2020, 14(2), 119-139
Novitas-ROYAL (Research on Youth and Language)
ISSN: 1307–4733

Research Article

Development and Validation of Digital Writing Scale for Preservice Teachers

Oğuzhan ATABEK[1]

[1]PhD., Akdeniz University, Antalya, TURKEY
oguzhanatabek@gmail.com
ORCID: 0000-0002-2695-1598

Article information

Submission	21/07/2020	Revision received	19/08/2020
Acceptance	24/09/2020	Publication date	20/10/2020

Keywords: Digital writing, Digital literacy, Hayes and Flower model, Process theory of writing, Writing process

Abstract: The purpose of this study was to develop and validate a Digital Writing Scale that measures the perspectives of individuals on digital writing. A total of 615 preservice teachers studying in the faculty of education at a state university in Turkey participated in the study (n = 615). The data were collected in two phases for exploratory factor analysis and confirmatory factor analysis. Three-hundred pre-service teachers participated in the first phase and 315 in the second phase of the study. In the analyses of the data obtained in the first phase, the exploratory factor analysis employed principal axis factoring technique with direct oblimin rotation and a two-factor model, both of which consists of 7 items, was obtained. The Cronbach's α coefficients were 0.851 for digital translating factor and 0.852 for digital reviewing factor. In the second phase, confirmatory factor analysis with maximum likelihood estimation demonstrated a statistically significant model fit to the data with five indices indicating a good fit and one indicating a substantial fit. The study, which endorsed the Hayes and Flower model and cognitive process theory of writing, resulted in a valid and reliable Digital Writing Scale. Digital Writing Scale is the first Turkish scale that measures the perspectives of individuals on digital writing. Factor scores did not differ according to sex or department of the respondents.

Anahtar Sözcükler: Dijital yazma, Dijital okuryazarlık, Hayes ve Flower modeli, Yazmayla ilgili süreç kuramı, Yazma süreci

Dijital Yazma Ölçeğinin Geliştirilmesi ve Geçerliliğinin Sınanması

Özet: Bu çalışmanın amacı, bireylerin dijital yazmaya yönelik perspektiflerini ölçen Dijital Yazma Ölçeği'ni geliştirmek ve geçerliliğini sınamaktır. Çalışmaya Türkiye'deki bir devlet üniversitesinin eğitim fakültesinde öğrenim gören 615 öğretmen adayı katılmıştır (n=615). Veriler, açımlayıcı etken çözümlemesi ve doğrulayıcı etken çözümlemesi için iki aşamada toplanmıştır. Çalışmanın birinci aşamasına 300, ikinci aşamasına ise 315 öğretmen adayı katılmıştır. Birinci aşamada elde edilen verilerin çözümlenmesinde, açımlayıcı etken çözümlemesi için doğrudan enküçültücü eğik (direct oblimin) döndürmeli temel eksen etken çıkarım yöntemi kullanılmış ve her ikisi de 7 öğeden oluşan iki etkenli bir model elde edilmiştir. Cronbach's α katsayısı dijital dönüştürme etkeni için 0.851, dijital gözden geçirme etkeni için ise 0.852 olarak hesaplanmıştır. İkinci aşamada, en büyük olabilirlik kestirimi ile gerçekleştirilen doğrulayıcı etken çözümlemesi, beşinin iyi uyumu birinin de güçlü uyumu gösterdiği beş endeks ile verilere istatistiksel olarak anlamlı biçimde uyumlu bir modeli göstermiştir. Hayes ve Flower modeli ile yazmayla ilgili bilişsel süreç kuramını temel alan bu çalışma, geçerli ve güvenilir bir Dijital Yazma Ölçeği ile sonuçlanmıştır. Dijital Yazma Ölçeği, bireylerin dijital yazmaya yönelik perspektiflerini ölçen ilk Türkçe ölçektir. Etken puanları katılımcının cinsiyetine ya da bölümlerine göre farklılık göstermemiştir.

To Cite This Article: Atabek, O. (2020). Development and validation of digital writing scale for preservice teachers. *Novitas-ROYAL (Research on Youth and Language)*, *14*(2), 119-139.

1. Introduction

Symbolic language, writing, and print, which were three great communication revolutions, have led to the current revolution of information technology (IT) (Ferris, 2002). Apparently, the social phenomena which are conceptualized as information revolutions seem to be always related to writing activity. Additionally, Ferris (2002) states that the computer was a product of a literate society. Bolter (1996a) goes even further and argues that computers are late developments of the print age. Therefore, information technologies are accepted as electronic extensions of prevailing models of literacy (Ferris, 2002). Moreover, ITs such as computers are now thought to be the primary medium for verbal communication (Bolter, 1996b). Hence, it seems that, tools or methods that are used for writing are paving the way for the invention of new tools or methods of writing. Remarkably, new tools or methods of writing always bring with them innovations that affect many aspects of society other than writing. Writing with ITs such as desktop, laptop, tablet computers, smartphones, handheld devices, game consoles, smart TVs, Internet, etc. is referred to as electronic or digital writing. Digital writing differs from traditional writing in many aspects including, but not limited to, nonlinearity, fixity, interactivity, etc. (Ferris, 2002). Being a writer in contemporary times requires new skills (Rowsell & Decoste, 2012). Digital writers, who are using multiple tools to produce written communication, are considered to be literate in both traditional and digital ways of written communication (Troia, 2010). Especially in advanced technological societies, today, most writing is digital (DeVoss et al., 2010). The prevalence of digital writing makes it even more important for educators and educational researchers to consider.

Writing "is such an important learning tool because it helps students to understand ideas and concepts better" (Voon Foo, 2007, p. 4). Voon Foo (2007) argued that writing is "a skill which invokes the higher cognitive functions like analysis and synthesis" (p. 5). On the other hand, as the world becomes increasingly dependent on IT (Eriksson & Giacomello, 2006), ITs significantly alter traditional conceptions of writing (Ferris, 2002). Dahlström (2019) stresses that not only the communication but also the ways we make meaning are changing. Bailie and Huset (2015) report that while ITs affect the writing process, conversely, writing processes and styles affect ITs as well. They argue that there is a symbiotic relationship between technology and writing technique that cannot be ignored. Learning new writing techniques is more important than learning how to use the technology that is used for writing (Bailie & Huset, 2015). In parallel with the change in the way we write, instructional practices and writing assessments are slowly changing to meet writing demands and needs of modern learners too (Heath, 2013). Therefore, in addition to the importance arising from its prevalence, digital writing emerges as an important research area due to the changes it creates in learning and teaching.

Pointing out the effects of digital writing on traditional text, Ferris (2002), calls for a re-examination of the prevailing print metaphor for online writing. Moreover, Dahlström (2019) urges that due to the changes resulting from the effects of IT on writing, it becomes relevant to discuss how meaning is made in education and to investigate the possibilities and the challenges in the use of digital tools in education. Despite all, National Commission on Writing indicated that writing research has been the most neglected area of study as compared with the research in reading and arithmetic (National Commission on Writing, 2004). Even though digital writing and measurement of it has become increasingly important for teachers and hence for preservice teachers (Neal, 2011), validation studies of the tools used to measure digital writing are lacking (Poe, 2013). A review of the literature also did not reveal any instrument that might be suitable for measuring the perspectives of teachers or preservice teachers on digital writing, let alone developed according to the Hayes and Flower's model. Hence, it seems that there is a deficiency in measurement tools that can be used in researching digital writing, contributing to the scarcity of research on writing. Considering the inherent dependence of the teaching profession on writing and assessment of writing, a research tool that can be employed for measuring the perspectives of preservice teachers, who are future teachers, on writing can contribute to the efforts aimed at elimination of this deficiency. Therefore, considering the change created by ITs on the writing process and assessment of writing, significance of digital writing in today's world, lack of a Turkish scale for measuring digital writing behavior, and the need for research on digital writing (Heath, 2013, Hillocks, 2007; Juzwik et al., 2006; National Commission on Writing, 2004; Poe, 2013; Troia, 2010), this study aims to contribute to the literature by developing a digital writing scale, that is reported to be needed for research on digital writing in order to provide writing researchers with a new tool for investigating the perspectives of individuals on digital writing. The research is intended to develop and validate a research instrument which can be used to measure the perspectives of individuals on digital writing.

