

Examining the Relationship between Digital Literacy and Academic Performance of Students in Distance Education System

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Abstract

The purpose of this study was to examine the relationship between digital literacy and the academic performance of distance learners. An analysis of the relationship between these two variables from the perspective of the students could bring crucial information to enhance the effectiveness of strategies in distance learning system. The researcher employed quantitative research design and survey research method for this study. The data were obtained by the researcher using the modified five-point Likert scale questionnaire. The population of the study was all the students enrolled in different departments of distance education university in Pakistan. The sample of the study consisted of 400 students selected through convenient sampling technique. Findings of the study confirmed that there is a strong positive correlation between academic performance and digital literacy, which indicates that more digitally literate pupils will have better academic performance. This paper illustrates that digital literacy skills can improve learning results, self-directed learning and student performance generally by the role that digital capabilities have in accessing online resources, controlling them, and utilizing them.

Keywords: *Digital literacy, academic performance, achievement, digital tools*

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Introduction

Rapid advancements in digital technology have had a big impact on educational systems. Changes in how people approach a variety of activities, including their pursuit of education, are sparked by digital technology. Since the COVID-19 epidemic has accelerated the global shift toward online learning, digital literacy has become a crucial requirement for student success. In contrast to conventional classroom settings, distant learning necessitates that students use digital platforms, online resources, and collaborative tools on their own.

In this situation, the performance of students in school usually depends not only on their familiarity with a subject but also on their aptitude to use digital tools. Nonetheless, in developing countries like Pakistan, the differences in the level of digital literacy and inadequate access to technology roots in unsatisfactory learning outcomes. There is a need for a digital platform to complete assignments, watch lectures, participate in discussions, and conduct research work. Digital literacy, or the capability to use digital tools and study in distance or online learning platforms, is a significant element in students' academic performance. In such settings, academic performance depends on the students' capability to use digital tools as well as their knowledge of subject matter. However, disparities in digital literacy and unequal access to technology result in varied learning results in underdeveloped countries like Pakistan.

Information accessibility has decreased. Technology has advanced to the point where accessing news from around the world in a split second is no longer considered remarkable. Technology advancements have significantly improved education by simplifying and easing the distribution of knowledge. Nowadays, using technological devices is a part of most daily tasks. It is now necessary to use a mobile phone. Email and instant chat are commonly utilized in corporate settings. The majority of people perform a variety of tasks on various websites. Even students now receive their education primarily through digital devices rather than books. Students born in 1980 are referred to as "Digital Citizens" and "the Net Generation" since they are thought to have had the most exposure to digital technology. Students in this milieu are very proficient in technology (Oblinger & Oblinger, 2005). Eshet-Alkalai (2009) claims that although several writers have written about "Digital literacy," no one has agreed upon a single definition.

Many academics have still tried to characterize it from different perspectives. First of all, in 1997, Gilster, a highly respected author, clearly defined the new phrase "digitally literate". He stated, "The ability to comprehend and practice the information which was presented through

computers in a variety of formats and from a varied range of sources is identified as digital literacy." The ability to locate, assess, share, and generate content on the internet is known as digital literacy (Widana, 2020).

The growing use of digital-based learning necessitates high levels of digital literacy, which many students do not have. The paper is a response to the question of the role of digital literacy in the academic performance of distance education learners.

Digital literacy has become a central contributor to the educational performance of students, particularly in distance learning settings, with the rising use of digital technologies in education. Nevertheless, not every student is given the necessary digital skills, and that can influence their performance. The present research is based on the contributions of Paul Gilster (1997) and George Siemens (2005) and aims to fill the gaps in the current literature by analyzing the connection between digital literacy and academic performance.

