

-
- **Global Social Sciences Review (GSSR)** ▪ **Vol. VII, No. II (Spring 2022)** ▪ **Pages:** 196–206
-
- **DOI:** 10.31703/gssr.2022(VII-II).19 ▪ **URL:** [http://dx.doi.org/10.31703/gssr.2022\(VII-II\).19](http://dx.doi.org/10.31703/gssr.2022(VII-II).19)
-
- **L- ISSN:** 2520-0348 ▪ **p- ISSN:** 2520-0348 ▪ **e-ISSN:** 2616-793X
-
- **Citation:** Khan, R., & Gul, F. (2022). Exploring the relationship between digital literacy skills and Technological Pedagogical and Content Knowledge (TPACK) among secondary school teachers. *Global Social Sciences Review*, VII(II), 196–206.
[https://doi.org/10.31703/gssr.2022\(VII-II\).19](https://doi.org/10.31703/gssr.2022(VII-II).19)
-



Cite Us



Exploring the relationship between digital literacy skills and Technological Pedagogical and Content Knowledge (TPACK) among secondary school teachers

Ruzina khan^{*}

Fariha Gul[†]

Contents:

- [Introduction](#)
- [TPACK Knowledge Framework](#)
- [Digital literacy](#)
- [Objectives of the study](#)
- [Methodology](#)
- [Results and Findings](#)
- [Discussions](#)
- [Recommendations and Future Research](#)
- [References](#)

Abstract: *There is an increasing demand for teachers to present technological pedagogical and content knowledge (TPACK) in their classrooms with the help of their digital literacy skills (DLS). Though the teachers at the secondary school level are provided with digital gadgets, however, the teachers are still struggling with the use of digital tools during the teaching-learning process. Lack of digital literacy might be the cause of this reluctance, so the current study aims to explore the relationship between the digital literacy skills of teachers with respect to Technological, Pedagogical and Content Knowledge (TPACK). Data was collected from four hundred school teachers through Digital Literacy Scale (DSL) and TPACK inventory. The results indicate a low level of digital literacy and knowledge of TPACK, identified through descriptive statistics. However, a significantly positive relationship was identified through a significant correlation relationship ($r = .587, p < .001$) between both variables. On the basis of results, more trainings are recommended for teachers on both digital literacy and content pedagogy.*

Key Words: : Technological, Pedagogical and Content Knowledge TPACK, digital pedagogy, Digital Literacy (DL)

Introduction

The rapid advancement in technology has changed lives dramatically, and the transformation from physical to virtual world due to the pandemic served as the cherry on top. Graham (2011) endorsed the opinion of [Mishra & Koehler \(2006\)](#) that the person, as well as the professional lives of individuals in all walks of life, was highly influenced by a digital-driven environment. The incorporation of

technology in the learning process is thus gaining attention around the globe, giving birth to many policy reforms in Japan (Nurutdinova & Dmitrieva, 2017) USA (Office of Educational Technology, 2017) and Canada (Alberta Education, 2013) and Turkey (FATIH project, 2010). A similar project was also initiated in the local context, where schools were provided with computer labs and internet resources. All aforementioned projects focused on providing physical infrastructure and resources to

^{*} MPhil Graduate, Department of Education, University of Management & Technology Lahore, Punjab, Pakistan.

[†] Assistant Professor, Department of Education, University of Management & Technology Lahore, Punjab, Pakistan.

Email: fariha.gul@umt.edu.pk (Corresponding Author)

the students in order to develop their digital mastery, thus ultimately improving learning. Though these projects were aimed to provide physical resources, however, the internal factors, including teachers' motivation and competencies, were ignored. The teachers' competencies to assimilate technology in order to improve learning are one of the most influential factors in assimilating digital tools during teaching ([Anderson & Maninger, 2007](#); [Baek, Jong & Kim, 2008](#); [Teo & Noyes, 2011](#); [Tondeur et al., 2013](#)). [Calvani et al. \(2012\)](#) have defined a digitally literate person as the individual who can use and analyze information collected through digital tools for solving problems creatively, adhering to ethical values of using technology. The research indicates that though teachers are provided with digital resources, however, there is still a lack of integration technology in the teaching-learning process ([Fahser-Herro & Steinkuehler, 2009](#); [Henderson, 2011](#)). Contrarily, the students at the secondary school level are prepared for future studies and the job market, so it is necessary to learn a certain level of digital skills. However, the research indicates otherwise ([Ertmer & Ottenbreit-Leftwich, 2010](#); [Lee & Tsai, 2010](#)), thus making it necessary to examine the digital literacies of secondary school teachers, that is, in turn, influencing the digital competencies of secondary school students. This research is an effort to survey the perceived level of digital literacy among secondary school teachers.

