literacy in the Curriculum	Digital Literacy in the Curriculum	7
Technical Domain and Technology Use	Applying the Knowledge to the Technology	Applying the Knowledge to the Technology	5

Table 3.1 (cont'd)

Domain	Sub-Domain	Component	Number Of Items in Item Pool
Technical Domain and Technology Use	Applying the Knowledge to the Technology	Applying the Knowledge to the Technology	5
Technical Domain and Technology Use	Applying the Knowledge to the Technology	Accessing the Technology	8
Technical Domain and Technology Use	Applying the Knowledge to the Technology	Digital Security - Safe Use	28
Technical Domain and Technology Use	Applying the Knowledge to the Technology	Digital Security - Information Security	11
Technical Domain and Technology Use	Applying the Knowledge to the Technology	Digital Security - Verifying the Information	11
Technical Domain and Technology Use	Using The Correct Technology in the Variety of Cases - Interpreting the Knowledge to The Current and New Technology	Using The Correct Technology in the Variety of Cases - Interpreting the Knowledge to The Current and New Technology	13
Technical Domain and Technology Use	Creative Use	Creative Use	7

Table 3.1 (cont'd)

Domain	Sub-Domain	Component	Number Of Items in Item Pool
Technical Domain and Technology Use	Ethical Use	Ethical Use	7
Technical Domain and Technology Use	Effective Use	Effective Use	6
Technical Domain and Technology Use	Efficient Use	Efficient Use	5
Technical Domain and Technology Use	Problem Solving Skills in Digital Cases	Problem Solving Skills in Digital Cases	12
Technical Domain and Technology Use	Digital Content Design	Digital Content Design	8
Technical Domain and Technology Use	Instructional Material Design	Instructional Material Design	4
Social Domain	Using the Technology for Social Benefits	Using the Technology for Social Benefits	21
Social Domain	Digital Behaviors	Digital Behaviors	37
Social Domain	Attitude Against a New Technology	Attitude Against a New Technology	15
Social Domain	Social Engagement and Social Interaction while Learning a New Technology	Social Engagement and Social Interaction while Learning a New Technology	10
Social Domain	Integrating the Technology into the Social Life	Integrating the Technology into the Social Life	12

Table 3.1 (cont'd)

Domain	Sub-Domain	Component	Number Of Items in Item Pool
Social Domain	Producing and Sharing Content in Digital Platform	Producing and Sharing Content in Digital Platform	9
Social Domain	Self Confidence in Digital Environment and Society	Self Confidence in Digital Environment and Society	10
Social Domain	Approaches To New Technologies	Approaches To New Technologies	8
Social Domain	Acceptance of New Technology or Digital Innovative Idea	Acceptance of New Technology or Digital Innovative Idea	6
Social Domain	Learning the Technology Within the Social Environment	Learning the Technology Within the Social Environment	6
Social Domain	Applying Social Structure to The Digital Tools - Designing Responsive Digital Tools in Terms of Social and Cultural Structure	Applying Social Structure to The Digital Tools - Designing Responsive Digital Tools in Terms of Social and Cultural Structure	10
		Total: 54 Components	Total :459 Items

Table 3.2 Item Distribution by the Categories of Bloom's Taxonomy

Domain	Categories	Item Distribution
Affective Process	Characterization By a Value or Complex	3
	Organization	7
	Valuing	25
	Responding	24
	Receiving	23
Cognitive Process	Evaluation	53
	Synthesis	40
	Analysis	32
	Application	128
	Comprehension	55
	Knowledge	68
	Total: 54 Components	Total :459 Items

3.2.3 Expert Reviews

The items have been submitted for the expert opinion after completing the scale item pool. A total of four experts have examined the items. Three of the experts reviewed the items in terms of content, terminology and comprehensiveness as well as comprehensibility. Last expert checked items in terms of language use, grammar, legibility and meaningfulness.

All three experts were academicians holding a PhD degree from Computer Education and Instructional Technology and have affiliations in Faculties of Education at different universities in Turkey. They all give comprehensive feedback regarding principles of writing scale items as well as content, terminology and comprehensiveness for each item at different times in the course of revisions. All notes and comments have been applied to the related items, and the item pool has been revised.

As a result of the first revision, a few items have been added or removed from the item pool. In the second revision, items in cognitive and technical domains have been revised and items with similar statements or addressing similar cases were detected and eliminated. Consequently, the number of items in the pool was decreased to 226. In the third revision, selected items have been iteratively analyzed, and at the end of the revision process, item number has been reduced to 91. Due to the hierarchical nature of components inherited from Bloom's Taxonomy, the items measuring simple components that might be concluded from more complex components were removed to maintain the sustainability and applicability. To illustrate, "Knowledge of Key Concepts in the Digital World" is one of the digital literacy components defined in the cognitive domain. This component can be observed as nested in another component, namely, "Knowledge of Main Digital Terminology". Therefore, items written to measure "Knowledge of Key Concepts in the Digital World" were removed. Finally, after the last revision, 25 items were further eliminated yet one optional component was added and the final 68 items were identified from the item pool. Then, an expert in Turkish Language and Literature gave feedback for the grammar and wording of the remaining items. Most of the items were found as comprehensible except for one item which was removed. Moreover, some wording and grammatical corrections have been applied to a few items and the scale was finalized.

Throughout the whole preparation process, all items have been regularly re-checked regarding readability. While calculating item readability, Ateşman's (1997) readability formula for Turkish texts was used, and readability of each item was increased as much as possible. Because of the time limitation and regarding the positive and affirmative feedbacks, an additional pilot study was not conducted and the final scale with 67 items after the revisions have been used for the exploratory factor analysis. Since the dramatic changes in the item pool happened heavily after the third and fourth expert review, the item distributions after these reviews were listed in Table 3.3.

Table 3.3 Changes in Item Distribution as a Result of Expert Review

			Number of Items		
Domain	Sub-Domain	Component	Item Pool	Third Revision	Fourth Revision
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Main Digital Terminology	6	1	1
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Key Concepts in the Digital World	7	1	0
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge About Digital Jargon Used in Journals or Other Media Technology Columns	8	1	1
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Digital Symbols	4	1	0
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Trend Technologies	3	2	1
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Convention of Technology	4	2	0
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge About the Category of Technology	3	1	1

Table 3.3 (cont'd)

Domain	Sub-Domain	Component	Number of Items Item Pool	Third Revision	Fourth Revision
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge on Techniques and Required Skills About Technology Use	8	1	1
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Innovative Idea Lying Background of the Technology	7	1	1
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Knowledge of Choosing Correct Technology in A Variety of Cases	8	1	1
Cognitive Domain	Awareness And Knowledge of Digital Innovation	Recalling the Prior Knowledge During the Process of Learning New Technology	4	1	1
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Summarizing a Digital Tool with Its Necessary Functions	6	1	1
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Interpretation of Existing Technical Knowledge for The Specific Cases	3	1	1

Table 3.3 (cont’d)

			Number of Items		
Domain	Sub-Domain	Component	Item Pool	Third Revision	Fourth Revision
Cognitive Domain	Awareness and Knowledge of Digital Innovation	Being Aware of How to Learn New Technology – Being Aware of Personal Effective Methods About How to Learn Using New Technology	5	1	1
Cognitive Domain	Learning About New Technology	Extrapolating Specific Functions of New Technology	7	1	1
Cognitive Domain	Learning About New Technology	Comparing the Technology with The Previous One or Other Equivalents	6	2	2
Cognitive Domain	Analysis of the Digital Structures	Analyzing a Technology with Pieces or Parts That Build It	10	2	2
Cognitive Domain	Analysis of the Digital Structures	Explaining The Relations Between the Parts of a Technology	9	2	2
Cognitive Domain	Analysis of the Digital Structures	Modelling The Relations Between Technologies	5	1	0

Table 3.3 (cont'd)

			Number of Items		
Domain	Sub-Domain	Component	Item Pool	Third Revision	Fourth Revision
Cognitive Domain	Analyzing The Principles of Technologies from The Pieces of Digital Structures	Analyzing The Principles of Technologies from The Pieces of Digital Structures	5	1	0
Cognitive Domain	Critical Thinking	Critical Thinking About Grounded Idea of a Technology	12	2	2
Cognitive Domain	Critical Thinking	Critical Thinking on the Technology Development Process	5	1	0
Cognitive Domain	Critical Thinking	Critical thinking on Technology Efficiency and Usability	16	4	2
Cognitive Domain	Critical Thinking	Producing Advice to Strengthen the Week Points of the Technology	4	1	1
Cognitive Domain	Formulating the Ideal Technology with its Week and Strong Sides	Formulating the Ideal Technology with its Strong Sides	3	1	1

Table 3.3 (cont'd)

Domain	Sub-Domain	Component	Number of Items		
			Item Pool	Third Revision	Fourth Revision
Cognitive Domain (Educational Perspective)	Learning New Instructional Media	Learning New Instructional Media	6	2	0
Cognitive Domain (Educational Perspective)	Creating New Instructional Media	Designing a Project to Develop New Instructional Media	9	1	0
Cognitive Domain (Educational Perspective)	Creating New Instructional Media	Creating New Platforms to Use in Education by Using Online Generator Tools	4	1	1
Cognitive Domain (Educational Perspective)	Integrating The New Media to The Education And Instructional Design Process	Integrating the New Media into The Education and Instructional Design Process	6	1	0
Cognitive Domain (Educational Perspective)	Digital Literacy in Curriculum	Digital Literacy in the Curriculum	7	1	1
Technical Domain and Technology Use	Applying The Knowledge to The Technology	Applying the Knowledge to the Technology	5	1	1

Table 3.3 (cont'd)

			Number of Items		
Domain	Sub-Domain	Component	Item Pool	Third Revision	Fourth Revision
Technical Domain and Technology Use	Applying The Knowledge to The Technology	Accessing the Technology	8	1	1
Technical Domain and Technology Use	Applying The Knowledge to The Technology	Digital Security - Safe Use	28	7	5
Technical Domain and Technology Use	Applying The Knowledge to The Technology	Digital Security - Information Security	11	3	3
Technical Domain and Technology Use	Applying The Knowledge to The Technology	Digital Security - Verifying the Information	11	2	1
Technical Domain and Technology Use	Using The Correct Technology in The Variety of Cases (Interpreting the Knowledge To The Current and New Technologies)	Using The Correct Technology in the Variety of Cases - Interpreting the Knowledge to The Current and New Technology	13	3	3
Technical Domain and Technology Use	Creative Use	Creative Use	7	1	1

Table 3.3 (cont'd)