Literature Review

According to Sari and Wardhani (2020), literacy is the capacity to comprehend, use, and reproduce written material, accomplish one's objectives, and acquire the information and potential necessary to engage with a community. Digital literacy refers to the ability to accept and use knowledge, as well as to produce and disseminate knowledge and concur with that created by others (Sari D. M., 2019). The acquisition of information that will contribute to the development of knowledge through literacy in reading and writing is associated with literacy knowledge (Sari D. M., 2019). Graduates must take an interest in the learning process in higher education when it comes to new literacy. The fourth industrial revolution has brought with it new challenges for higher education. As we enter the fourth industrial revolution, digital literacy must be reinforced because the students on campus are members of Generation Z, who have traits associated with the internet and online (Sari, 2022).

The idea of digital literacy was borrowed from Gilster's (1997) book on the subject. Early in the twenty-first century, Gilster's publications began to make an impression, as seen by numerous references to his generally acknowledged definition of strength (Bawden, 2008). Technological developments are creating new demands, behaviors, possibilities, and, subsequently, new literacy. Different new literacies have emerged, each with unique levels and practices that vary depending on evolving demands (Belshaw, 2012; Churchill, 2009).

According to Ng (2012), digital literacy includes the technical, cognitive, and socioemotional abilities required for successful engagement in online learning environments. According to earlier studies, digital literacy is strongly correlated with academic achievement, student involvement, and perseverance in distant learning (Parkes, Stein, & Reading, 2015; Spante et al., 2018). More digitally literate students are better able to use learning management systems, assess digital content critically, and work together virtually. On the other hand, poor digital literacy frequently results in poorer academic performance since it is difficult to adjust to digital platforms and obtain the materials that are required.

A study conducted in 2016 by Siddiq, Scherer, and Tondeur further supported the idea that digital literacy is a predictor of achievement, especially in settings where technology is prevalent. Fairlie et al. (2010) found noteworthy favorable benefits on school graduation and other consequences related to the field of education. It was also discovered that students' performance on further academic assignments and their overall results were influenced by their computer literacy. In a similar vein, Lopez-Islas and Jose's (2013) study on a group of underprivileged high school students found a strong association between students' academic achievement in an online learning program shaped by the school and their level of digital literacy. The study formed an opinion that healthier surroundings and convenient access to DL and ICT boost students' performance.

Academic performance

Academic performance can be defined as the degree to which a student has attained academic objectives and learning outcomes. It demonstrates the knowledge, skills, and competencies that a student develops as a result of a course or program. In educational research, academic performance is often used as a key indicator of students' success and the effectiveness of learning processes. In this study, academic performance is measured using the Cumulative Grade Point Average (CGPA). CGPA represents the average of grade points obtained across all completed courses. It is calculated on a standard scale (e.g., 0.0 – 4.0 or 0.0 – 5.0). A higher CGPA indicates better academic performance.

Students' digital literacy and academic performance

Although many variables might affect the relationship such as self-regulation and access to technology, students' academic performance in distant learning is greatly impacted by their level of digital literacy. Many studies often indicate a positive relationship because digital literacy aids students in navigating online spaces, obtaining information, and communicating clearly, all of which lead to upgraded academic

performance. Some studies, however, show conflicting findings, indicating that assistance from online learning settings and social media use are equally important contributors. (Yuan, N., Yu, Q., & Liu, W., 2025). With the incorporation of digital and online technologies, education is changing quickly on a global scale (Malik & Akkaya, 2021; Noreen & Malik, 2020). Digital literacy is now just as important for academic and professional success as fundamental literacy skills like reading and writing were in the past (Amin et al., 2021).

The goal of digital literacy is to deliver to students the skills they need to advance in a smart society as technology continues to transform the world (Friedman, 2005). According to the literature, there may be a stronger relationship between students' academic performance and certain digital literacy skills. Gui (2007) outlines important information skills like the capacity to locate information using digital tools, evaluate information critically, and use it responsibly to further one's pursuit of both personal and professional objectives. According to Amiri's (2009) investigation, pupils' academic performance was positively impacted by digital literacy. Similarly, the study conducted by Brown (2009) to investigate the connection between students' achievement and digital literacy found that the two were positively correlated.