1.1. Writing

Writing is a phenomenon which causes the period of time from the beginning of life to the invention of itself to be called "prehistoric." Daniels (1996) stated that "[h]umankind is defined by language; but civilization is defined by writing" (p. 1). Coulmas (2003) argues that "[t]he immensity of written record and the knowledge conserved in libraries, data banks, and multilayered information networks make it difficult to imagine an aspect of modern life unaffected by writing" (p. 1). There are many meanings of the word "writing." Coulmas (2003) distinguishes six meanings of writing: "(1) a system of recording language by means of visible or tactile marks; (2) the activity of putting such a system to use; (3) the result of such activity, a text; (4) the particular form of such a result, a script style such as block letter writing; (5) artistic composition; (6) a professional occupation" (p. 1). This study is concerned about (2): the activity of putting the system of recording language by means of visible or tactile marks into use.

As is the case with the meaning of the word, there are numerous theories of writing. Boltz (1999) defines writing as "graphic representation of speech" (p. 110). Richardson (2000) argues that writing is a "way of knowing—a method of discovery and analysis" (p. 923). Goody (1986), controversially, defines writing as the technology of the intellect. In "A Study on Writing," which was the most widely cited work on writing for a long time (Coulmas, 2003), Gelb defines writing as "a system of human intercommunication by means of conventional visible marks" (1963, p. 12). On the other hand, Coulmas (2003) stresses that the function of writing is not limited to the representation of sounds. He contends that "writing cannot and should not be reduced to speech" (p. 16). In a similar vein, de Saussure (2011) articulates that "language and writing are two distinct systems of signs" (p. 28). Therefore, understanding of writing ranges from a mere representation of sounds to a distinct system of signs —a language on its own. It is seen as a way of knowing (Richardson, 2000), a way of thinking and meaning making (Bergman, 1984), and even a way of feeling (Lyons, 2013). Digital writing further extends this range by bringing new possibilities and challenges to the writing process. Abundance in the number of models and theories of writing reflects the different perspectives of researchers from various scientific fields. Understanding of how writing works and how it can be studied seems to differ between scientific disciplines (Coulmas, 2003). There may even be differences between branches of the same disciplines. Prestin (2008) argues that "research on writing as a human competence is based upon both process-oriented and product-oriented methods" because "while the writing systems are a traditional domain of theoretical linguistics, the production (and comprehension) of written language falls into the realm of cognitive linguistics" (p. 226). Hence there are competing theories and models of writing.

Most of the contemporary research on writing is concerned with cognitive and linguistic aspects of composition (Coulmas, 2003). Cognitive theories of composition underlines that "writing is thinking" (Galbraith, 2009a, p. 20). Inspired by research on problem solving, cognitive theories of composition aimed at shedding light on the mental processes involved in writing. Researchers who endorse cognitive theories of composition consider writing as a knowledge-constituting (Galbraith, 2009b) and choice-making (Flower & Hayes, 1981) process. The Hayes and Flower's (1980) model of writing, which is the first cognitive model of writing (Hyland, 2003), is also the first general model on writing (Alamargot & Chanquoy, 2001).

1.2. Digital Writing

National Writing Project defines digital writing as "compositions created with, and oftentimes for reading or viewing on, a computer or other device connected to the Internet" (DeVoss et al., 2010, p. 7). Information technologies are so pervasive that they affect almost all aspects of human behavior including but not limited to observing, accessing, reading, thinking, and expressing. Bruce (1997) argues that the word technology seems unavoidable in discussions of literacy theory and practice. Barker (2005) states that, at present, most of the students use information technologies for researching and producing written work which is used as part of assessment process afterwards. Grabill and Hicks (2005) emphasizes that teachers and teacher educators should no longer have a conversation about literacy without considering IT. Today, digital writing goes beyond being a simple necessity, and it is suggested that digital writing should be evaluated while measuring students' writing ability (Li, 2006). Moreover, Kutlu (2013) reported that information technologies let students improve their writing skills more easily compared to traditional ways of improvement. Students also demonstrated a belief that information technologies enhance their capacities to write (Snyder, 1993). Similarly, prospective teachers evaluated digital writing as advantageous in terms of "legibility and spelling check, reader and writer interaction and visual appeal, time saving and convenience, affordability, quick feedback and constructive criticism, encouragement, archiving possibilities and socialization" (Aytan, 2017, p. 1).

Writing is not a series of events that are arranged in a linear order and are happening in a single-pass timeline. Schwartz (1984) stressed that writing is not a series of "chronologically ordered tasks" (p. 239). Rather it is a complex of recursive and embedded activities (Flower & Hayes, 1981) and includes many different processes (Harmer, 2004). Therefore, the act of writing requires individuals to prepare in advance. Remarkably, compared to writing with pen and paper, individuals do less pre-planning while writing with computers (Li, 2006). It seems that pen and paper, after all, may not be the perfect tools for writing at least under all circumstances. Writing has its challenges especially considering its physical and psychological constraints. Writing with pen and paper may be slow, revising the text may be toilsome, identifying errors may be difficult, and limitations of memory may also be a hindrance (Daiute, 1983). Information technologies such as computers can reduce the effects of such constraints and ease the burden of writing (Kutlu, 2013). Previous research indicates that writing with computers helped developing writers to revise more, including higher level revisions (Bernhardt et al., 1989; Daiute, 1985; Dalton & Hannafin, 1987; Johnson, 1988; Li, 2006; Li & Cumming, 2001; McAllister & Louth, 1988). Snyder (1993) also reports that review of the research on digital writing reveals that with the use of a word processor there is a decrease in mistakes and an increase in revisions and correction of mistakes. Moreover, Pruden et al. (2017) indicate that digital writing contributed to an increase in student writing interest, text production, self-efficacy, and scaffolded writing processes.

Positive effects of digital writing are not limited to the logistical aspects of the writing process. Digital writing has a potential to positively influence individuals' understanding of writing (Rowsell & Decoste, 2012), perception of writing (Nobles & Paganucci, 2015), ability in writing (Alshumaimeri, 2011; Jones et al., 2009; Relles & Tierney, 2013), competence in writing (Tan et al., 2006), and skill in writing (Alshumaimeri, 2011; Avgerou & Vlachos, 2016; Choo & Li, 2017; Duwila & Khusaini, 2019; Nobles & Paganucci, 2015; Wheeler & Wheeler, 2007; Yunus et al., 2013). It has been shown to have a positive impact on students' quality of writing, as well (Alshumaimeri, 2011; Cheung, 2016; Choo & Li, 2017; Lee, 2004). Digital writing is reported to facilitate students' learning process about writing (Yunus et al., 2013), nurture a positive attitude towards writing (Tan et al., 2006), encourage to engage in more writing processes (Choo & Li, 2017), and even alter their writer identities (Buckingham, 2008; Relles & Tierney, 2013).

Previous research reveals that while writing with computers, individuals write essays of better quality (Bernhardt et al., 1989; Kitchin, 1991; Lam & Pennington, 1995; Li, 2006; Li & Cumming, 2001; Owston et al., 1992; Pennington, 1996; Williamson & Pence, 1989). Cheung (2016) reports that, compared to the ones using paper and pencil, those who composed on computers did better in "stating rhetorical situation, setting the macro rhetorical goal, organizing the information to achieve the macro rhetorical goal, and choosing the words in order to suit the rhetorical situation" (p. 29). Lam and Pennington (1995) indicate that students writing with a computer significantly outperformed the ones writing with paper and pencil in organization, vocabulary, language use, and mechanics of composition. The scores were nearly significantly better in the aspect of content of the composition, as well. Similarly, Adair-Hauck et al. (2000) report that students who use information technologies while learning the writing skill are able to improve writing skills more significantly because of having access to feedback about their errors in grammar, style and spelling through the features of those technologies. Additionally, Snyder (1993) emphasizes that computer-writing context in the classroom was more interactive, cooperative and collaborative compared to the pen context. Moreover, results of meta-analyses conducted on studies comparing writing with computers vs. paper-and-pencil demonstrate significant mean effect sizes in favor of computers for quantity of writing and quality of writing (Goldberg et al., 2003). Meta-analyses results indicate that the writing process is "more collaborative, iterative, and social in computer classrooms as compared with paper-and-pencil environments" (p. 2).