			Number of Items		
Domain	Sub-Domain	Component	Item Pool	Third Revision	Fourth Revision
Technical Domain and Technology Use	Ethical Use	Ethical Use	7	2	2
Technical Domain and Technology Use	Effective Use	Effective Use	6	1	1
Technical Domain and Technology Use	Efficient Use	Efficient Use	5	2	2
Technical Domain and Technology Use	Problem Solving Skills in Digital Cases	Problem Solving Skills in Digital Cases	12	2	2
Technical Domain and Technology Use	Digital Content Design	Digital Content Design	8	1	0
Technical Domain and Technology Use	Instructional Material Design	Instructional Material Design	4	1	1
Social Domain	Using the Technology for Social Benefits	Using the Technology for Social Benefits	21	2	2
Social Domain	Digital Behaviors	Digital Behaviors	37	6	4

Table 3.3 (cont'd)

			Number of Items		
Domain	Sub-Domain	Component	Item Pool	Third Revision	Fourth Revision
Social Domain	Attitude Against New Technology	Attitude Against a New Technology	15	2	2
Social Domain	Social Engagement and Social Interaction	Social Engagement and Social Interaction While Learning a New Technology	10	1	1
Social Domain	Integrating The Technology to The Social Life	Integrating the Technology into the Social Life	12	1	1
Social Domain	Producing And Sharing Content for Digital Platform	Producing and Sharing Content in Digital Platform	9	3	2
Social Domain	Self Confidence in Digital Environment and Society	Self Confidence in Digital Environment and Society	10	2	2
Social Domain	Approaches To New Technologies	Approaches To New Technologies	8	3	1
Social Domain	Acceptance The New Technology or Digital Innovative Idea	Acceptance of New Technology or Digital Innovative Idea	6	1	0
Social Domain	Learning the Technology Within the Social Environment	Learning the Technology Within the Social Environment	6	1	1

Table 3.3 (cont'd)

			Number of Items		
Domain	Sub-Domain	Component	Item Pool	Third Revision	Fourth Revision
Social Domain	Applying Social Structure to The Digital Tools - Designing Responsive Digital Tools in Terms of Social And Cultural Structure	Applying Social Structure to The Digital Tools - Designing Responsive Digital Tools in Terms of Social and Cultural Structure	10	1	1
		Total: 54 Components	Total: 459 Items	Total: 91 Items	Total: 67 Items

3.3 Sample and Data Collection

The sample for the study is selected from teachers participated in the Digital Teachers Project, realized by Middle East Technical University in collaboration with ING Turkey and Habitat Association. Designed by adopting a "learning by doing" approach, the project aims to improve digital literacy knowledge and skills of primary school teachers in Turkey to contribute to Turkey's digital transformation in education. It is open to all primary school teachers from around the country, where they can apply to participate in online courses on that are offered twice a year in fall and spring semesters.

For exploratory factor analysis and confirmatory factor analysis, two different samples were drawn from a pool of participants of this project. In exploratory factor analysis, the participants were teachers who were attending to the fifth period offered in the 2022 fall semester. For the exploratory factor analysis, the responses are collected from 428 primary school teachers. In this data, repetitive answers for all items have been removed. In other words, responses of the participants who marked all the questions with the same expression have been removed to clean the data. In addition, participants choosing the education level as the high school have been omitted since being a teacher in Turkey is the condition for sample selection. At the end of data cleaning procedures, 407 responses were left for the exploratory factor analysis.

As for confirmatory factor analysis, the data was collected from the teachers, who participated to the Digital Teachers Project's previous four periods between 2020 and 2022. Similar to exploratory factor analysis, same data cleaning procedures were followed. After removing cases with repetitive responses, 125 cases were left for the confirmatory factor analysis.

All in all, there were 532 participants for the explanatory and confirmatory factor analysis. In the following tables, participants' demographic information is presented including gender, age education level, subject matter expertise and years of experience.

Table 3.4 Demographic Distribution for Gender

Gender	Number of Participants
Male	441
Female	91
Total	532

Table 3.5 Demographic Distribution for Age

Age	Number of Participants
18-25	14
26-41	360
42-57	155
58+	3
Total	532

Table 3.6 Demographic Distribution for Education Level

Education Level	Number of Participants
Graduate	353
Master (Cont'd)	53
Master	113
PhD (Cont'd)	6
PhD	7
Total	532

Table 3.7 Demographic Distribution for Expertise Level

Expertise Levels	Number of Participants
0-2 years	18
3-5 years	42
6-10 years	98
11-15 years	121
16-20 years	130
21-25 years	78
>25 years	45
Total	532

Participant's fields of expertise and number of participants from each subject matter is listed in Table 3.8.

Table 3.8 Demographic Distribution for Fields of Expertise

Fields	Number of Participants
Information Technologies	3
Biology	3
Geography	1
Culture of Religion and Knowledge of Ethics	10
Science and Related Branches	59
Physics	2
Visual Arts	6
Mathematics (Elementary)	29
Mathematics	46
English	9
Music	6
Preschool Teacher	12
Special Education	11
Psychological Counsellor/Guide	21
Social Sciences	11
History	1
Technology and Design	6
Turkish Language and Literature	4
Turkish	24
Other Fields	268
Total	532

3.4 Data Analysis Procedures

The instrument of the study is a questionnaire made up of two parts. In the first part, there are demographic questions. In the second part, the scale items are placed. In the exploratory factor analysis, the sample group members accessed the questionnaire via the digital platform of the Digital Teachers Project. For the confirmatory factor analysis, the questionnaire has been prepared with Microsoft Forms, and the questionnaire link has been sent to the participants by e-mail. IBM SPSS Statistics software platform version 29.0 was used for the exploratory factor analysis, and Confirmatory Factor Analysis was conducted with IBM SPSS AMOS software version 26. The data has been anonymously collected. The scale is formed in 5-Point Likert Scale response format, and in the first version of the scale, 7 items were reversely coded.

3.5 Postulates, Predictions and Researchers' Biases

The postulate of the research is about the data collection method. In this research, the collected data is based on self-report. Participants were informed about the study in the first and the last parts of the questionnaire, and expectations for honest responses were stated. Consequently, it is postulated that the questionnaire has been objectively responded. The predictions of the study and researcher can be described at two points. Firstly, there are predictions about the scale development process. The items of the digital literacy scale were extracted from the digital literacy framework. The framework has been prepared with three domains and 54 components. However, containing numerous components may increase the item number in the scale. Thus, to avoid an excessive number of items, all the components may not be measured at the end of the scale development process. The second prediction is for the research question, about primary school teachers' digital literacy. The researcher does not expect dramatic differences regarding teachers' digital literacy. By the end of the research, it is expected that most sample group members will report high digital literacy.

3.6 Validity Concerns of the Study

This research defines digital literacy as a group of skills and abilities. It can be inferred from the definitions that a group of abilities have been called digital literacy. Domains of digital literacy can be defined as dependent variables while components of each domain can be defined as independent variables. In addition, a correlation between the cognitive and technical domains might be expected because detailed knowledge may increase the quality of technical practices. Technical practices may also bring about new experiences and feed the cognitive process. Thus, in Figure 3.3, the possible relationships between the variables of the study can be visualized.

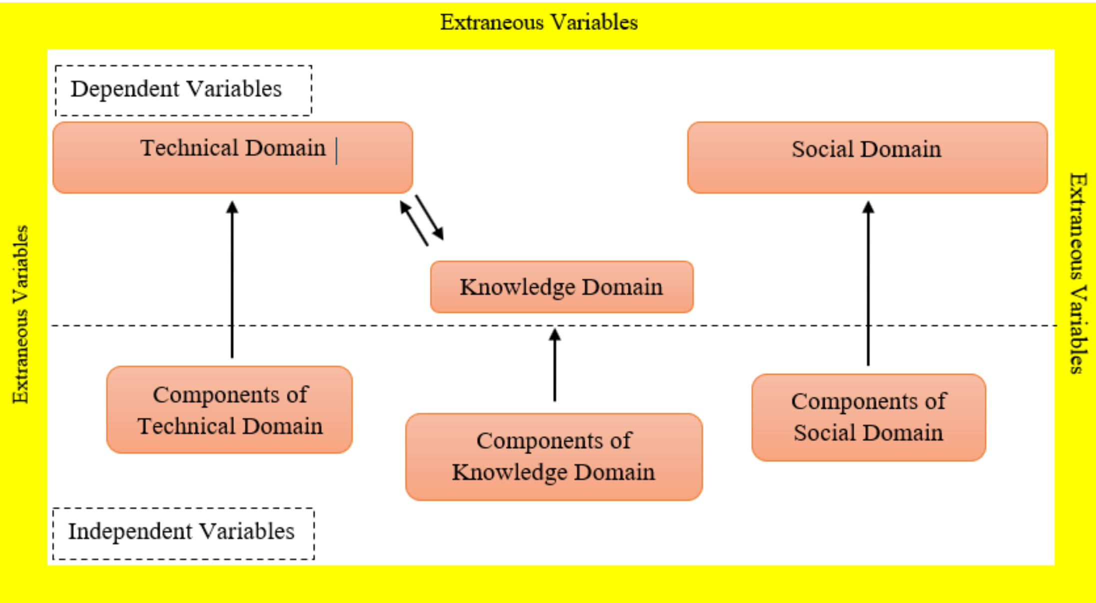

Figure 3.3 Independent, Dependent and Extraneous Variables

There are also some factors that cannot be controlled, estimated and blocked. Fraenkel et al. (2012) categorizes the extraneous variables as uncontrolled independent variables. The extraneous variables should be accepted as constant to eliminate their effects. However, there might be some influence on the results. In this research, extraneous variables are the factors that effects digital literacy components. Some extraneous variables of the research are

- Disabilities that limit the technology use
- Socioeconomic Status
- Biases against the technology and digitalization concept

3.6.1 External Validity Concerns

External validity is a generalization parameter of the results for the biggest group of environments (Frenkel et al., 2012). The applicability of the results is another factor that should be considered in the case of external validity. As a result of the study, the instrument should be feasible and represent the scale item pool with significant components. In this study, a compact scale was extracted from a large scale item pool. However, components in the social domain were not included. In addition, Oppenheim (2000) points to honest responses and protecting the study from stereotypes. Homogeneity in the sample group and concentration during the administration are significant points with sample size.

Social environment and career are other factors that impact external validity. The expert field of teachers can manipulate the digital literacy levels of the sample group members. In some cases, teachers' branches may provide an advantage for practicing digital concepts. To illustrate, ICT teachers may be more familiar with digital concepts. Lack of technology access is another obstruct for individuals who cannot do any practice.

The coronavirus pandemic and lockdowns led the researchers to examine the teachers' digital competence. Consecutive researchers and data collection processes may affect the individuals. In addition, in the self-report technique, the data may not confirm the reality. There is a concern about estimating the behaviors with the self-report. Exactness can be increased with the respondents who canalize their attention on themselves (Pryor et al., 1997). Therefore, self-report technique may influence the results of the study.