The effective aspect of digital literacy is high among young people because they are used to exploring a wide range of online materials and can navigate hypertext quickly. However, there is a deficiency in the ability to critically assess internet content (Gui & Argentin, 2011). According to Eurostat report (2015), about 80% of young people use the internet only for social purposes. However, very few people used technology for educational purposes. Adams-Becker et al. (2017) suggest that higher education institutions should assimilate digital development into their undergraduate and graduate studies and consider other support when it comes to digital literacy training in a bid to meet the industry demands in the future.

Students feel better when they use technologies like e-text and e-library since they enable them to be innovative and up-to-date while also making excellent presentations. According to another study by Bliss (2019), students who use technology widely and intensely are more likely to adopt a learning style that uses a variety of technical instruments to aid in the learning process. Technology has been demonstrated to increase the scores in the tests, and it has also been proposed that technology must only be applied appropriately within a constructivist framework that will make students practice higher-order thinking skills (Latham, 1999; Schacter, 1999).

Even though the teachers have long-term access to technology, they are hardly equipped to apply it in such a manner. Teacher training programs were not adequate to satisfy the needs of future teachers widely (Crews and McCannon, 2000). Matthewman and Triggs (2004) and Newman (2009) stated that computers and other technology tools give creative ways of teaching, introducing new information, and providing students with interesting experiences. According to the discussion on student performance and instruction technology (Earle, 2002; Latham, 1999), if technology is applied in the right way. It can increase student performance. Therefore, while studying English, the students also learnt computer skills (Gardner, 1997). Newman (2009) proclaims that allowing students to connect with technology in ways that allow them to communicate, make decisions, and solve problems is essential to improving learning.

Distance education context

Digital literacy interacts with environmental and demographic factors (e.g., work, caregiving duties) that frequently distinguish distance learners from students on campus. According to earlier research, talent inequalities may be made worse by uneven access to digital infrastructure and a lack of institutional support. On the other hand, a well-planned orientation and focused training on digital skills can greatly enhance learners' engagement and results. Digital literacy in this study is theoretically grounded in the concept introduced by Paul Gilster (1997), who defined digital literacy as the ability to access, understand, evaluate, and use information through digital technologies. Furthermore, the concept of learning in the digital era through networks and technological platforms is supported by the theory of George Siemens (2005) on connectivism. These perspectives are a reminder that digital literacy is not only a collection of technical skills, but a collection of critical thinking, information evaluation, and the ability to communicate and collaborate with the assistance of digital technologies.

Conceptual framework

The conceptual framework of this research is grounded on the fact that digital literacy has a major effect on academic performance among distance education students. Digital literacy is taken to be the independent variable, and academic performance (measured on a CGPA) is the dependent variable. Digital literacy is a multi-dimensional construct made up of:

- i) Understanding of Digital Literacy
- ii) Digital Communication
- iii) Curation
- iv) E safety

v) Collaboration

These dimensions help students to access, assess, and utilize digital resources effectively, which improves the learning process and eventually academic performance. This framework is reinforced by Paul Gilser (1997), who has pointed to the significance of critical thinking and information analysis in the digital realm, and George Siemens (2005), whose theory of connectivism identifies learning in digital networks and interactions. These theories indicate that students who are more digitally literate will have a better chance of achieving success in their studies.

Purpose of the Study

The objectives of this study were:

1. To identify the level of digital literacy among distance education students.
2. To explore the relationship between the digital literacy of the students and their academic performance.