1.3. Hayes and Flower's Model

Prestin (2008) describes Hayes and Flower's (1980) model as "the first general model of text production with the focus on problem-solving activities" (p. 226). Among all models, the model of Hayes and Flower is still a prominent basis for writing research (Alamargot &

Chanquoy, 2001). The writing model of Hayes and Flower (1980), as well as all other cognitive models and theories of writing, is predicated on the work of Janet Emig (1971). Emig published her famous study titled "The Composing Processes of Twelfth Graders" for the National Council of Teachers of English of the United States of America in 1968. In her study, she broke down the writing process into distinct parts. Murray (1972) organized her parts into three phases: prewriting, writing, and rewriting. Advancing the work of Emig (1971) and Murray (1972), Hayes and Flower initially developed a general model of the processes involved in writing (1980). Subsequently, they developed a theory of writing expertise (Hayes & Flower, 1986). The term of model is considered as a blueprint or an outline. Writing models allow researchers to focus on some dimensions of the writing task, without forgetting that these dimensions belong to a complex system (Alamargot & Chanquoy, 2001) such as theories of composition.

Flower & Hayes (1980) stated that their approach has been to study writing as a problem-solving, cognitive process. They (1980) define the act of writing as an unpredictable, exploratory, cognitive, and problem-solving oriented creative thinking process which consists of both discovering the thought to be expressed and expressing what is discovered in an appropriate way. The writing model of Hayes and Flower (1980) consists of three recursive processes that are at the center of competent writing: planning, translating and reviewing (Coulmas, 2003). The planning process includes generating ideas, determining goals, and organization. The translating process includes converting conceptual content—discovered thoughts—into language form. Finally, the reviewing process is for reading (evaluating) and editing (revising) the text (Flower & Hayes, 1981). The Hayes and Flower's model is an empirically based one and "is also a useful starting point for characterizing the cognitive processes involved in writing and … design requirements for computer support for those processes" (Neuwirth et al., 2000, p. 537-538). This model was also reported to be suitable for characterizing digital writing activities such as online writing (Xu, 2018) and wiki-based writing (Wichmann & Rummel, 2013). Moreover, Skains (2017) stated that it is a suitable framework from which to analyze digital writing. Therefore, the Hayes and Flower's model was considered the suitable theoretical framework for the scale to be developed in this study.

1.4. Present Study

After symbolic language, writing, and print, it is argued that we are in the process of another information revolution caused by ITs (Ferris, 2002; Li, n.d.; Turner & Baker, 2019). ITs have a significant impact on writing activity and process (Ferris, 2002; Huset, 2015). In parallel with the change in the way we conceive writing and the way we write, instructional practices and writing assessments are also changing (Heath, 2013). Writing and assessment of writing is a natural and substantial part of teaching profession. Since a crucial part of the writing activity of students and teachers is now taking place in the form of digital writing, research on digital writing and therefore the tools to be used for the research on digital writing are essential. However, there is a need for scales to be used for research on digital writing (Poe, 2013). A review of literature reveals that there are instruments such as the scale of story writing skill (Temizkan, 2011), writing self-efficacy scale (Demir, 2013), and writing disposition scale (İşeri & Ünal, 2010), however there is no scale to measure perspectives of the individuals on digital writing. Therefore, the purpose of this study is to develop a digital writing scale in order to provide writing researchers with a new research instrument for investigating the perspectives of individuals on digital writing. Since this is the first scale to measure perspectives of individuals on digital writing, it was not possible to compare it with other scales. Thus, following research question was addressed:

1. Is Digital Writing Scale a valid and reliable measure of the perspectives of the preservice teachers on digital writing?

2. Method

2.1. Research Design

The research was designed as a scale development study consisting of two phases. The first phase was aimed at exploring the factor structure of the newly developed Digital Writing Scale (DWS) while the second phase was aimed for confirming the extracted factor structure. Throughout the study, "Ethical Principles of Psychologists and Code of Conduct" was followed (American Psychological Association, 2002).

2.2. Participants

A total of 615 preservice teachers participated in both phases of the study (n = 615). All the participants were students enrolled in one of the five BSc programs of the faculty of education at a public university in south-western part of Turkey. Out of 615 preservice teachers, 300 (48.78%) participated in the first study (n_1=300), and 315 (51.21%) participated in the second study (n_2=315). Those who participated in the first study could not participate in the second one. Demographic information of participants is demonstrated in Table 1. Participants were determined through convenience sampling at the university where the researcher is also a member of the faculty. The scale was prepared to be used by all university students and university graduates—hence the target population. However, accessible population of this study was preservice teachers since the actual sampling frame was the faculty of education of the university where the researcher is a faculty member. The sample was the students enrolled in the undergraduate programs provided by the faculty: early childhood education (ECE), classroom teaching (CT), Turkish language teaching (TLE), primary mathematics education (PME), and science education (SE). All of the students were invited to the study. Only consenting individuals have participated in the research. Which questionnaire was filled in by which of the participants was unbeknownst to the researcher.

Table 1.

Demographic information of the participants

	Study 1			Study 2			Total		
	f (%)	$\bar{x}$	s	f (%)	$\bar{x}$	s	f (%)	$\bar{x}$	s
Age		21.20	1.88		21.01	1.89		21.11	1.89
Sex		0.26	0.43		0.30	.045		0.28	0.44
Female	222(74)			222(70.5)			444(72.2)		
Male	78(26)			93(29.5)			171(27.8)		
Program									
ECE	80(26.7)			82(26)			162(26.3)		
CT	110(36.7)			83(26.3)			193(31.4)		
TLE	33(11)			28(8.9)			61(9.9)		
PME	53(17.7)			89(28.3)			142(23.1)		
SE	23(7.7)			33(10.5)			56(9.1)		

Grade		2.60	1.05		2.41	1.07		2.50	1.07
1st	56(18.7)			76(24.1)			132(21.5)		
2nd	80(26.7)			101(32.1)			181(29.4)		
3rd	88(29.3)			69(21.9)			157(25.5)		
4th	73(24.3)			68(21.6)			141(22.9)		

2.3. Data Collection

A review of literature did not reveal previously published instruments measuring perspectives of individuals on digital writing, let alone developed in accordance with the Hayes and Flower's model of writing. Nevertheless, three scales were determined as a starting point for the construction of the item pool: AbuSeileek's (2006) Attitude towards Computer-aided Writing Questionnaire (ACWQ), Cunningham's (2000) Attitudes towards Using Computers in Writing Classes Questionnaire (AUCWCQ), and Yilmaz and Erkol's (2015) Attitude towards Writing with Computers Questionnaire (AWCQ). ACWQ was developed for measuring attitude towards computer-mediated writing and consists of 30 items. AUCWCQ was developed for eliciting student perceptions about advantages and disadvantages of and for measuring attitude towards using computers for writing. It consists of 37 items. AWCQ was developed for examining attitudes towards writing with computers and consists of 22 items.

Eighty-nine items of the three aforementioned scales were thoroughly examined, and 25 new items were constructed for the pool. Since these scales were measuring attitude, not perspective, and do not endorse process theory of writing, none of those 89 items were reused. However, they served as inspiration for the new ones. For ensuring content validity, two experts of educational measurement and evaluation, an expert of Turkish education, an expert of writing instruction, and an expert of educational technology reviewed the item pool. None of the items were removed from the initial pool. However, all items were revised. Until 100% agreement was reached, all disagreements were resolved by discussion. The result of the expert review was a pilot scale consisting of 25 items. The pilot scale was a 5-point Likert-type scale. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree).

The pilot instrument, which included the pilot scale and demographic questions, was prepared as a paper-and-pencil survey. Permissions were received from institutional officials. The data were collected in the classrooms during the lessons and were analysed by statistical measures. The first study concluded with the construction of a revised scale consisting of 14 items through the exploratory factor analysis (EFA). The second study was applied in a similar way to the first study except that the revised scale was used. A revised instrument was prepared this time with a revised scale, demographic questions, and four more questions aimed at investigating the respondent's use of digital writing. The data collected in the second study were analysed by statistical measures, as well.