3.6.2 Internal Validity Concerns

Frenkel et al. (2012) state that validity is concluding the research based on the collected data. The data should support the research regarding appropriateness, meaningfulness, and usefulness. A valid study should transform the data into information. In the following section, validity issues have been analyzed concerning the research variables. Content validity is a type of validity that requires the representatives of the content. DeVellis (2003) defines content validity as the sampling of items representing the whole space of the related content. On a typical scale, the content should represent the research field. In this study, domains and components were defined by Bloom's taxonomy. Current understandings of the technology were included as possible. In the digital literacy framework, 54 components were identified under three domains. Cognitive and technical domains contain 33 components, and 11 most significant of them were scaled. DeVellis (2003) also recommends that researchers consult experts in the field about the content's representativeness to increase accuracy. In such a case, experts may warn the researcher about the additional domains that should be included in the scale items, or some items may be omitted. The digital literacy scale has been submitted to expert opinion in this research. Then, the items of the scale were redefined or removed. The results of the study and other studies were compared in terms of criterion-related evidence of validity. Studies containing scale development processes need evidence that shows the strength of the results. They need to be supported by another dataset which is called as creation (Frenkel et al., 2012). Creation – related validity includes the process of proof.

As mentioned above, the results of this study show consistency compared with the other studies other studies about teachers' digital literacies. The digital literacy construct was also tested with the exploratory analysis and confirmatory factor analysis, and the two-factor construct was specified.

CHAPTER 4

RESULTS

4.1 Factor Analysis of the Scale Development Process

4.1.1 Exploratory Factor Analysis

The scale development process aims to scale a group of components of the digital literacy framework. Items in the categories of knowledge, comprehension and application were primarily included. Furthermore, items stated for more complex abilities in Bloom's Taxonomy have been intended to place in the scale. Having collected the responses, explanatory factor analysis has been conducted. Özdamar (2017) states that the data should meet some conditions for exploratory factor analysis. Multivariate normality and linearity are two of them. The type of data and collecting data without any mistakes are also included in these prerequisites. In this study, a 5-point Likert scale was used, and the data was collected with online platforms. The test of linearity between the domains was conducted through the averages. In the following figures, the results of the tests of linearity between the domains are displayed.

The linearity between the Cognitive and technical domain, R^2=.57 and the Linearity between the Technical and social domain R^2=.52 are greater than .5. The R^2 value is .35 for the social domain.

Table 4.1 Linearity between the Domains

	Cognitive – Technical Domain	Cognitive – Social Domain	Technical – Social Domain
R^2	.57	.52	.35

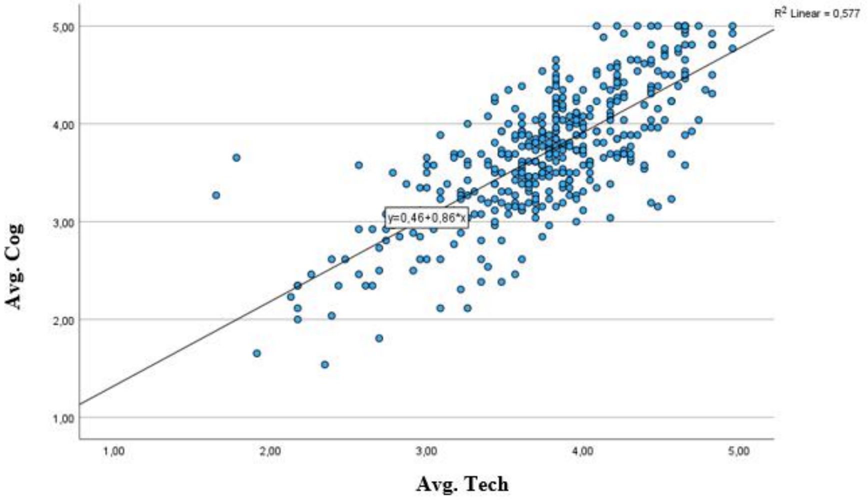

Figure 4.1 Linearity between the Cognitive and Technical Domains

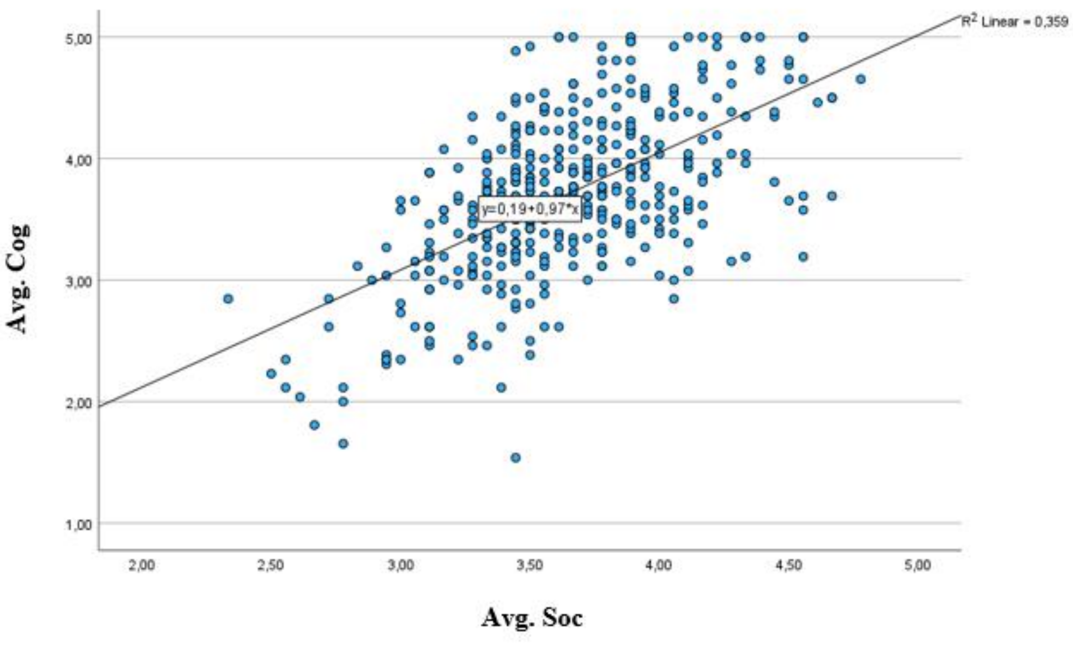

Figure 4.2 Linearity between the Cognitive and Social Domains

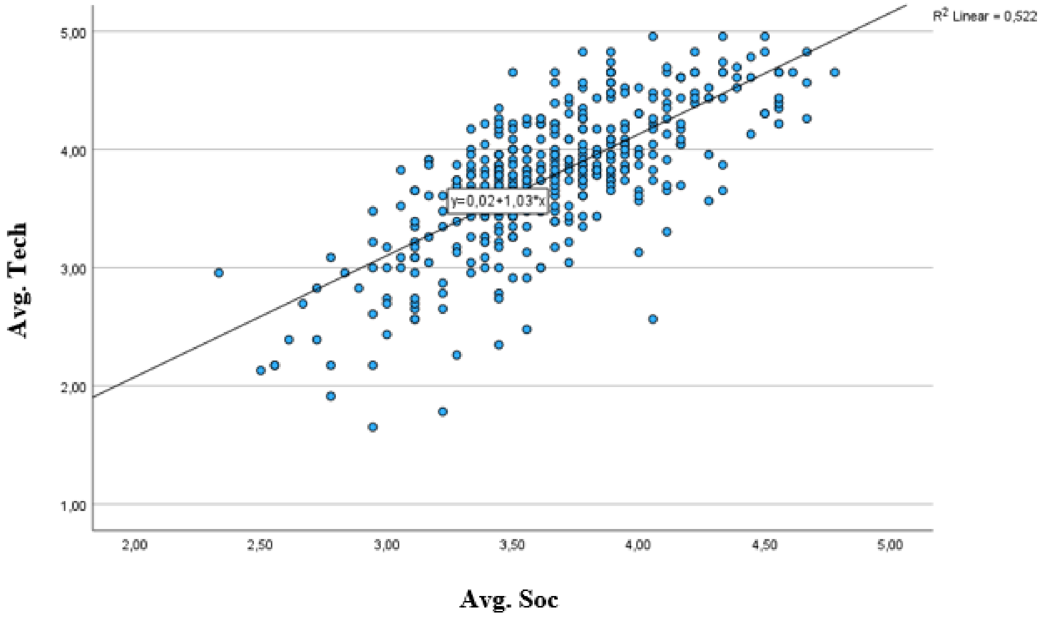

Figure 4.3 Linearity between the Technical and Social Domains

The data has been tested in terms of normality. For this purpose, univariate and multivariate normality tests were conducted. For the univariate normality, Skewness, Kurtosis, their division to the Std values, Histograms, Detrended Normal Q-Q Plot Test, Normal Q-Q Plot test, Kolmogorov-Smirnov values and the coefficient of the variance have been analyzed.

These tests were run with different types of data such as the data of cognitive, technical and social domains, T scores, and means of the individuals. Visual outputs like Q-Q Plot tests and histograms may be the determinative indicators of univariate normality. Fabrigar and Wegener (2012) include the skewness and Kurtosis values while handling the normality analysis. In this study, Skewness and Kurtosis values were between -1,5 and +1,5. However, histogram, Normal Q-Q Plot, and Detrended Normal Q-Q Plot tests mostly showed nonnormal distribution or arguable results. Kolmogorov-Smirnov values also mostly indicate the nonnormal distribution. Values obtained by dividing Skewness and Kurtosis values into Standard Errors are also mostly out of the range between -1,96 and +1,96. All in all, the univariate normal distribution was severely violated. For the exploratory factor analysis, the primary and intended type of normality is multivariate normality. Multivariate normality is necessary for the Maximum Likelihood method, and it is examined with the Mahalanobis Distance value. The maximum Mahalanobis Distance value is 28,962, greater than the Chi-Square value ($X^2(3,407) = 7.81$, p=.05). Therefore, Multivariate normality was not met. In the Table 4.2, the results of the multivariate normality test are presented.