Methodology

The current study is primarily descriptive in nature. The survey approach was used to collect responses using a modified questionnaire based on five-point Likert scales. Using the convenience sample approach, a total of 400 respondents who were enrolled in distance education completed this study. The convenience sampling was determined by the availability and time factor, especially given the distance learners who were spread out. support this approach, arguing that it is appropriate to exploratory and correlational research, although John W Creswell (2016) and Uma Sekaran and Roger Bougie (2016) argue that generalizability may be limited. A digital literacy scale was adapted, which was developed by Paul Gilster (1997). Questionnaires were revised based on professional input to guarantee correctness in the local context. The reliability of the instrument was calculated using Cronbach's alpha. An online questionnaire on a five-point Likert scale was used to gather data for this study. The 400 students who were chosen were emailed the questionnaire, which was created in a Google Form. Descriptive statistics and Pearson correlations were applied using SPSS. Students were assessed based on their Cumulative Grade Point Average (CGPA), which they reported in self-acquired academic records and, as such, was used to obtain the academic performance. CGPA was used as a measure of the overall performance of the students in their respective programs.

Findings

This research paper was based on the association between digital literacy and academic performance among distance education learners. Mean, standard deviation, and frequency distributions are included in descriptive statistics.

Table 1

Demographic characteristics of the sample

Characteristics	Sub group	Frequency	Percentage
Gender	Male	160	40%
	Female	240	60%
Departments	History	100	25
	Department	130	32.5
	English	170	42.5
	department	400	100
Usage of Digital Gadgets	B.Ed. program	160	40
	Total	120	30
	Laptop	120	30
	Tablets	400	100
	Smart Phones		
	Total		

According to the respondents' demographic profile, 60% of the sample was made up of female students ($n = 240$), whereas 40% ($n = 160$) were male students. The B.Ed. program (42.5, $n = 170$) was the first academic department in terms of the number of percentages, and then the English department (32.5, $n = 130$), and lastly the History department (25, $n = 100$). Regarding gadget utilization, laptops accounted for 40% of all devices used ($n = 160$), with tablets and smartphones being used equally (30% each, $n = 120$). These findings explain the fact that despite the importance of mobile devices in learning, the main tool used by distance education students in carrying out academic tasks is the laptop.

Table 2

Digital Literacy by gender

Gender	<i>N</i>	<i>M</i>	<i>SD</i>
Male	160	3.85	0.90
Female	240	4.08	0.84

The results showed that female students ($M = 4.08$, $SD = 0.84$) reported slightly higher levels of digital literacy than male students ($M =$

3.85, $SD = 0.90$). This implies that female students could be more engaged or skilled in using digital tools in distance education settings

Table 3
Digital Literacy by Department

Department	<i>N</i>	<i>M</i>	<i>SD</i>
History	100	3.70	0.88
English	130	3.95	0.85
B. ED Program	170	4.20	0.82

The results revealed that students from the B.Ed. The program ($M = 4.20$, $SD = 0.82$) had the highest digital literacy, whereas History students ($M = 3.70$, $SD = 0.88$) had the lowest level of digital literacy. This might be because teacher preparation courses are more likely to require teachers to use digital tools and pedagogical technologies.

Table 4
Level of digital literacy

Scale	<i>M</i>	<i>SD</i>
Understanding of Digital Literacy	4.19	2.09
Digital Communication	4.32	2.40
Curation	3.70	2.21
E safety	4.02	2.11
Collaboration	3.80	3.90
Overall Digital Literacy	3.99	8.72
Academic Performance (GPA)	3.45	0.45

Based on the descriptive data, students indicated a relatively high level of digital literacy in most of the categories. Digital communication was ranked the highest ($M = 4.32$, $SD = 2.40$), followed by the understanding of digital literacy ($M = 4.19$, $SD = 2.09$). This demonstrates that students are aware of the position of digital skills and how to effectively apply online forms of communication. Scores in e-safety were average ($M = 4.02$, $SD = 2.11$), which means that pupils are reasonably aware of the online privacy and security procedures. However, the scores in the areas of cooperation ($M = 3.80$, $SD = 3.90$) and curation ($M = 3.70$, $SD = 2.21$) were significantly lower, indicating challenges with planning, managing, and creating digital content in a team. The mean score of students in overall digital literacy ($M = 3.99$) shows that the proficiency level is generally positive. Academic performance measure (GPA) was reported as 3.45 ($SD = 0.45$), which was associated with low variance and good performance.