2.4. Data Analysis

Statistical analyses were performed by the IBM SPSS Statistics computer program (IBM SPSS Statistics version 25). In the second study, IBM SPSS Amos (IBM SPSS Amos version 24) computer program was also used. To explore the underlying factor structure of the DWS, EFA was utilized by employing principal axis factoring (PAF) technique with direct oblimin rotation (Fabrigar et al., 1999; Tabachnick & Fidell, 2013). The Cronbach's α internal consistency estimate was calculated for the pilot scale for checking the reliability of the instrument. For determining whether the factor structures obtained using EFA could be confirmed, a confirmatory factor analysis (CFA) with maximum likelihood estimation was performed on the data collected by the revised scale. Additionally, Mann-Whitney U test, Kruskal-Wallis H test, Person's product-moment correlation coefficient, and Spearman's rank-order correlation coefficient were used to analyse the data.

3. Findings

3.1. Findings from Study 1

For conducting the EFA, a PAF with direct oblimin rotation was performed on the data collected by pilot scale for examining whether items were aggregating in factors. All item correlations were lower than 0.9, hence, assumption of multicollinearity was satisfied (Field, 2018). Bartlett's test of sphericity was significant ($\chi^2(300) = 3096.554$, $p = 0.000$) indicating that correlation matrix among the items was not an identity matrix and sphericity assumption was not violated (Field, 2018). Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.911, indicating that the sample size was adequate for EFA (Field, 2018; Tabachnick & Fidell, 2013). Initially, six factors were identified (Table 2). Only factors with an eigenvalue greater than one were extracted (Field, 2018; Tabachnick & Fidell, 2013). These six factors accounted for 63.498% of the variance.

Table 2.

Eigenvalues and total variance explained by factors from initial EFA

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	8.958	35.832	35.832	8.497	33.989	33.989	6.507
2	1.996	7.985	43.817	1.503	6.013	40.002	1.613
3	1.464	5.854	49.671	1.007	4.027	44.030	6.541
4	1.289	5.156	54.828	0.766	3.062	47.092	3.932
5	1.109	4.437	59.265	0.611	2.442	49.534	2.002
6	1.058	4.234	63.498	0.585	2.342	51.876	0.639

However, scree plot of eigenvalues and factors (Figure 1) suggested a two-factor model might represent the data better than a six-factor model. Factor structure of the DWS was further explored by examining pattern matrix (Table 3). Factor 1 and Factor 3 accounted for 33.989% and 4.027% of the total variance, respectively. Both factors were loaded by eight items and together, they accounted for 38.016% of the variance. Factor 2, Factor 5, and Factor 6 were not considered to be sound factors since they were loaded by only two items each, and scree plot supported a two-factor model. Factor 4 was loaded by six items; however, three of them were below 0.4, and one was only 0.419. Hence, Factor 4 was also dismissed. Item 1 was discarded since it loaded onto both Factor 1 and Factor 3. Item 23 was discarded on the grounds that its loading was relatively low (0.341). Therefore, Factor 1 and Factor 3—both loaded by seven items—were considered as sound factors.

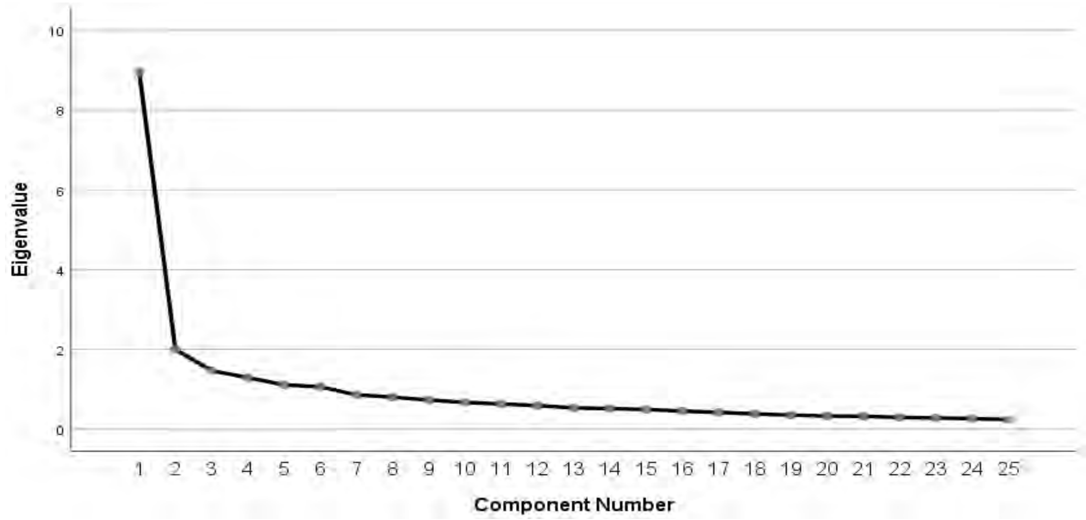

Figure 1. Scree plot of the pilot scale

Table 3.

Pattern matrix of the first EFA

	Factors					
	1	2	3	4	5	6
Item 01	0.313		0.461			
Item 02			**0.636**			
Item 03			**0.717**			
Item 04			**0.596**			
Item 05					0.610	
Item 06			**0.446**	0.365		
Item 07			**0.581**			
Item 08			**0.630**			
Item 09			**0.655**			
Item 10					0.617	
Item 11				0.513		
Item 12				0.613		
Item 13				0.419		
Item 14	**0.629**					
Item 15		0.601				
Item 16	**0.515**					
Item 17	**0.693**					
Item 18	**0.832**					
Item 19	**0.637**					
Item 20		0.552				
Item 21	**0.634**					0.315
Item 22	**0.541**					
Item 23	0.341					
Item 24				0.348		
Item 25				0.320		0.356

Note: Rotation converged in 17 iterations. Loading values are bolded for selected items.

Having determined the factors and respective items, a second run of EFA was performed. In the second EFA, which also employed a PAF technique with direct oblimin rotation, Bartlett's test of sphericity was significant ($\chi^2(91)$ = 1689.377, p = 0.000), and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.911. Only two factors had an eigenvalue greater than one. Factor 1 and 2 respectively accounted for 40.494% and 6.761% of the variance, while total variance explained was 54.515%. Table 4 illustrates the pattern matrix of the second EFA. Cronbach's α internal consistency estimates were calculated for assessing the reliability of the scale and extracted factors. Cronbach's α coefficient was 0.899 for 14-item set. Cronbach's α coefficients of Factor 1 and Factor 2 were 0.851 and 0.852, respectively. All coefficients indicated that the scale as well as the factors were reliable (DeVellis, 2017; Field, 2018).

Moreover, for both of the factors, mean inter-item correlations was 0.4. All items correlated with their respective factors supporting convergent validity. Mean of item-total score correlations was 0.73. Intercorrelation between factors were below 0.7 as Tabachnick and Fidell (2013) recommended ($r = 0.62$, $n_1 = 300$, $p = 0.000$). Finally, significant correlation between a global item (asking the participant to indicate how much better he or she thinks he or she can write using IT) and the total score of the scale supported the nomological validity of the scale, ($r = 0.3$, $n_1 = 300$, $p = 0.000$) (Churchill Jr, 1979; Edison & Geissler, 2003). Therefore, this 14-item subset of the pilot scale was accepted as the "revised scale."

Table 4.