Table 4.2 Mahalanobis Distance Values for Multivariate Normality

	Minimum	Maximum	Mean	Std. Deviation	N
Predictive Value	160,46	234,59	204,00	11,248	407
Std. Predicted Value	-3,871	2,720	,000	1,000	407
Standard Error of Predicted Value	5,968	31,927	11,051	3,699	407
Adjusted Predictive Value	163,69	236,07	204,01	11,317	407
Residual	-215,787	210,609	,000	117,096	407
Std. Residual	-1,836	1,792	,000	,996	407
Stud. Residual	-1,843	1,815	,000	1,002	407
Deleted Residual	-217,456	215,981	-,005	118,339	407
Stud. Deleted Residual	-1,849	1,820	,000	1,003	407
Mahal. Distance	,049	28,962	2,993	3,076	407
Cook's Distance	,000	,049	,003	,004	407
Centered Leverage Value	,000	,071	,007	,008	407

Although the multivariate distribution can be achieved with a transformation in the dataset, response removal or some other methods were not preferred. Fabrigar and Wegener (2012) state that methods that do not require multivariate normality can be preferred instead of data transformation. Moreover, suppose the data distribution meets the multivariate normality in an arguably way. In that case, the researchers are recommended to analyze the data with methods which do not assume multivariate normality after applying the maximum likelihood method. Before the exploratory factor analysis, the inter-item correlation was also examined. Low correlated and reverse-coded items were noticed. In exploratory factor analysis, the principal axes factoring, which does not require multivariate normality, was preferred as the extraction method. Regarding the rotation method, orthogonal and oblique rotation are two choices. The rotation method was selected with the estimation of the existence of a correlation between the factors. At the beginning of the research, the correlation between the Cognitive and Technical Domain had been expected.

In addition, weak correlations between the social domain and other domains had been expected. Therefore, oblique rotation was selected. Thompson (2004) underlies the superiority of the Promax method as an oblique rotation. Hedrickson and White (as cited in Thompson, 2004) also state that, Promax is a proper alternative if oblique rotation is selected. In this study, Promax rotation was preferred as a rotation method with the Kappa value of 4. According to the results of the KMO and Bartlett's Test, it is available to run factor analysis with the scale items (KMO = .963). Moreover, the result of Bartlett's test is significant (X^2 (1176, N=407) = 14,337, p<.001). At the beginning of the test, the factor number was inputted as three. The Total Variance, with Eigen Values greater than one, can be examined in Table 4.3. It can be inferred from table 3.11 that the Eigen Value of the Variances indicate the construct with three factors.

Table 4.3 Eigenvalues and Cumulative Values of the Factors

				Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a] Total
Factor	Total	Initial Eigen values % of Variance	Cumulative %	Total	% of Variance	Cumulative %	
1	20,811	42,472	42,472	20,346	41,523	41,523	18,304
2	3.106	6,338	48,811	2,606	5,318	46,841	17,739
3	2,641	5,389	54,200	2,148	4,383	51,224	3,055
4	1,542	3,147	57,347				
5	1,362	2,779	60,126				
6	1,183	2,415	62,540				
7	1,013	2,067	64,608				
8	,951	1,940	66,548				
9	,878	1,792	68,340				
10	,837	1,707	70,047				

In the following part, the Scree Plot is located. The conformity of the structure with three factors also be examined with the Scree Plot.

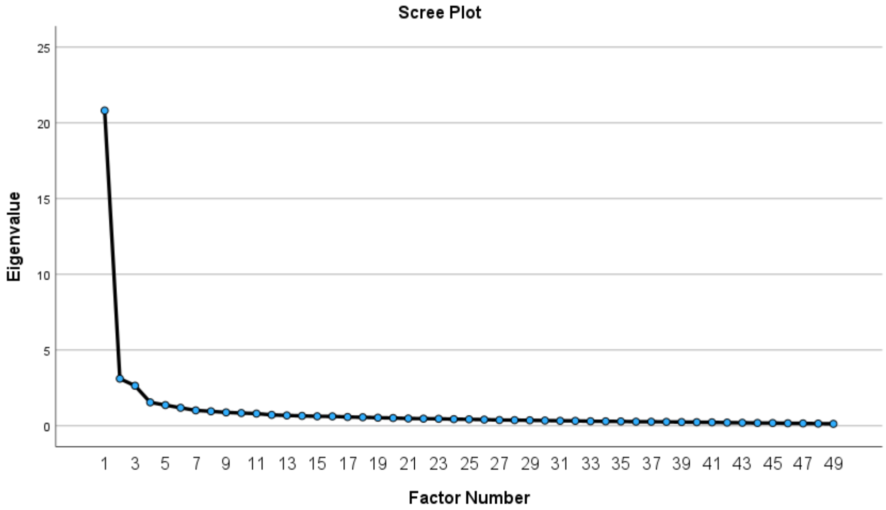

Figure 4.4 Scree Plot

During the process of exploratory factor analysis, 18 items were removed from the initial scale because of the factor loadings and communality values. As stated above, items with reverse code were under observation, and according to the results, they have been removed from the scale except three of them. The pattern matrix and factors can be analyzed in Table 4.4.

Table 4.4 Pattern Matrix

Item #	Factor			Item #	Factor		
	1	2	3		1	2	3
C7	,834			T34		,722	
C14	,815			T37		,714	
C9	,803			T32		,712	
C13	,799			T31		,654	
C12	,790			T41		,648	
C10	,766			T39		,639	
C8	,748			T52		,632	
C19	,729			T42		,615	
C6	,721			T33		,605	
C11	,719			T51		,556	
C3	,687			T43		,533	
C4	,639			T48		,520	
C17	,623			T30		,505	
C5	,618			T49		,491	
C16	,615		,405	T61		,479	
C2	,613			T64		,476	
C23	,593			S54			,702
C21	,586			S56			,650
C20	,568			S55			,542
C1	,563			S53		,305	,420
C15	,532		,359				
C24	,507						
C22	,504						
T38		,882					
T45		,747					
T36		,744					
T44		,743					
T47		,743					
T46		,728					

Pattern matrix indicates that, cognitive domain comprises 23 items, while technical domain includes 22. In this study, it was assumed that most cognitive components have the corresponding technical component. In other words, it was predicted that each cognitive component of the digital literacy framework has a reflection in the technical domain. Hence, the close item numbers in the cognitive and technical domains were found to be significant. As a result of the exploratory factor analysis, most items were filtered in the social domain. Four items in the scale were asked in the social domain; however, they have a practical meaning, too. The results of the exploratory factor analysis suggested changes in the items' domain. After analyzing these items' wording and taxonomy categories, changing the domains of four items was deemed acceptable. Four items in the social domain were replaced in the technical domain, and the social domain was conserved with four items. In the following figure, factor loads can be examined via factor matrix. The differences between the factor loads are greater than 0,1, which is an expected case for exploratory factor analysis. Communalities are another output of the exploratory factor analysis. Except one item, the extraction values are greater than 0,3. The extraction value of item S55 is .291 very close to the 0,3. The item load of S55 is sufficient, and because of the extraction value, the related item was not removed from the scale. Factor matrix and communalities can be seen in the following Table 4.5 and Table 4.6.

Table 4.5 Factor Matrix

Item #	Factor			Item #	Factor		
	1	2	3	1	2	3	4
T47	,763			S64	,647		
C23	,759			T31	,642		
C24	,752			C4	,641		
C14	,743			T41	,632	,371	
C11	,732			T44	,620	,392	
T36	,725			C15	,617	-,388	
T46	,721			T49	,617		
T32	,720			S52	,611	,384	
C12	,720			T34	,579		-,311
C13	,719		,330	C6	,575		
C9	,717			T48	,566		
C19	,714	-,384		C1	,566		
C16	,713	-,440		T43	,557		
C10	,713			T39	,540		-,340
C7	,712			S61	,524		
C22	,711			S53	,467	-,312	
C20	,704			S54		,582	,370
T30	,694			S56		,559	,315
C21	,689			S55		,464	
T38	,687		-,313				
C17	,680						
C3	,674						
T45	,670						
T42	,665						
S51	,664						
C2	,658						
C5	,657						
C8	,656						
T33	,651						
T37	,648						

Table 4.6 Communalities

Item #	Initial	Extraction	Item #	Initial	Extraction
C1	,550	,351	T37	,598	,511
C2	,726	,470	T38	,688	,616
C3	,674	,512	T39	,487	,410
C4	,563	,466	T41	,671	,539
C5	,569	,486	T42	,620	,490
C6	,518	,413	T43	,443	,352
C7	,675	,601	T44	,626	,551
C8	,643	,514	T45	,621	,543
C9	,700	,599	T46	,658	,587
C10	,694	,578	T47	,730	,648
C11	,676	,614	T48	,497	,349
C12	,680	,612	T49	,470	,397
C13	,721	,628	S51	,567	,472
C14	,723	,634	S52	,585	,522
C15	,709	,533	S53	,439	,380
C16	,808	,703	S54	,586	,477
C17	,715	,549	S55	,482	,291
C19	,762	,664	S56	,557	,412
C20	,638	,517	S61	,442	,313
C21	,648	,511	S64	,537	,444
C22	,705	,534			
C23	,755	,608			
C24	,693	,570			
T30	,629	,559			
T31	,620	,478			
T32	,719	,584			
T33	,595	,473			
T34	,509	,438			
T36	,650	,598			

The correlation matrix is the indicator indicating the correlation between the factors. Correlations between the cognitive and technical domains can be examined in the Table 4.7.

Table 4.7 Factor Correlation Matrix

Factor	1	2	3
1	1,000	,744	,179
2	,744	1,000	,099
3	,179	,099	1,000

As a result of the exploratory factor analysis, 49 items were obtained. The data displays that "*Strongly Disagree*" is the fewer statement in the answers. Therefore, "*Strongly Disagree*" was selected as a controller item. However, according to the results, this item was not used because it failed to indicate the respondents who marked the items randomly. After exploratory factor analysis, the remaining items were analyzed regarding the taxonomy categories. In Table 4.8, the distribution can be examined.

Table 4.8 Item Distribution by Bloom's Taxonomy

	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Cognitive Domain	C1 C2 C4 C5 C6 C7 C11	C3 C8 C9 C10 C12 C13 C14	T30 T32 T33 T34 T37 T38 T39 T41 T42 T43 T45 T47 T48	C15 C16 C17	C24	C19 C20 C21 C22 C23
Technical Domain		T31 T36 T44 T52 S64-T64 - Responding	S51 - T51 - VALUING S61 - T61- Valuing		T49	T46
Social Domain	S56 – Receiving	S53 - Responding S54 - Responding		S55- Organization		

4.1.2 The Confirmatory Factor Analysis

Confirmatory factor analysis is a type of structural equation modelling and basically works on theory. In confirmatory factor analysis, relations between the factors, latent variables and items are covered (Brown, 2006). Maximum likelihood method can tolerate minor violations of normality (Chou & Bentler, 1995 as cited in Brown, 2006). Therefore, the data of the confirmatory factor analysis was not modified for the normality. In the questionnaire, the scale items were ordered concerning the domains before the exploratory factor analysis.