Table 5
Relationship between digital literacy and academic performance

Variables	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>1</i>	<i>2</i>
Digital literacy	400	3.09	-	-	.60**
Academic performance	400	3.45	0.45	.60**	

Note. ** $p < .001$

The above table shows the means, standard deviations, and Pearson correlation of digital literacy to academic performance among 400 distance education students. The overall level of digital literacy was reported as high ($M = 3.99$, $SD = 0.87$), which means that the majority of students are relatively well-versed in digital literacy, digital communication, information curation, e-safety, and collaborative skills. The average GPA was 3.45 ($SD = 0.45$), which is an average academic performance among participants with a relatively low variation. Digital literacy and academic performance were identified as having a strong and statistically significant relationship ($r = .60$, $p < .001$), according to the findings of the Pearson correlation study. According to this research, students who are more digitally literate typically perform better academically in distance learning courses. Put another way, students who are more digitally cultured are probably going to do better academically.

Discussion

The present study examined the academic performance of distance learning students in relation to their level of digital literacy. The outcomes verified that the respondents were comparatively well-digitally literate, and the scores were high in digital communications and in the knowledge of digital literacy. This suggests that students are enhancing their capability to communicate and to use digital platforms, which are consistent with new studies that confirm the advantages of communication technologies for distance learning (Ng, 2012; Spante et al., 2018).

It is noteworthy that areas like curation and collaboration had relatively lower mean scores, which means that students still face trouble in organizing content effectively and working together in digital contexts. These findings are aligned with earlier research, as Hatlevik & Christophersen (2013) indicated that, although students are comfortable with computers, they still face difficulties with advanced digital skills like collaboration in a group project and dealing with digital information. These differences demonstrate that there is a need to integrate specific training programs into the distance education courses to expand the digital collaboration and communication skills of students. Furthermore, it was

also shown that there was a positive and statistically significant ($r = .60$, $p < .001$) correlation between digital literacy and academic performance.

It generates the idea that the more students are digitally literate, the more they do well in academics. These findings are aligned with the findings of other research that recognized digital skills as a predictor of student performance in an online and blended learning setting (Tang and Chaw, 2016; Siddiq, Hatlevik, Olsen, Throndsen, and Scherer, 2016). The outcomes lend weight to the perception that digital literacy is not only a skill but is a requirement for academic success in the distance learning context. This paper points out the status of digital literacy as a fundamental feature to increasing the performance of students and their learning in the remote learning setting.

Conclusion

This study examined the relationship between students' digital literacy and academic performance in distance learning. According to the results, students' digital literacy was usually good. Digital communication and understanding of digital literacy concepts had the strongest mean values while content curation and digital cooperation had the lowest mean value. The study also found a large and statistically significant positive relationship between academic performance and digital literacy ($r = .60$, $p < .001$), which showed that students who were more digitally literate performed better academically. These results confirm that digital literacy is such a heavy factor in the performance of distance learning. Digital literacy must be considered to be an element of educational policy and practice within the online and distance educational setting.

Based on study results, some suggestions are given here. Universities and distance learning organizations should include digital literacy training units in their curriculum with a particular focus on advanced skills such as digital cooperation, curation, and critical analysis of online content. Regular workshops and seminars should be organized where the students will be made to improve their practical digital skills of the students, and these are mainly in the areas of online safety, correct usage of digital possessions, and team project management. Distance learning institutions must focus on digital literacy training, access to reliable technology, and train instructors on effective online pedagogy. All these measures can lead to heightened student engagement, better academic performance, and a successful digital learning environment. To lessen digital disparity and ensure that all students have an equal chance to succeed, institutions must ensure steadfast access to digital devices and internet connectivity, especially for distance learners. Distance learning

institutions ought to design and implement structured digital literacy training programs to enhance the skills of students in communication, information management, collaboration, and e-safety. Digital literacy needs to be integrated into an academic curriculum so that students can acquire all the necessary skills in addition to the knowledge of the subject.