Results of the second EFA

	Factors		Communalities		Descriptives		Pearson's Correlation with Factor Score
	1	2	Initial	Extraction	$\bar{x}$	s	
Item 02		0.745	0.519	0.524	4.21	0.728	0.760*
Item 03		0.762	0.470	0.485	4.18	0.672	0.737*
Item 04		0.632	0.466	0.494	4.21	0.665	0.737*
Item 06		0.604	0.416	0.400	4.09	0.742	0.702*
Item 07		0.472	0.351	0.359	4.08	0.694	0.667*
Item 08		0.632	0.459	0.419	4.13	0.797	0.723*
Item 09		0.735	0.536	0.562	4.21	0.695	0.781*
Item 14	0.643		0.508	0.500	4.38	0.593	0.736*
Item 16	0.482		0.303	0.270	3.98	0.824	0.663*
Item 17	0.726		0.541	0.590	4.19	0.675	0.796*
Item 18	0.868		0.542	0.618	4.34	0.632	0.783*
Item 19	0.701		0.471	0.506	4.20	0.642	0.742*
Item 21	0.668		0.540	0.532	4.29	0.635	0.743*
Item 22	0.609		0.357	0.356	3.99	0.684	0.674*

Note: *$p < 0.001$. $\bar{x}$ and s represent mean and standard deviation, respectively.

3.2. Findings from Study 2

A CFA with maximum likelihood estimation was performed on the data collected by revised instrument to examine validity and applicability of the hypothesized constructs.

Figure 2 shows the path diagram for the revised scale. Several indices were interpreted for examining the level of the goodness-of-fit of the factor model of revised scale. In addition to chi-square (χ^2), degrees of freedom (df), χ^2/df, and p-value, Jöreskog and Sörbom (2001) emphasize that most commonly used indices are goodness-of-fit index (GFI) and adjusted goodness-of-fit (AGFI), normed fit index (NFI), and root mean square residual (RMR). Moreover, Steiger's (1990) root mean square error of approximation (RMSEA), Bentler and Bonett's nonnormed fit index (NNFI, 1980), Bentler's comparative fit index (CFI, 1990), and standardized root mean square residual (SRMR, 1995) were also examined. All items significantly loaded demonstrating adequate convergent validity.

Results validated the factor structure of the revised scale: $\chi^2(103) = 265.33$, $p = 0.000$, $\chi^2/df = 2.5$, RMSEA = 0.074, GFI = 0.90, AGFI = 0.86, RMR = 0.030, SRMR = 0.055, NFI = 0.95, NNFI = 0.96, CFI = 0.97. According to the evaluation criteria of Schermelleh-Engel et al. (2003), overview of the fit indices is illustrated in Table 5.

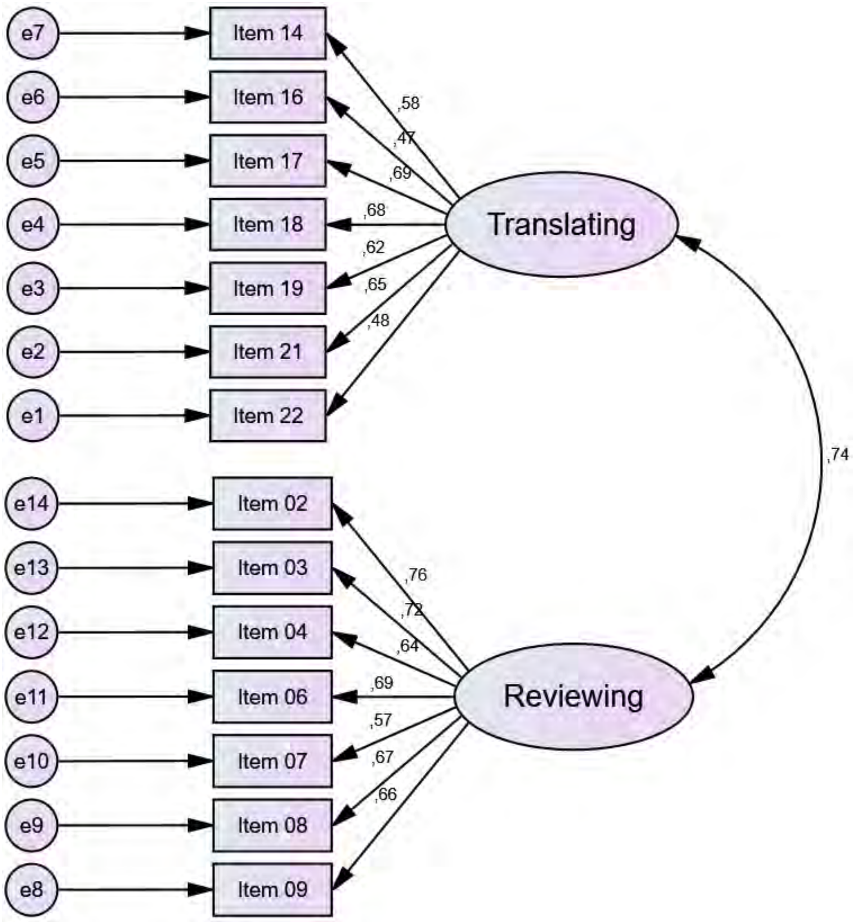

Figure 2. Path diagram of the revised scale with standardized estimates

Statistical significance of χ^2 confirmed the lack of a close model fit with the data. However, that result was not considered pervasive in this study since χ^2 is sensitive to sample size (Hair et al., 2006). On the other hand, other indices revealed a fairly good fit of the model and were preferred for evaluating the model (Marsh et al., 1994). As summarized in Table 5, in addition to one adequate and two acceptable fit evaluations, five indices indicated good fit, and one indicated a substantial fit. Hence, indices produced by CFA demonstrated a statistically significant model fit to the data.

Table 5.

Fit indices for the hypothesized model

Index	Criterion	Result	Evaluation
p	>0.05	0.000	Not fit
χ^2/df	≤ 3 acceptable, ≤ 2.5 substantial	2.5	Substantial fit
RMSEA	< 0.1 mediocre, < 0.08 adequate < 0.05 good	0.074	Adequate fit
GFI	> 0.85 acceptable, > 0.90 good > 0.95 substantial	0.90	Good fit
AGFI	> 0.80 acceptable, > 0.90 good > 0.95 substantial	0.86	Acceptable fit
RMR	Close to 0 is good fit	0.030	Good fit
SRMR	< 0.1 acceptable, < 0.05 good	0.055	Acceptable fit
NFI	> 0.90 acceptable, > 95 good	0.95	Good fit
NNFI	> 0.95 acceptable, > 0.97 good	0.96	Good fit
CFI	> 0.95 acceptable, > 0.97 good	0.97	Good fit

Finally, Factor 1 and Factor 2 were respectively named as "Digital Translating" and "Digital Reviewing" since they corresponded to translating and reviewing steps of Hayes and Flower's (1980) model. Items of Digital Translating factor were re-enumerated from 1 to 7. Items of Digital Reviewing factor were re-enumerated from 8 to 14. Digital Translating factor included items such as "Information technologies make it easier for me to work intertextually while writing." Digital Reviewing factor included items such as "Information technologies make me notice mistakes in my writing." This final version of the scale is "Digital Writing Scale." DWS is a research instrument that can be used to measure the perspectives of individuals on digital writing—writing with IT devices such as desktop or laptop PC, tablet computer, smartphone, etc. An overview of descriptive statistical information about the scale is illustrated in Table 6.

Table 6.

Overview of descriptive statistical information about the scale

	Digital Translating		Digital Reviewing		DWS	
	Mean	Sum	Mean	Sum	Mean	Sum
Minimum	2	15	2	15	4	31
Maximum	5	35	5	35	10	70
Mean	4.2	29.37	4.17	29.16	8.36	58.55
Median	4	28	4	28.00	8.14	57
Standard Deviation	0.489	3.423	0.522	3.655	0.916	6.409
Inter-Item Correlation	0.4	-	0.4	-	-	-
Item-Total Correlation	0.73	-	0.73	-	-	-

3.3. Demographic Variables

In order to contextualize the DWS, associations of Digital Translating and Digital Reviewing with demographic variables were investigated. Analyses revealed that factor scores did not differ according to sex or department of the participants. However, a Kruskal-Wallis H test showed that there was a statistically significant difference in Digital Reviewing between grade levels, $H(3) = 10.597$, $p = 0.014$. Follow up Mann-Whitney U tests revealed that regarding Digital Reviewing, seniors had significantly higher scores than freshmen ($U = 7966$, $p = 0.038$), and juniors ($U = 12055$, $p = 0.015$) as well as seniors ($U = 10543$, $p = 0.007$) had significantly higher scores than sophomores. In parallel with grade levels, Spearman's rank-order correlation coefficient calculations indicated that age had weak but positive correlations with Digital Translating ($\varrho = 0.095$, $p = 0.023$) and Digital Reviewing ($\varrho = 0.089$, $p = 0.032$).