For the confirmatory factor analysis, items were mostly ordered with respect to the domains. Four items' domains were changed after the explanatory factor analysis, and four items in the social domain were included in technical domain. In the item order, two of them were placed in the technical domain, while two items were placed in the social domain. In table 4.9, the model fit indices are demonstrated. The model was analyzed with the CMIN/DF, Goodness-of-Fit Index (GFI), Normed Fit Index Delta1 (NFI), Comparative Fit Index (CFI), Root Mean Square Error Of Approximation (RMSEA) and Standardized Root Mean Squared Residual (SRMR) values. Brown (2006) states that reporting model fit indices and their cutoff criteria are controversial issues. In this study, the cutoff values were accepted as 0,9 for GFI, NFI and CFI indices (Özdamar, 2017; Kelloway, 1998). For TLI, 0,95 is determined as the cutoff value (Hu & Bentler, 1999). For RMSEA and SRMR indices, 0,6 and 0,8 were respectively determined as the cutoff values.

Table 4.9 Model Fit Indices

Indices	CMIN/DF	GFI	NFI DELTA1	CFI	RMSEA	SRMR
Obtained Value	1,156	,924	,918	,988	,035	,0465

Ng (2012) provided a digital literacy scale frequently used by other studies. In the questionnaire, there are eight items in cognitive and technical dimensions. Attitude statements are scaled with seven items, while the social emotional dimension includes two. Compared with this scale, item numbers were close for the cognitive and technical domains. In this study, cognitive and technical domains have been scaled with 12 items. As stated above, the number of items in the social domain was diminished according to the results of exploratory factor analysis. In confirmatory factor analysis, a factor with less four items was not preferred. Consequently, some items in the social domain were filtered, and eventually, the social domain was removed from the scale while conducting the confirmatory factor analysis. Item removals and applied two modifications were applied. All in all, the significant components of the digital literacy framework have been scaled with the more proper model fit indices, reliability, and validity values. Factor loadings of the cognitive domain and technical domain can be examined in the figure 4.5. In the figure, F1 represents the cognitive domain while F2 indicates the technical domain, and standardized regression weights are included. All standardized regression weights are greater than 0,5, other criteria of the Construct Validity (Andotra & Abrol, 2016)

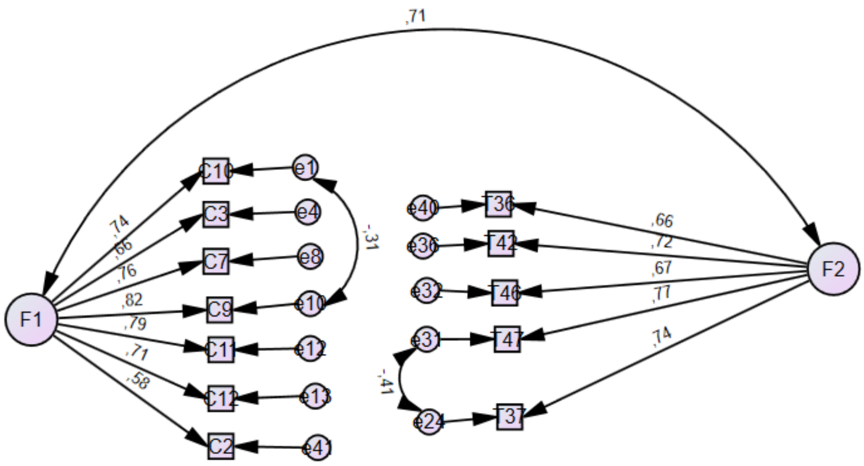

Figure 4.5 Two-Factor Model with Standardized Regression Weights

In the following figure, non-standardized regression weights are demonstrated.

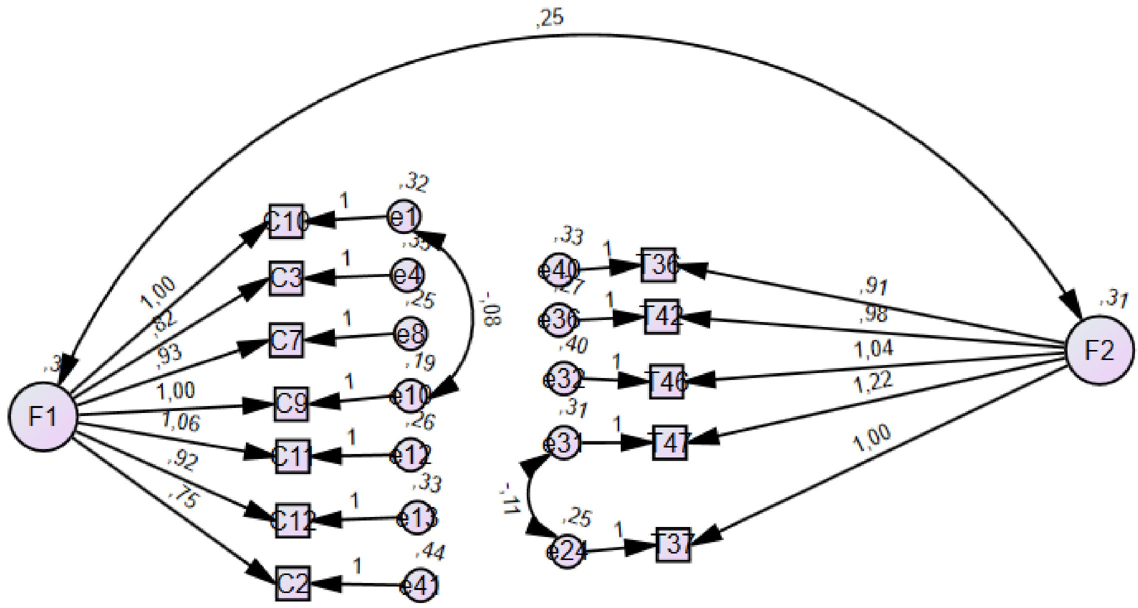

Figure 4.6 Two-Factor Model with Non-Standardized Regression Weights

4.2 Reliability of the Scale – Composite Reliability

Measuring the reliability with Cronbach Alpha is an arguable method for the structure with multiple factors. Moreover, the change in Cronbach Alpha value according to the item number is another point for criticism (Yurdugül & Sırakaya, 2013). In this study, the reliability test is conducted by calculating the composite reliability, also called construct reliability, a reliable method especially for the multi-factor construct.

The composite reliability is calculated for each factor, and reliability scores should be greater than 0,7 (Nunnully & Bernstein, 1994 as cited in Yurdugül & Sırakaya, 2013). In this study, composite reliability is met for both factors. In the following table composite reliability values are demonstrated.

Table 4.10 Composite Reliability Scores of the Domains

Domains	Composite Reliability
Cognitive Domain	0,88
Technical Domain	0,83

4.3 Validity of the Scale – Construct Validity

4.3.1 Convergent Validity

Convergent validity is a type of validity stating how the measurements catch a common structure (Carlson & Herdman, 2012). To calculate the convergent validity, average variances extracted (AVE) values have been calculated for both factors. It is required that AVE values should be greater than 0,5 for convergent validity (Peterson, 2000). AVE values are listed in Table 4.11, for cognitive and technical domains.

Table 4.11 Average Variances Extracted (AVE) Values

Domains	AVE Values
Cognitive Domain	0,52
Technical Domain	0,51

4.3.2 Discriminant Validity

Discriminant validity is of the validity type based on comparing the square root of AVE values with the correlation between the factors. Accordingly, the square root of the AVE value should be greater than the correlation between the factors (Fornel and Larcker, 1981, as cited in Yurdugül & Sırakaya, 2013).

Table 4.12 AVE Values and Correlation Between the Factors

Domains	Square Root of AVE Values	Correlation
Cognitive Domain	0,72	0,708
Technical Domain	0,71	

The Results show that the scale has appropriate values for composite reliability and construct validity with convergent and discriminant validities. In Table 4.13, standardized regression weights, estimates of the variances ($p \leq 0.001$) and the composite reliability values of each domain have been listed with the scale items.

Table 4.13 Standardized Regression Weights, Estimates of the Variances and Composite Reliability Values of Each Domain

	Item No	Item	Standardized Regression Weight	Variance Estimates	Domain Composite Reliability
Cognitive Domain	C2	Teknolojideki gelişmeleri ve dijital yenilikleri farklı kaynaklardan takip ederim.	.577	.44	0,88
	C3	Geleceğin dijital ürünleri ve sunabilecekleri yenilikler hakkında fikir yürütür, öngörüde bulunurum.	.658	.34	
	C7	Çevremle yaptığım sohbetler sırasında duyduğum sorunlara çözüm olabilecek uygun teknoloji aklımda belirir.	.759	.24	
	C9	Dijital ürünlerin kullanım amaçlarını kendi yorumlarımı da ekleyerek özetlerim.	.821	.19	
	C10	Sohbet sırasında bahsedilen sorunlara teknik bilgilerimi kullanarak çözüm üretirim.	.741	.32	
	C11	Yeni bir dijital ürünün kullanımını öğrenmek için nereden başlamam gerektiğinin bilincindeyim.	.794	.25	
	C12	Aktif olarak kullandığım dijital bir ürünün gelecek versiyonlarındaki olası yeni özellikleri tahmin edebilirim.	.708	.33	
Technical Domain	T36	Dijital ortamda bilgi güvenliğini sağlayan temel tedbirleri açıklayabilirim.	.661	.32	0,83
	T37	Dijital ortamda oluşturduğum hesapların güvenliğini sağlamak için hesaba erişim sırasında SMS ile doğrulama gibi kimlik doğrulama yöntemlerini araştırırım.	.740	.25	
	T42	Sorunların çözümünde öncelikli olarak teknoloji temelli yöntemlere başvururum.	.721	.27	
	T46	Günlük hayatta kullanmakta olduğum dijital cihazların sunduğu tüm olanakları hakkıyla kullanıp kullanmadığımı sorgularım.	.674	.40	
	T47	Teknolojiden sıklıkla yararlandığım konularda aynı işlemi daha hızlı yapabileceğim yeni dijital ürünler araştırırım.	.774	.30	

4.4 Distribution of The Items in The Bloom's Taxonomy and Scaled Components of the Digital Literacy Framework

In this part, the scale items and their categories are examined. As stated in the previous parts, some priorities were defined in the scale development process. To avoid the excessive number of items, more comprehensive and relatively significant components were intended to include in the scale. These components state the fundamentals of digital literacy, and they are generally in the knowledge, comprehension and application categories. Then, the components belonging to the categories of analysis, synthesis and evaluation have been aimed to hold as possible. In other words, if the item number unintendedly increases in the scale development process, items in knowledge, comprehension and application categories are primarily conserved. In the scale development process, items in the knowledge and comprehension categories are mostly included in the cognitive domain while the items in the application category are generally in the technical domain. In Table 4.14, item distribution by Bloom's Taxonomy has been handled.