References

- Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall Giesinger, C., & Ananthanarayanan, V. (2017). *NMC Horizon Report: 2017 Higher Education Edition*. New Media Consortium. <https://files.eric.ed.gov/fulltext/ED582134.pdf>
- Amin, H., Malik, M. A., & Akkaya, B. (2021). Development and validation of the digital literacy scale (DLS) and its implications for higher education. *International Journal of Distance Education and E-Learning*, 7(1), 24-43.
- Amiri, S. (2009). The effects of information and communication technology on at-risk children of low economic status: Make It-Take It Case Study. *International Journal of Education and Development Using ICT*, 5(3), 141-147.
- Bawden, D. (2008). Origins and concepts of digital literacy. *Digital literacies: Concepts, policies and practices*, 30(2008), 17-32.
- Belshaw, D. (2012). *What is 'digital literacy'? A Pragmatic investigation* (Doctoral dissertation, Durham University). <https://etheses.durham.ac.uk/id/eprint/3446/>
- Bliss, R. (2019). What works the fundamental? *Erkenntnis*, 84(2), 359-379.
- Brown, B. C. (2009). *An examination of the relationship between digital literacy and student achievement in Texas elementary schools* (Doctoral dissertation, The University of Oklahoma, United States). <https://shareok.org/items/2ea7e729-822d-4c26-8a54-72e7c25d6871>
- Churchill, D. (2009). Educational applications of Web 2.0: Using blogs to support teaching and learning. *British journal of educational technology*, 40(1), 179-183.
- Creswell, J. W. (2016). Reflections on the MMIRA: The Future of mixed methods task force report. *Journal of Mixed Methods Research*, 10(3), 215-219.
- Crews, T. B., & McCannon, M. (2000). Comparison of communication skills needed by information systems undergraduates and

- graduates as perceived by information systems professionals. *Journal of Information Systems Education*, 11(3), 151-156.
- Earle, R. S. (2002). The integration of instructional technology into public education: Promises and challenges. *Educational technology*, 42(1), 5-13.
- Eshet-Alkalai, Y. (2009). Real-time thinking in the digital era. In M. Khosrow-Pour (Ed.), *Encyclopedia of Information Science and Technology* (2nd ed., pp. 3219–3223). Information Science Reference. <https://doi.org/10.4018/978-1-60566-026-4.ch514>.
- Fairlie, R. W., Beltran, D. O., & Das, K. K. (2010). Home computers and educational outcomes: Evidence from the NLSY97 and CPS. *Economic inquiry*, 48(3), 771-792.
- Friedman, E. J. (2005). The reality of virtual reality: The internet and gender equality advocacy in Latin America. *Latin American Politics and Society*, 47(3), 1-34.
- Gilster, P., & Gilster, P. (1997). *Digital literacy* (p. 1). New York: Wiley Computer Pub.
- Gardner, B. (1997) Students click with learning. *NEA Today*, 16(3), 19.
- Gui, M. (2007). Formal and substantial Internet information skills: The role of socio-demographic differences on the possession of different components of digital literacy. *First Monday*, 12(9). <https://doi.org/10.5210/fm.v12i9.2009>
- Gui, M., & Argentin, G. (2011). Digital skills of internet natives: Different forms of digital literacy in a random sample of northern Italian high school students. *New media & society*, 13(6), 963-980.
- Hatlevik, O. E., & Christophersen, K. A. (2013). Digital competence at the beginning of upper secondary school: Identifying factors explaining digital inclusion. *Computers & education*, 63, 240-247.
- Latham, A. (1999). Computers and achievement. *Educational Leadership*, 56(5), 87–88.