Regarding the ITs that preservice teachers use for writing, findings revealed that those who have a desktop computer ($U = 37475$, $p = 0.015$) or laptop computer ($U = 37412$, $p = 0.018$) had a more positive perspective of both Digital Translating and Digital Reviewing. However, while those who had a tablet computer had a stronger score only on Digital Reviewing ($U = 37050$, $p = 0.021$), scores did not differ according to having a smartphone or not. Moreover, there was a statistically significant difference in Digital Reviewing in terms of the most commonly used IT devices for writing, $H(3) = 11.245$, $p = 0.010$. Follow up Mann-Whitney U tests revealed that regarding Digital Reviewing, those who mostly use laptop computers ($U = 1865.5$, $p = 0.028$) or smartphones ($U = 33234.5$, $p = 0.011$) for writing had significantly higher scores compared to those who mostly use desktop computers. Finally, there were no correlations between Digital Translating, Digital Reviewing, and frequency of using IT for writing.

4. Discussion and Conclusion

The purpose of this study was to develop and validate a digital writing scale in order to provide researchers with a new Turkish tool which can be utilized for investigating perspectives of the individuals on digital writing. Even though the scale was developed to be used by all university students and university graduates, accessible population of this study was preservice teachers since the actual sampling frame was the faculty of education of the university where the researcher is a faculty member. Through a two phased study employing EFA and CFA, the Digital Writing Scale comprised of a 7-item Digital Translating factor and a 7-item Digital Reviewing factor was produced. Findings of this study revealed that DWS is a valid and reliable instrument for measuring the perspectives of individuals on digital writing in the context of cognitive process theory of writing. Results of the study indicated that, educational technology courses that students take in the second and third grades seem to be influential on their perspectives of digital writing regarding reviewing process. Since Digital Translating did not differ according to grade, the difference seemed to be more related to using functionalities of ITs to "work on" the texts rather than starting or drafting a new one. This finding was in parallel with the correlation that age had with Digital Translating and Digital Reviewing. Age or experience gained in school may be helping preservice teachers gain or maintain a more positive perspective of digital writing.

Having a desktop or laptop computer was indicative of a more positive perspective of digital writing, while having a tablet PC made a difference only in Digital Reviewing. Digital writing scores did not differ according to having a smartphone. It seems that tablet PCs are used for corrections rather than being used for full-fledged work. Results on smartphones may be due to the widespread use of smartphones among prospective teachers. Out of 615 preservice teachers, 592 (96%) had a smartphone. Remarkably, those who mostly use laptop computers or smartphones for writing had a significantly more positive perspective of Digital Reviewing compared to the ones who mostly use desktop computers. It seems that, for more serious tasks, such as starting to write a new text, desktop computer is still important, while the laptop and smartphone replace the desktop for reviewing-oriented jobs. On the other hand, using IT more often for writing appears to have no effect on students' perspectives on digital writing. Hence, it is understood that rather than frequency of using IT for writing or participant's program at university, perspective of the individual on digital writing appears to be related to his or her competence or experience in writing with IT, the type of writing job, and the IT device that will be used for writing.

Digital writing is writing with ITs such as desktop, laptop, and tablet computers, smartphones, handheld devices, game consoles, smart TVs, Internet, etc. As the world becomes more dependent on IT (Eriksson & Giacomello, 2006), IT becomes the primary medium of writing. While IT significantly alters traditional conceptions of writing, writing in turn, affects design, development, and utilization of IT. Hence, IT and writing are mutually transforming each other (Bailie & Huset, 2015; Ferris, 2002). Instructional practices and writing assessments are slowly changing, as well (Heath, 2013). On the other hand, writing research has been the most neglected area of study (National Commission on Writing, 2004). Therefore, the newly developed scale may be useful while investigating the effects of IT on the process and quality of writing as well as effects of digital writing on the writing skill. It should also be noted that ITs other than personal computers such as Internet of Things devices are reported to be the most confusing and contradictory global technology trend bringing along tens of billions of networked devices with enormous economic impact (Hosek et al., 2017). Smartphone is not only one of the Internet of Things devices but also an IT appliance that is used to control them. According to Statista, as of 2019, there are 3.3 billion smartphone users in the world (Holst, 2019). DWS was designed considering the primacy of IT for writing, and prevalence of IT devices other than personal computers such as smartphones.

Acknowledgements

I extend my sincere gratitude to Ayşe Nur Kutluca Canbulat for her support, assistance, and comments that greatly improved the manuscript.

Ethical Issues

The author(s) confirm(s) that the study does not need ethics committee approval according to the research integrity rules in their country.

References

AbuSeileek, A. F. (2006). The use of word processor for teaching writing to EFL learners in King Saud University. *Journal of King Saud University, 19*(2), 1-15. Retrieved November 16, 2019, from https://jes.ksu.edu.sa/en/node/5260

Adair-Hauck, B., Willingham-McLain, L., & Youngs, B. E. (2000). Evaluating the integration of technology and second language learning. *CALICO journal, 17*(2), 269-306. Retrieved November 16, 2019, from https://www.jstor.org/stable/24152630

Alamargot, D., & Chanquoy, L. (2001). *Through the models of writing*. Dordrecht: Kluwer Academic.

Alshumaimeri, Y. (2011). The effects of wikis on foreign language students writing performance. *Procedia - Social and Behavioral Sciences, 28*, 755-763. https://doi.org/10.1016/j.sbspro.2011.11.139

American Psychological Association. (2002). Ethical principles of psychologists and code of conduct. *American Psychologist, 57*(12), 1060-1073. https://doi.org/10.1037/0003-066X.57.12.1060

Avgerou, E., & Vlachos, K. (2016). The blog as an innovative tool for the development of the writing skill in the Greek EFL class. *Research Papers in Language Teaching and Learning, 7*(1), 212-232.

Aytan, T. (2017). Evaluation of electronic writing experiences of Turkish teacher candidates at WATTPAD environment. *Higher Education Studies, 7*(4), 1-8. http://doi.org/10.5539/hes.v7n4p1

Bailie, R. A., & Huset, J. (2015). The effect of CMS technology on writing styles and processes: Two case studies. *IEEE Transactions on Professional Communication, 58*(3), 309-327. https://doi.org/10.1109/TPC.2016.2516642

Barker, P. (2005). Teaching and assessing electronic writing skills. *Information and Communication Technology*. Retrieved November 16, 2019, from http://hdl.handle.net/10797/14608

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*(2), 238-246. https://doi.org/10.1037/0033-2909.107.2.238

Bentler, P. M. (1995). *EQS structural equations program manual*. Encino: Multivariate Software.

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88*(3), 588−606. https://doi.org/10.1037/0033-2909.88.3.588

Bergman, C. A. (1984). Writing Across the Curriculum: students as scholars, scholars as students. *Journal of Advanced Composition, 5*(1984), 79-86. Retrieved from https://www.jstor.org/stable/20865562

Bernhardt, S. A., Edwards, P., & Wojahn, P. (1989). Teaching college composition with computers: A program evaluation study. *Written Communication, 6*(1), 108-133. https://doi.org/10.1177/0741088389006001007

Bolter, J. D. (1996a). Virtual reality and the redefinition of self. In L. Strate, R. Jacobson, & S. B. Gibson (Eds.), *Communication and cyberspace: Social interaction in an electronic environment* (pp. 105-120). Cresskill: Hampton Press.

Bolter, J. D. (1996b). Ekphrasis, virtual reality, and the future of writing. In G. Nunberg (Ed.), *The future of the book* (pp. 253-272). Berkeley: University of California Press.