Table 4.14 Item Distribution by Bloom’s Taxonomy

Item No	Item	Item Domain	Related Component	Taxonomy Category	Taxonomy Subcategory
C2	Teknolojideki gelişmeleri ve dijital yenilikleri farklı kaynaklardan takip ederim.	Cognitive Domain	Knowledge About Digital Jargon Used in Journals or Other Media Technology Columns	Knowledge	Knowledge of Terminology
C3	Geleceğin dijital ürünleri ve sunabilecekleri yenilikler hakkında fikir yürütür, öngörüde bulunurum.	Cognitive Domain	Knowledge of Trend Technologies	Comprehension	Extrapolation
C7	Çevremle yaptığım sohbetler sırasında duyduğum sorunlara çözüm olabilecek uygun teknoloji aklımda belirir.	Cognitive Domain	Knowledge of Choosing Correct Technology in A Variety of Cases	Knowledge	Knowledge of Methodology
C9	Dijital ürünlerin kullanım amaçlarını kendi yorumlarımı da ekleyerek özetlerim.	Cognitive Domain	Summarizing A Digital Tool with Its Necessary Functions	Comprehension	Interpretation

Table 4.14 (cont'd)

Item No	Item	Item Domain	Related Component	Taxonomy Category	Taxonomy Subcategory
C10	Sohbet sırasında bahsedilen sorunlara teknik bilgilerimi kullanarak çözüm üretirim.	Cognitive Domain	Interpretation of Existing Technical Knowledge for The Specific Cases	Comprehension	Interpretation
C11	Yeni bir dijital ürünün kullanımını öğrenmek için nereden başlamam gerektiğinin bilincindeyim.	Cognitive Domain	Being Aware of How to Learn New Technology – Being Aware of Personal Effective Methods About How to Learn Using New Technology	Knowledge	Metacognitive Knowledge
C12	Aktif olarak kullandığım dijital bir ürünün gelecek versiyonlarındaki olası yeni özellikleri tahmin edebilirim.	Cognitive Domain	Extrapolating Specific Functions of New Technology	Comprehension	Extrapolation

Table 4.14 (cont'd)

Item No	Item	Item Domain	Related Component	Taxonomy Category	Taxonomy Subcategory
T36	Dijital ortamda bilgi güvenliğini sağlayan temel tedbirleri açıklayabilirim.	Technical Domain	Digital Security - Information Security	Comprehension	Interpretation
T37	Dijital ortamda oluşturduğum hesapların güvenliğini sağlamak için hesaba erişim sırasında SMS ile doğrulama gibi kimlik doğrulama yöntemlerini araştırırım.	Technical Domain	Digital Security - Information Security	Application	-
T42	Sorunların çözümünde öncelikli olarak teknoloji temelli yöntemlere başvururum.	Technical Domain	Using The Correct Technology in the Variety of Cases - Interpreting the Knowledge to The Current and New Technology	Application	-

Table 4.14 (cont'd)

Item No	Item	Item Domain	Related Component	Taxonomy Category	Taxonomy Subcategory
T46	Günlük hayatta kullanmakta olduğum dijital cihazların sunduğu tüm olanakları hakkıyla kullanıp kullanmadığımı sorgularım.	Technical Domain	Effective Use	Evaluation	-
T47	Teknolojiden sıklıkla yararlandığım konularda aynı işlemi daha hızlı yapabileceğim yeni dijital ürünler araştırırım.	Technical Domain	Efficient Use	Application	-

4.5 Findings on Teachers' Digital Literacy Levels

The data collected for exploratory factor analysis and confirmatory factor analysis have been analyzed regarding the responses finalized scale items. In Table 4.15, items average points out of five and standard deviations are demonstrated. Then, responses were analyzed and interpreted regarding the research question in the following part.

Table 4.15 Averages of Items and Standard Deviation

Item	Average	Std. Dev.
C2	3,979323	0,921364
C3	3,827068	0,924749
C7	3,896617	0,847411
C9	3,894737	0,83034
C10	3,734962	0,874012
C11	4,024436	0,800991
C12	3,667293	0,906257
T36	3,855263	0,908067
T37	4,144737	0,825506
T42	3,954887	0,858016
T46	3,81203	0,921804
T47	3,894737	0,90417

4.5.1 Awareness and Knowledge of Digital Innovation

In the scale, items C2, C3, C7, C9, and C10 were mainly stated to scale the individuals' awareness and knowledge about digital innovation. More explicitly, individuals are expected to follow significant technological developments and predict the future of technology based on existing knowledge. In addition, explaining the production purpose of a digital device and providing solutions for problematic digital cases are also included. Teachers scored an average of 3,86 (*SD*=0,87). Figure 4.7 shows the distribution of responses regarding teachers' in awareness and knowledge about digital innovation.

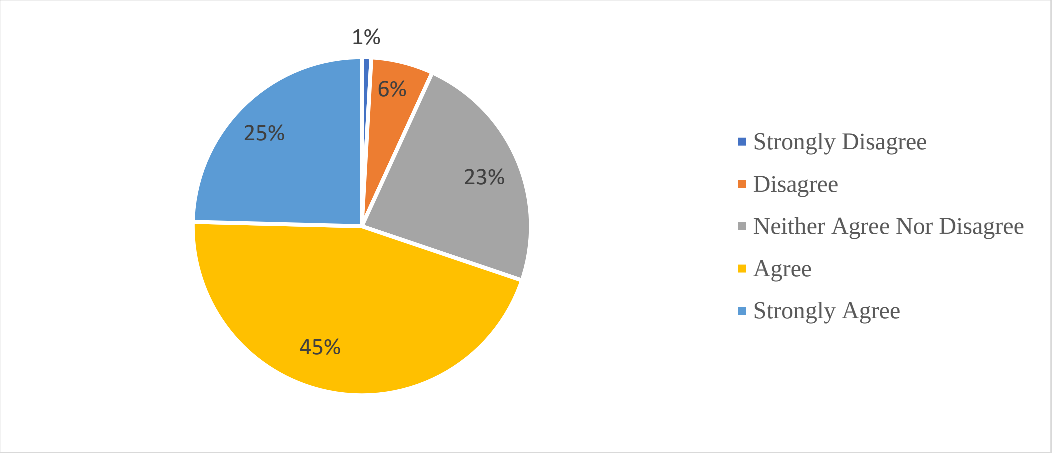

Figure 4.7 Response Distribution for Awareness and Knowledge of Digital Innovation

4.5.2 Learning about New Technology

Individuals' self-learning methods and some metacognitive skills are measured with the items C11 and C12. More precisely, to learn about new technology, individuals are expected to extrapolate possible enhancements for the next generation of similar technologies. Teachers scored an average of 3,84 (*SD*=0,85). Figure 4.8 shows the distribution of the responses for learning about new technology.

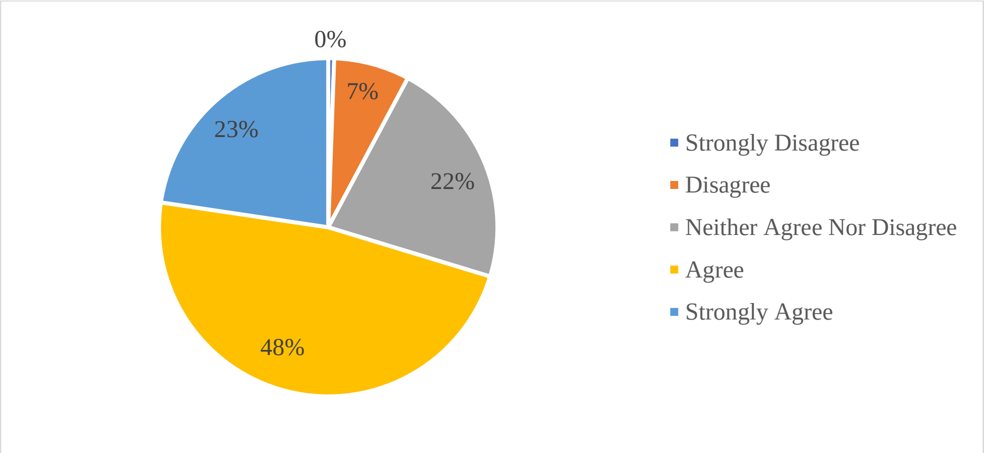

Figure 4.8 Response Distribution of Items for Learning about New Technology

4.5.3 Digital Privacy and Information Security

Items T36 and T37 scale the practice-based components. Information security concepts and basic digital precautions were handled with more specific components. Teachers scored an average of 3,99 (*SD*=0,86). Figure 4.9 shows the distribution of the responses regarding the digital privacy and information security.

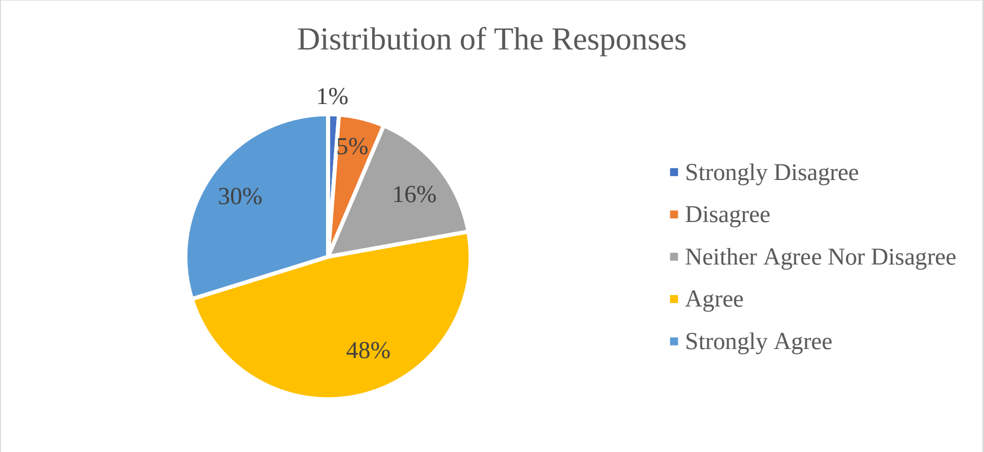

Figure 4.9 Response Distribution of Items about Applying the Knowledge to the Technology

Individuals are expected to prioritize the technology in practice in item 42. Knowledge interpretation and selecting the right technology in various cases are the significant points of the related component. Teachers scored an average of 3,95 (*SD*=0,85). Figure 4.10 shows the distribution of responses regarding the using correct technology in the variety of cases and interpreting the knowledge to the technology.