- Latham, G. P., & Seijts, G. H. (1999). The effects of proximal and distal goals on performance on a moderately complex task. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, 20(4), 421-429.
- López-Islas, G., & Jose, R. (2013). *Digital literacy and academic success in online education for underprivileged communities. the prep@net case*. (Doctoral dissertation, The University of Texas at Austin). <https://hdl.handle.net/2152/20948>
- Malik, M. A., & Akkaya, B. (2021). Comparing the academic motivation of conventional and distance education students: A study about a Turkish university. *Sir Syed Journal of Education & Social Research*, 4(2), 341-351.
- Matthewman, S., & Triggs, P. (2004). 'Obsessive compulsive font disorder': the challenge of supporting pupils writing with the computer. *Computers & Education*, 43(1-2), 125-135.
- Newman, T. (2009). *Consequences of a digital literacy review: Moving from terminology to action*. [PowerPoint slides]. SlideShare. <https://www.slideshare.net/slideshow/digital-literacy-literature-review-from-terminology-to-action/1258628>
- Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & education*, 59(3), 1065-1078
- Noreen, S., & Malik, M. A. (2020). Digital technologies for learning at Allama Iqbal Open University (AIOU): Investigating needs and challenges. *Open Praxis*, 12(1), 39-49.
- Oblinger, D. G., & Oblinger, J. L. (2005). Educating the net generation. EDUCAUSE. <https://www.educause.edu/research-and-publications/books/educating-net-generation>
- Parkes, M., Stein, S., & Reading, C. (2015). Student preparedness for university e-learning environments. *The Internet and Higher Education*, 25, 1-10.
- Sari, D. M. (2019). An error analysis of students' translation text. *Eralingua: Jurnal Pendidikan Bahasa Asing dan Sastra*, 3(2), 65-74.

- Sari, D. M. M. (2022). Digital literacy and academic performance of students' self-directed learning readiness. *Elite Journal: International Journal of Education, Language and Literature*, 2(3), 127-136.
- Sari, D. M. M., & Wardhani, A. K. (2020). Critical thinking as learning and innovation skill in the 21st century. *Journal of English Language and Pedagogy*, 3(2), 27-34.
- Schacter, D. L. (1999). The seven sins of memory: Insights from psychology and cognitive neuroscience. *American psychologist*, 54(3), 182.
- Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach*. John Wiley & sons.
- Siddiq, F., Hatlevik, O. E., Olsen, R. V., Throndsen, I., & Scherer, R. (2016). Taking a future perspective by learning from the past: A systematic review of assessment instruments that aim to measure primary and secondary school students' ICT literacy. *Educational Research Review*, 19, 58–84. <https://doi.org/10.1016/j.edurev.2016.05.002>.
- Siddiq, F., Scherer, R., & Tondeur, J. (2016). Teachers' emphasis on developing students' digital information and communication skills (TEDDICS): A new construct in 21st century education. *Computers & Education*, 92, 1-14.
- Siemens, G. (2005). Connectivism: Learning as network-creation. *ASTD Learning News*, 10(1), 1-28.
- Spante, M., Hashemi, S. S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent education*, 5(1), 1519143.
- Tang, C. M., & Chaw, L. Y. (2016). Digital Literacy: A Prerequisite for Effective Learning in a Blended Learning Environment? *Electronic Journal of E-learning*, 14(1), 54-65.
- Widana, I. W. (2020, July). The effect of digital literacy on the ability of teachers to develop HOTS-based assessment. *Journal of Physics:*

Conference Series, 1503(1), Article 012045.
<https://doi.org/10.1088/1742-6596/1503/1/012045>

Yuan, N., Yu, Q., & Liu, W. (2025, August). The impact of digital literacy on learning outcomes among college students: the mediating effect of digital atmosphere, self-efficacy for digital technology and digital learning. *Frontiers in Education*, 10, Article 1641687. <https://doi.org/10.3389/feduc.2025.1641687>

Mehmood, M. (2025). Examining the relationship between digital literacy and academic performance in distance education students. *Pakistan Journal of Distance and Online Learning*, 11(2), 15-31.