Boltz, W. G. (1999). Language and writing. In M. Loewe & E. Shaughnessy (Authors), *The Cambridge history of ancient China: From the origins of civilization to 221 BC* (pp. 74-123). Cambridge: Cambridge University Press. https://doi.org/10.1017/CHOL9780521470308.004

Bruce, B. C. (1997). Critical issues literacy technologies: What stance should we take? *Journal of literacy Research, 29*(2), 289-309. https://doi.org/10.1080/10862969709547959

Buckingham, D. (2008). Introducing identity. In D. Buckingham (Ed.), *Youth, identity, and digital media* (pp. 1–24). Cambridge, MA, USA: The M.I.T. Press. https://doi.org/10.1162/dmal.9780262524834.001

Cheung, Y. L. (2016). A comparative study of paper-and-pen versus computer-delivered assessment modes on students' writing quality: A Singapore study. *The Asia-Pacific Education Researcher, 25*(1), 23-33. https://doi.org/10.1007/s40299-015-0229-2

Choo, Y. B., & Li, K. L. (2017). Digital writing in English language writing instruction. *ARIEL-An International Research Journal of English Language and Literature, 28*, 1-16. Retrieved from http://sujo.usindh.edu.pk/index.php/ARIEL/article/view/19

Churchill Jr, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research, 16*(1), 64-73. https://doi.org/10.1177/002224377901600110

Coulmas, F. (2003). *Writing systems: An introduction to their linguistic analysis*. Cambridge: Cambridge University Press.

Cunningham, K. (2000). Integrating CALL into the writing curriculum. *The Internet TESL Journal, 6*(5), 9-22. Retrieved November 16, 2019, from http://iteslj.org/Articles/Cunningham-CALLWriting/

Dahlström, H. (2019). Digital writing tools from the student perspective. *Education and Information Technologies, 24*(2), 1563-1581.https://doi.org/10.1007/s10639-018-9844-x

Daiute, C. (1983). The computer as stylus and audience. *College Composition and Communication, 34*(2), 134-145. https://doi.org/10.2307/357400

Daiute, C. (1985). Do writers talk to themselves? In S. Freedman (Ed.), *The acquisition of written language: Response and revision* (pp. 133-139). Norwood: Ablex.

Dalton, D. W., & Hannafin, M. J. (1987). The effects of word processing on written composition. *The Journal of Educational Research, 80*(6), 338-342. https://doi.org/10.1080/00220671.1987.10885779

Daniels, P. T. (1996). Grammatology. In P. T. Daniels & W. Bright (Eds.), *The world's writing systems* (pp. 1-18). Oxford: Oxford University Press.

De Saussure, F. (2011). *Grundfragen der allgemeinen Sprachwissenschaft*. Berlin: Walter de Gruyter.

Demir, T. (2013). Study of the relationship between the creative writing skills of primary school students and their self-efficacy perception. *Uluslararası Türkçe Edebiyat Kültür Eğitim (TEKE) Dergisi, 2*(1), 84-114.

DeVellis, R. F. (2017). *Scale development: Theory and applications* (4th ed.). Los Angeles: Sage.

DeVoss, D. N., Eidman-Aadahl, E., & Hicks, T. (2010). *Because digital writing matters: Improving student writing in online and multimedia environments*. San Francisco: Jossey-Bass.

Duwila, S. A., & Khusaini, T. (2019). Pedagogical strategy of writing paragraph using Edmodo to enhance writing skill for EFL students. *Journal of English Language Teaching and Islamic Integration (JELTII), 2*(2), 155-167. Retrieved from http://e-journal.hikmahuniversity.ac.id/index.php/jeltii/article/view/181

Edison, S. W., & Geissler, G. L. (2003). Measuring attitudes towards general technology: Antecedents, hypotheses and scale development. *Journal of Targeting, Measurement and Analysis for Marketing, 12*(2), 137-156. https://doi.org/10.1057/palgrave.jt.5740104

Emig, J. (1971). *The composing processes of twelfth graders*. Urbana: NCTE.

Eriksson, J., & Giacomello, G. (2006). The information revolution, security, and international relations: (IR)relevant theory? *International Political Science Review, 27*(3), 221-244. https://doi.org/10.1177/0192512106064462

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*(3), 272–299. https://doi.org/10.1037/1082-989X.4.3.272

Ferris, S. P. (2002). Writing electronically: The effects of computers on traditional writing. *Journal of Electronic Publishing, 8*(1). https://doi.org/10.3998/3336451.0008.104

Field, A. (2018). *Discovering statistics using IBM SPSS Statistics* (5th ed.). London: Sage.

Flower, L., & Hayes, J. R. (1980). The cognition of discovery: Defining a rhetorical problem. *College Composition and Communication, 31*(1), 21-32. https://doi.org/10.2307/356630

Flower, L., & Hayes, J. R. (1981). A cognitive process theory of writing. *College Composition and Communication, 32*(4), 365-387. https://doi.org/10.2307/356600

Galbraith, D. (2009a). Cognitive models of writing. *German as a Foreign Language, 2*(3), 7-22. Retrieved November 16, 2019, from http://www.gfl-journal.de/Issue_2_2009.php

Galbraith, D. (2009b). Writing about what we know: Generating ideas in writing. In R. Beard, D. Myhill, J. Riley, & M. Nystrand (Eds.), *The SAGE handbook of writing development* (pp. 48-64). London: Sage.

Gelb, I. J. (1963). *A study of writing* (2nd ed.). Chicago: University of Chicago Press.

Goldberg, A., Russell, M., & Cook, A. (2003). The effect of computers on student writing: A meta-analysis of studies from 1992 to 2002. *The Journal of Technology, Learning and Assessment, 2*(1), 1-52. Retrieved November 16, 2019, from https://ejournals.bc.edu/index.php/jtla/article/view/1661

Goody, J. (1986). *The logic of writing and the organization of society*. Cambridge: Cambridge University Press.

Grabill, J. T., & Hicks, T. (2005). Multiliteracies meet methods: The case for digital writing in English education. *English Education, 37*(4), 301-311. Retrieved November 16, 2019, from http://www.jstor.org/stable/40173204

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed.). Upper Saddle River: Pearson.

Harmer, J. (2004). *How to teaching writing*. Harlow: Pearson.

Hayes, J. R., & Flower, L. S. (1980). Identifying the organization of the writing process. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3-30). Hillsdale: Lawrence Erlbaum Associates.

Hayes, J. R., & Flower, L. S. (1986). Writing research and the writer. *American Psychologist, 41*(10), 1106-1113. https://doi.org/10.1037/0003-066X.41.10.1106

Heath, V. L. (2013). *Elementary writing assessment platforms: A quantitative examination of online versus offline writing performance of fifth grade students* (Unpublished doctoral dissertation). Indiana University, Indiana, USA.

Hillocks, G., Jr. (2007). *Narrative writing learning a new model for teaching*. Portsmouth: Heinemann.

Holst, A. (2019). *Number of smartphone users worldwide 2014-2020*. Retrieved August 6, 2019, from https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/

Hosek, J., Masek, P., Andreev, S., Galinina, O., Ometov, A., Kropfl, F., Wiedermann, W., & Koucheryavy, Y. (2017). A SyMPHOnY of integrated IoT businesses: Closing the gap between availability and adoption. *IEEE Communications Magazine, 55*(12), 156-164. https://doi.org/10.1109/MCOM.2017.1700028

Hyland, K. (2003). *Second language writing*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511667251

İşeri, K., & Ünal, E. (2010). The adaptation of writing disposition scale into Turkish. *Eğitim ve Bilim, 35*(155), 104-117.

Jöreskog, K., & Sörbom, D. (2001). *LISREL 8: User's reference guide* (2nd ed.). Lincolnwood: SSI.

Johnson, M. A. (1988). Word processing in the English as a second language classroom. In J. L. Hoot & S. B. Silvern (Eds.), *Writing with computer in the early grades* (pp. 107–121). New York: Teachers College Press.

Jones, S., Johnson-Yale, C., Millermaier, S., & Pérez, F. S. (2009). US college students' Internet use: Race, gender and digital divides. *Journal of Computer-Mediated Communication, 14*(2), 244-264. https://doi.org/10.1111/j.1083-6101.2009.01439.x

Juzwik, M. M., Wolbers, K., Moxley, K., Dimling, L., & Shankland, R. (2006). Writing into the 21st century an overview of research writing, 1999 to 2004. Written Communication, 23(4), 451-476. https://doi.org/10.1177/0741088306291619

Kitchin, D. A. (1991). *Case study of ESL community college students using computer-based writing tools in composition course* (Unpublished doctoral dissertation). University of San Francisco, California, USA.