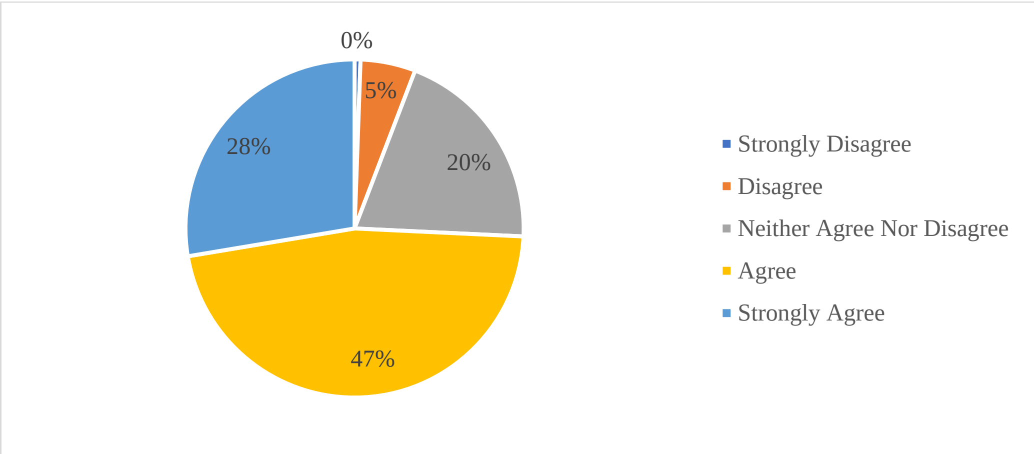

Figure 4.10 Response Distribution of Items about Using the Correct Technology in the Variety of Cases and Interpreting the Knowledge to The Current and New Technology

4.5.4 Effective and Efficient Technology Use

Items T46 and T47 examine the fundamentals of ideal technology use. Individuals are expected to use technology effectively and efficiently. Effective technology use (T46) was stated to scale component in the evaluation taxonomy category. For the effective technology use, teachers scored an average of 3,81 (*SD*=0,92). In terms of the efficient use, the average score is 3,89 (*SD*=0,90). Figure 4.11 and 4.12 shows the distribution of responses regarding the effective and efficient technology use.

Effective Use:

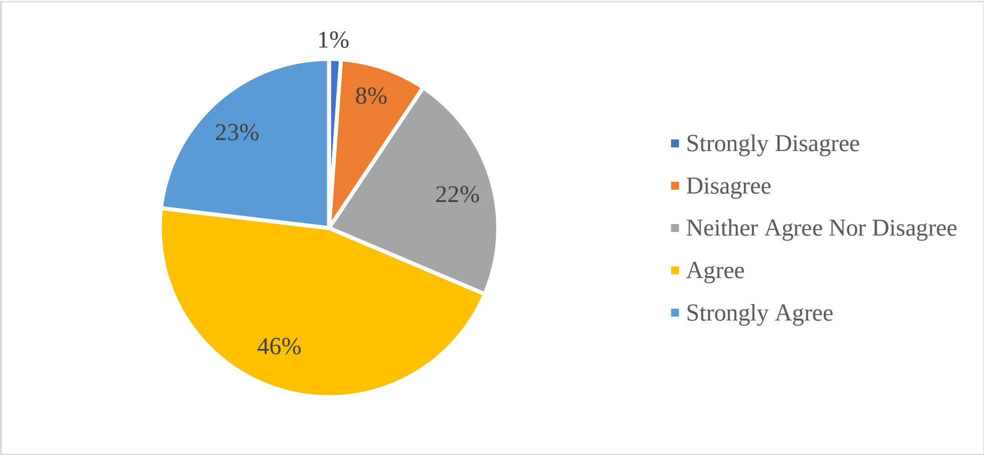

Figure 4.11 Response Distribution of Items about Effective Technology Use

Efficient Use:

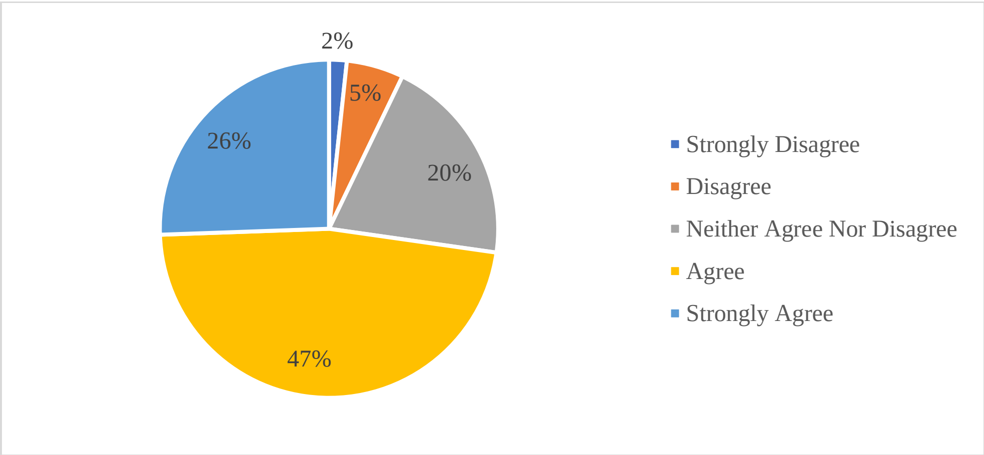

Figure 4.12 Response Distribution of Items about Efficient Technology Use

4.6 Summary

At the end of data analysis, teachers mostly selected "Agree" and "Strongly Agree" statements. According to the results, participants consider they meet the relevant components of the digital literacy framework. It can be reported from the results that teachers perceive themselves as they have an awareness of digital concepts and self-learning methods; they can extrapolate the digital innovations and use the technology effectively and efficiently in a secure way.

CHAPTER 5

DISCUSSIONS AND RECOMMENDATIONS

The results of the study are consistent with other studies that explore teachers', pre-service teachers' or students' digital literacies and beliefs on digital literacy. In this study, perceived digital literacies have been scaled. However, performance tests and other measurements, types without self-report, may indicate different cases. Porat et al. (2018) addressed this situation and conducted a study to measure digital literacy. The study compared the self-reported results with the reality, and a difference was reported. Self-confidence in digital literacy skills was high; however, except in a few cases, the actual performances did not meet the estimations. Participants' positive perceptions about digital skills were also stated in some other studies. Zhao et al. (2021) conducted a systematic review and reported that participants were proficient in fundamentals. Ng (2012) explored digital literacy levels and whether the participants can learn to use unknown technologies. As a result of the study, it was reported that they were capable of using such technologies to develop a work. Studies show that individuals may overestimate the digital literacy skills they have. On the contrary, they may perform as a digital native and use basic digital literacy skills. The ability test or objective measurements can be administered to measure the exact digital literacy. Reliable measurements and scores indicating a high level of digital literacy show that teachers have sufficient knowledge level and technical capabilities. This may be a factor assisting the instructional design process. Moreover, higher digital literacy skills may allow the integration of digital literacy with the curriculum and positively affect the educational settings and the education of learners who will face digital challenges in the near future.

5.1 Recommendations for Further Research

As stated in the earlier chapters, digital literacy is the trend research topic in interdisciplinary fields. In this research, items of the digital literacy scale are prepared in Turkish. For global use, the scale can be translated into other languages. During the scale development process, some items, especially in the social domain have been removed because of item loadings, reliability and validity issues. With larger sample sizes, some components in the social domain can be included in the digital literacy scale. In other words, more comprehensive scales may be available with larger sample groups. Studies for the standardization process can also be conducted with a larger sample size. As a recommendation the scale can be used by ICT teachers.

The components included by the scale can be integrated with the education process. Digital literacy framework can be placed in the ICT course syllabuses. The scale is administrated at the beginning of the course, and the scale components can be measured with ability tests in the evaluation process of the course. Especially the integration with the evaluation processes may give clues about the students' self-perceptions on digital literacy. Instructional designers may also use the digital literacy framework while designing a course. The framework may provide a detailed perspective on digital concepts and their taxonomy categories. The complexity of the components can be examined and ordered in the course design. Regarding the other teachers, the digital literacy structure and framework components may provide a broad perspective on the concept of digital literacy and technology. They can develop their skills and abilities with the help of the framework. The scale may also be used to understand the digital literacy requirements within the scope of included components. The following scoring procedure is recommended for ICT teachers and instructional designers. Teachers who integrate digital literacy components in the education process can use scale and ability tests. Then, the explanations in scoring procedures can be used to clarify the learning performance.

5.1.1 Recommended Scoring Procedures

The scoring procedure was prepared based on the taxonomy categories. The requirements were explained for each category, and Bloom's taxonomy categories were defined in the scope of technology. The scoring procedures can be used by ICT teachers and instructional designers who integrate the components of the digital literacy framework with the taxonomy categories. The scale can also be used in the scoring procedure; however, measuring the rest of the components, including the scale components, with performance tests may provide more detailed data.

Knowledge Layer: Individuals are expected to have detailed information about the terminology and fundamentals of the digital world. They are aware of the digital innovations and requirements of different technologies in terms of cognitive perspective. Moreover, individuals can recall prior knowledge, especially in the learning processes. In this layer, individuals have essential knowledge backgrounds about digital tools. They have detailed information on the theories and the concepts of technology. Individuals are also expected to be aware of their effective learning methods.

Comprehension Layer: Individuals summarize technology-based theories and digital tools. They can interpret the function of technologies. Individuals categorize digital tools in terms of their functions. Moreover, they can categorize them in terms of different perspectives, such as innovative ideas or roles in the digital environment. In the comprehension layer, individuals compare the technologies and with the help of such comparisons they explain the strengths and weaknesses of digital tools. In addition, individuals can guess the functions of the next version of the technology.

Application Layer: The application layer is the practice and technical part of the procedure. Individuals, in the application layer use put their knowledge in practice. They perform based on the knowledge base. In other words, individuals are expected to execute the information during a digital operation.

Interpreting the information, and preferring the correct technology are the basics of the stage. The application layer can be matched with the technical domain of the framework and mostly includes components.

Analysis Layer: Individuals deconstruct the technologies and digital tools. They explain each functional part technologies. The interrelations of the parts and the relations between the technologies, including integrated digital platforms, can be defined. Moreover, individuals explain how the pieces of technology can compose new digital tools. Individuals, also classify the parts of the technologies. They differentiate the parts of the digital tools and group them in terms of their tasks. At this point, the layer requires the analysis of physical hardware, software analysis and analysis of integrated digital platforms. Individuals can describe the sub functions of the software. They modularize the software and computer systems. Furthermore, individuals deconstruct the integrated digital platforms that include multiple technologies.

Synthesis Layer: Individuals can synthesise a digital device or a theory. They can establish connections between the parts. Individuals are also expected to bring the information together while identifying s digital-based theory.

Evaluation Layer: Individuals criticize the technologies with their strong and weak points. They can check the functionalities and properties of the digital tools and provide qualified information on whether they work correctly. In this layer, individuals have comprehensive knowledge backgrounds and implement the knowledge efficiently. Individuals use critical thinking skills and analyze the efficiency of the technologies. They report the ineffective functions of digital tools and provide recommendations to increase the efficiency of technology. In other words, individuals criticize technology and develop digital solutions that enhance digital tools.

5.2 Summary

This study examined the digital literacy concept from different perspectives to scale primary school teachers' digital literacies. Current digital literacy definitions and frameworks have been analyzed, and some common points were highlighted.

A digital literacy framework has been defined with three domains. Each domain includes components that explain a part of the digital literacy concept. The framework components have been categorized with Bloom's taxonomy, used while defining educational objectives. The study aims to develop a scale to measure some specific components. For this purpose, a scale development process was conducted. As a result of the exploratory and confirmatory factor analysis, the cognitive and technical domains were scaled with 12 items. The digital literacy scale included 11 components under four taxonomy categories. The responses to scale items show that primary school teachers perceive themselves as if they can meet the related digital literacy components. The study provides a digital literacy scale and a framework. The framework contains 54 components, each categorized with respect to the taxonomy categories. Therefore, it can be functional in integrating digital literacy with the education systems. Moreover, from the cognitive and technical perspective, the scale can be used to scale the related components of the digital literacy framework.

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APPENDICES

A. Ethical Approval

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

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01 ARALIK 2022

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Dr. Öğretim Üyesi Göknur KAPLAN

Danışmanlığını yürüttüğünüz Yunus PAŞALI'nın ***"Günümüz Dijital Yeterliliklerinin Bloom'un Taksonomisi ile Sınıflandırılması ve İlköğretim Seviyesinde Eğitim Veren Öğretmenlerin, Dijital Yeterliliklere Dair Algı ve Tutumlarını Ölçmek, Dijital Becerileri Üzerine Öngörülerde Bulunmak Amacıyla Dijital Okuryazarlık Ölçeği Geliştirilmesi Çalışması"*** başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek **605-ODTUİAEK-2022** protokol numarası ile onaylanmıştır.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Sibel KAZAK BERUMENT
Başkan

Prof. Dr. I.Semih AKÇOMAK
Üye

Dr. Öğretim Üyesi Müge GÜNDÜZ
Üye

Dr. Öğretim Üyesi Şerife SEVİNÇ
Üye

Dr. Öğretim Üyesi Murat Perit ÇAKIR
Üye

Dr. Öğretim Üyesi Süreyya ÖZCAN KABASAKAL
Üye

Dr. Öğretim Üyesi A. Emre TURGUT
Üye

B. Ethical Approval (Revised)

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ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

28 ŞUBAT 2023

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Dr. Öğretim Üyesi Göknur KAPLAN

Danışmanlığını yürüttüğünüz Yunus PAŞALI'nın **"DİJİTAL OKURYAZARLIĞI ÖLÇMEK: ÖĞRETMENLER İÇİN BİR ARACIN GELİŞTİRİLMESİ VE GEÇERLEMESİ"** başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek **0151-ODTUİAEK-2023** protokol numarası ile onaylanmıştır.

Bilgilerinize saygılarımla sunarım.

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Başkan

Prof.Dr. İ.Semih AKÇOMAK
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Doç. Dr. Ali Emre Turgut
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Dr. Öğretim Üyesi Şerife SEVİNÇ
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Dr. Öğretim Üyesi Murat Perit ÇAKIR
Üye

Dr. Öğretim Üyesi Süreyya ÖZCAN KABASAKAL
Üye

Dr. Öğretim Üyesi Müge GÜNDÜZ
Üye

C. Confirmatory Factor Analysis Results

The model is recursive.
Sample size = 125

Variable Summary (Group number 1)

Your model contains the following variables (Group number 1)

Observed, endogenous variables

C10
C3
C7
C9
C11
C12
T37
T47
T46
T42
T36
C2

Unobserved, exogenous variables

F1
e1
e4
e8
e10
e12

e13
F2
e24
e31
e32
e36
e40
e41

Variable counts (Group number 1)

Number of variables in your model:	26
Number of observed variables:	12
Number of unobserved variables:	14
Number of exogenous variables:	14
Number of endogenous variables:	12

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	14	0	0	0	0	14
Labeled	0	0	0	0	0	0
Unlabeled	10	3	14	0	0	27
Total	24	3	14	0	0	41

Models

Default model (Default model)

Notes for Model (Default model)

Computation of degrees of freedom (Default model)

Number of distinct sample moments:	78
Number of distinct parameters to be estimated:	27
Degrees of freedom (78 - 27):	51

Result (Default model)

Minimum was achieved
Chi-square = 58,943
Degrees of freedom = 51
Probability level = ,208

Group number 1 (Group number 1 - Default model)

Estimates (Group number 1 - Default model)

Scalar Estimates (Group number 1 - Default model)

Appendix C (Cont'd)

Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
C10	<---	F1	1,000				
C3	<---	F1	,824	,116	7,117	***	
C7	<---	F1	,928	,113	8,240	***	
C9	<---	F1	1,004	,126	7,947	***	
C11	<---	F1	1,063	,123	8,622	***	
C12	<---	F1	,922	,120	7,670	***	
T37	<---	F2	1,000				
T47	<---	F2	1,225	,181	6,771	***	
T46	<---	F2	1,042	,151	6,881	***	
T42	<---	F2	,981	,134	7,313	***	
T36	<---	F2	,910	,135	6,761	***	
C2	<---	F1	,752	,121	6,224	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
C10	<---	F1	,741
C3	<---	F1	,658
C7	<---	F1	,759
C9	<---	F1	,821
C11	<---	F1	,794
C12	<---	F1	,708
T37	<---	F2	,740
T47	<---	F2	,774
T46	<---	F2	,674
T42	<---	F2	,721
T36	<---	F2	,661
C2	<---	F1	,577

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
F1	<-->	F2	,245	,050	4,862	***	
e24	<-->	e31	-,115	,036	-3,230	,001	
e1	<-->	e10	-,075	,028	-2,656	,008	

Correlations: (Group number 1 - Default model)

			Estimate
F1	<-->	F2	,708
e24	<-->	e31	-,412
e1	<-->	e10	-,305

Appendix C (Cont'd)

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
F1	,390	,085	4,592	***	
F2	,307	,070	4,380	***	
e1	,320	,049	6,544	***	
e4	,347	,047	7,306	***	
e8	,247	,036	6,840	***	
e10	,190	,033	5,842	***	
e12	,258	,039	6,560	***	
e13	,330	,046	7,121	***	
e24	,254	,044	5,800	***	
e31	,308	,056	5,447	***	
e32	,400	,057	6,989	***	
e36	,272	,041	6,684	***	
e40	,327	,046	7,053	***	
e41	,441	,059	7,505	***	

Modification Indices (Group number 1 - Default model)

Covariances: (Group number 1 - Default model)

			M.I.	Par Change
e40	<-->	e41	5,197	,083
e12	<-->	e41	4,433	-,070
e10	<-->	e41	4,406	-,063
e1	<-->	e8	4,210	,058

Variances: (Group number 1 - Default model)

	M.I.	Par Change

Regression Weights: (Group number 1 - Default model)

			M.I.	Par Change
T36	<---	C2	4,429	,139

Minimization History (Default model)

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	5		-1,074	9999,000	698,538	0	9999,000
1	e	5		-,120	1,683	332,971	19	,503
2	e*	0	318,194		1,003	154,002	4	,837
3	e	0	89,740		,451	117,926	5	,000
4	e	0	57,196		,674	71,960	2	,000
5	e	0	86,473		,449	60,171	1	1,143
6	e	0	121,621		,184	58,978	1	1,098
7	e	0	130,103		,041	58,943	1	1,028

Appendix C (Cont'd)

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
8	e	0	130,908		,002	58,943	1	1,002
9	e	0	130,910		,000	58,943	1	1,000

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	27	58,943	51	,208	1,156
Saturated model	78	,000	0		
Independence model	12	721,641	66	,000	10,934

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	,030	,924	,883	,604
Saturated model	,000	1,000		
Independence model	,264	,312	,187	,264

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	,918	,894	,988	,984	,988
Saturated model	1,000		1,000		1,000
Independence model	,000	,000	,000	,000	,000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	,773	,710	,763
Saturated model	,000	,000	,000
Independence model	1,000	,000	,000

NCP

Model	NCP	LO 90	HI 90
Default model	7,943	,000	31,175
Saturated model	,000	,000	,000
Independence model	655,641	572,995	745,731

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	,475	,064	,000	,251
Saturated model	,000	,000	,000	,000
Independence model	5,820	5,287	4,621	6,014

Appendix C (Cont'd)

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	,035	,000	,070	,717
Independence model	,283	,265	,302	,000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	112,943	119,267	189,307	216,307
Saturated model	156,000	174,270	376,608	454,608
Independence model	745,641	748,452	779,581	791,581

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	,911	,847	1,098	,962
Saturated model	1,258	1,258	1,258	1,405
Independence model	6,013	5,347	6,740	6,036

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	145	163
Independence model	15	17

Execution time summary

Minimization: ,020
Miscellaneous: ,146
Bootstrap: ,000
Total: ,166

D. Digital Literacy Scale

Madde No	Madde	Kesinlikle Katılmıyorum	Katılmıyorum	Ne katılıyorum Ne katılmıyorum	Katılıyorum	Kesinlikle Katılıyorum
1	Teknolojideki gelişmeleri ve dijital yenilikleri farklı kaynaklardan takip ederim.					
2	Geleceğin dijital ürünleri ve sunabilecekleri yenilikler hakkında fikir yürütür, öngörüde bulunurum.					
3	Çevremle yaptığım sohbetler sırasında duyduğum sorunlara çözüm olabilecek uygun teknoloji aklımda belirir.					
4	Dijital ürünlerin kullanım amaçlarını kendi yorumlarımı da ekleyerek özetlerim.					
5	Sohbet sırasında bahsedilen sorunlara teknik bilgilerimi kullanarak çözüm üretirim.					
6	Yeni bir dijital ürünün kullanımını öğrenmek için nereden başlamam gerektiğinin bilincindeyim.					
7	Aktif olarak kullandığım dijital bir ürünün gelecek versiyonlarındaki olası yeni özellikleri tahmin edebilirim.					
8	Dijital ortamda bilgi güvenliğini sağlayan temel tedbirleri açıklayabilirim.					
9	Dijital ortamda oluşturduğum hesapların güvenliğini sağlamak için hesaba erişim sırasında SMS ile doğrulama gibi kimlik doğrulama yöntemlerini araştırırım.					
10	Sorunların çözümünde öncelikli olarak teknoloji temelli yöntemlere başvururum.					
11	Günlük hayatta kullanmakta olduğum dijital cihazların sunduğu tüm olanakları hakkıyla kullanıp kullanmadığımı sorgularım.					
12	Teknolojiden sıklıkla yararlandığım konularda aynı işlemi daha hızlı yapabileceğim yeni dijital ürünler araştırırım.					