Kutlu, Ö. (2013). Using technology for developing writing in an ESP class. *Procedia-Social and Behavioral Sciences, 70*, 267-271. https://doi.org/10.1016/j.sbspro.2013.01.0644

Lam, F. S., & Pennington, M. C. (1995). The computer vs. the pen: A comparative study of word processing in a Hong Kong secondary classroom. *Computer Assisted Language Learning, 8*(1), 75-92. https://doi.org/10.1080/0958822950080106

Lee, H. K. (2004). A comparative study of ESL writers' performance in a paper-based and a computer-delivered writing test. *Assessing Writing, 9*(1), 4-26. https://doi.org/10.1016/j.asw.2004.01.001

Li, J. (2006). The mediation of technology in ESL writing and its implications for writing assessment. *Assessing Writing, 11*(1), 5-21. https://doi.org/10.1016/j.asw.2005.09.001

Li, J., & Cumming, A. (2001). Word processing and second language writing: A longitudinal case study. *International Journal of English Studies, 1*(2), 127-152. Retrieved November 16, 2019, from https://revistas.um.es/ijes/article/view/48231

Li, X. (n.d.). *Complexity theory - the holy grail of 21st century*. Lane Department of CSEE, West Virginia University. Retrieved July 22, 219 from https://archive.is/20130815234045/http://www.csee.wvu.edu/~xinl/complexity.html#selection-11.0-11.17

Lyons, M. (2013). *The writing culture of ordinary people in Europe, c. 1860-1920*. Cambridge: Cambridge University Press

Marsh, H. W., Hau, K.-T., Roche, L., Craven, R., Balla, J., & McInerney, V. (1994). Problems in the application of structural equation modeling: Comment on Randhawa, Beamer, and Lundberg (1993). *Journal of Educational Psychology, 86*(3), 457-462. https://doi.org/10.1037/0022-0663.86.3.457

McAllister, C., & Louth, R. (1988). The effect of word processing on the quality of basic writers' revisions. *Research in the Teaching of English, 22*(4), 417-427. Retrieved November 16, 2019, from https://www.jstor.org/stable/40171196

Murray, D. (1972). Teach writing as a process not product. *The Leaflet, 71*(3), 11-14.

National Commission on Writing. (2004). *Writing a ticket to work . . . or a ticket out: A survey of business leaders*. New York: College Board.

Neal, M. (2011). *Writing assessment and the revolution in digital texts and technologies*. New York: Teachers College Press.

Neuwirth, C. M., Chandhok, R., Kaufer, D. S., Morris, J. H., Erion, P., & Miller, D. (2000). Computer supported collaborative writing: A coordination science perspective. In G. M. Olson, T. W. Malone, & J. B. Smith (Eds.), *Coordination theory and collaboration technology* (pp. 535–557). Mahwah, NJ: Lawrence Erlbaum Associates.

Nobles, S., & Paganucci, L. (2015). Do digital writing tools deliver? Student perceptions of writing quality using digital tools and online writing environments. *Computers and Composition, 38*, 16-31. https://doi.org/10.1016/j.compcom.2015.09.001

Owston, R. D., Murphy, S., & Wideman, H. H. (1992). The effects of word processing on students' writing quality and revision strategies. *Research in the Teaching of English, 26*(3), 249-276. Retrieved November 16, 2019, from https://www.jstor.org/stable/40171308

Pennington, M. C. (1996). *The computer and the non-native writer: A natural partnership*. Cresskill: Hampton Press.

Poe, M. (2013). Making digital writing assessment fair for diverse writers. Digital Writing Assessment and Evaluation. In H. A. McKee & D. N. DeVoss (Eds.), *Digital writing assessment & evaluation*. Logan: Computers and Composition Digital Press/Utah State University Press. Retrieved from http://ccdigitalpress.org/dwae

Prestin, E. (2008). Writing and reading. In G. Rickheit & H. Strohner (Eds.), *Handbook of communication competence* (pp. 225-256). Berlin: de Gruyter.

Pruden, M., Kerkhoff, S. N., Spires, H. A., & Lester, J. (2017). Enhancing writing achievement through a digital learning environment: Case studies of three struggling adolescent male writers. *Reading & Writing Quarterly, 33*(1), 1-19. https://doi.org/10.1080/10573569.2015.1059780

Relles, S. R., & Tierney, W. G. (2013). Understanding the writing habits of tomorrow's students: Technology and college readiness. *The Journal of Higher Education, 84*(4), 477-505. https://doi.org/10.1080/00221546.2013.11777299

Richardson, L. (2000). Writing: A method of inquiry. In N. Denzin & Y. Lincoln (Eds.). *Handbook of qualitative research* (pp. 923−948). London: Sage.

Rowsell, J., & Decoste, E. (2012). (Re)designing writing in English class: a multimodal approach to teaching writing. *Pedagogies: An International Journal, 7*(3), 246-260. https://doi.org/10.1080/1554480X.2012.685226

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online, 8*(2), 23-74.

Schwartz, H. (1984). Teaching writing with computer aids. *College English, 46*(3), 239-247. https://doi.org/10.2307/377031

Skains, R. L. (2017). The adaptive process of multimodal composition: How developing tacit knowledge of digital tools affects creative writing. *Computers and Composition, 43*, 106-117. https://doi.org/10.1016/j.compcom.2016.11.009

Snyder, I. (1993). Writing with word processors: a research overview. *Educational Research, 35*(1), 49-68. https://doi.org/10.1080/0013188930350103

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Harlow: Pearson.

Tan, B. H., Emerson, L., & White, C. (2006). Reforming ESL writing instruction in tertiary education: The writing centre approach. *The English Teacher, XXXV*, 1-14. Retrieved from http://journals.melta.org.my/index.php/tet/article/view/310

Temizkan, M. (2011). The effect of creative writing activities on the story writing skill. *Educational Sciences: Theory & Practice, 11*(1), 933-939.

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research, 25*(2), 173-180. https://doi.org/10.1207/s15327906mbr2502_4

Troia, G. A. (2010). *Instruction and assessment for struggling writers*. New York: The Guilford Press.

Turner, J. R., & Baker, R. M. (2019). Complexity theory: An overview with potential applications for the social sciences. *Systems, 7*(1), 4. https://doi.org/10.3390/systems7010004

Voon Foo, C. T. (2007). *The effects of the process-genre approach to writing instruction on the expository essays of ESL students in a Malaysian secondary school* (Unpublished doctoral dissertation). Universiti Sains Malaysia, Penang, Malaysia.

Wheeler, S., & Wheeler, D. (2007). Evaluating Wiki as a tool to promote quality academic writing skills. Paper presented at the *Conference ICL2007* (pp. 26-28). Villach, Austria. Retrieved from https://telearn.archives-ouvertes.fr/hal-00197280

Wichmann, A., & Rummel, N. (2013). Improving revision in wiki-based writing: Coordination pays off. *Computers & Education, 62*, 262-270. https://doi.org/10.1016/j.compedu.2012.10.017

Williamson, M. M., & Pence, P. (1989). Word processing and student writers. In: B. K. Britton & S. M. Glynn (Eds.), *Computer writing environments: Theory, research, and design* (pp. 93–127). Hillsdale: Erlbaum.

Xu, C. (2018). Understanding online revisions in L2 writing: A computer keystroke-log perspective. *System, 78*, 104-114. https://doi.org/10.1016/j.system.2018.08.007

Yilmaz, C., & Erkol, K. (2015). Using word processor as a tool to enhance the teaching of writing in a Turkish EFL context: An action research. *Journal of Theory and Practice in Education, 11*(1), 346-358. Retrieved November 16, 2019, from http://dergipark.gov.tr/eku/issue/5464/74167

Yunus, M. M., Nordin, N., Salehi, H., Embi, M. A., & Salehi, Z. (2013). The use of information and communication technology (ICT) in teaching ESL writing skills. *English Language Teaching, 6*(7), 1-8. https://doi.org/10.5539/elt.v6n7p1