The research designates that skill of integrating technology in teaching is not taught sufficiently in teacher training programs ([Kabakci-Yurdakul & Coklar, 2014](#)), same results were presented by [Voogt & McKenney in 2017](#). The framework presented by [Mishra and Koehler in 2006](#) explains and addresses the complexities of relations between Technological Pedagogical and Content Knowledge (TPACK), thus helping to examine the relationship between teachers' content knowledge and their pedagogical knowledge with their ability to integrate technology. The study aims to explore the knowledge of TPACK among secondary school teachers.

The use of technology during teaching learning process turned into an essential element

during the time of crisis. It can be stated that today zoom is the most significant tool to carry out the learning process. However, the reluctance and anxiety to use this tool were paramount initially, the main cause of which was a low level of digital literacy among teachers. The teachers from higher education institutions were using the technology somehow throughout their teaching ventures. However, the secondary school teachers were less aware of the concept. The temporary shift of teaching from a physical to a virtual environment created many difficulties, including the difficulties in using technology during the teaching process. All these circumstances lead towards the assumption that the teachers who were digitally literate were able to integrate technology into pedagogy, leading towards another assumption that all the teachers with better digital literacy would have a better score on TPACK. The current study is an effort to establish both assumptions based on empirical evidences.

On the contrary, there are many research studies that have already focused on the identification of Technological Pedagogical Content knowledge using multiple instruments, for example, the research carried out by [Joo, Park, & Lim in 2018](#) and another research carried out by [Dong, et al. earlier in 2015](#). The result of these studies presents that a lack of digital skills serves as a barrier to integrating technology into pedagogy ([Jang, 2010](#); [Liang et al., 2013](#)). Digital literacy skills are important factors that are an influence on the gathering of knowledge through internet and also the integration of technology into pedagogy ([Leu et al., 2017](#); [Ustundag et al., 2017](#)). There seems to be a gap in investigating the relationship between digital literacy and knowledge of TPACK, so the present research is an effort to bridge this breach by exploring the relationship between digital literacy and TPACK knowledge.

TPACK Knowledge Framework

The concept of TPACK was initially presented by [Shulman \(1986\)](#), which was later modified by many scholars in which the most recent and popular work came from [Mishra and Koehler \(2006\)](#). They have broadened the concept by providing the theoretical

groundings to the framework but also presented competencies that might be a prerequisite by teachers for the incorporation of technology in the teaching-learning process. The model presented by the aforementioned two scholars was composed of knowledge of content, pedagogy and content. It also presented the interaction between the above-said triad results into four fragments of knowledge, including technological pedagogical knowledge, technological pedagogical content knowledge, and pedagogical content knowledge (Koehler et al., 2014; Graham, 2011; Mishra & Koehler, 2006, 2009). The following study targets to explore the knowledge of TPACK among secondary school teachers.

Digital literacy

The individuals who are encircled by technology and can use it for multipurpose from daily life to the learning process were termed digital natives by Prensky (2001). However, the research has provided evidence that the availability of resources, compulsion to use technology and training in this perspective also influence the level of digital literacy of these digital inhabitants (Altun & Tantekin-erden, 2018; Ng, 2012a; Helsper & Eynon, 2010). The prevalent framework of digital literacy was present by Ng (2012a) that was comprised of three components including technical (daily usage of digital gadgets, for example, sending an email), cognitive (mental skills to process information gathered through digital resources) and socio-economic (ethical, legal and moral aspects of using technology) dimensions. The research studies have provided evidences that competence in these three dimensions proves an individual a competent technology user who can use technology in their carrier (Gunes & Bahcivan, 2018; Ustundag et al., 2017; Ng, 2012a). This is why the digital competency can be considered a likely conjecturer of TPACK competencies. The current study focuses on exploring the relationship between digital literacy and perceived knowledge of TPACK.

Objectives of the study

The objectives of the current study are as follows;

1. To identify the perceived level of digital literacy among secondary school instructors.
2. To identify the knowledge of TPACK among secondary school teachers.
3. To examine the relationship between digital literacy and TPACK.

Research Questions

The research questions based on the objectives of the study are as follows;

1. What is the perceived level of digital literacy among secondary school teachers?
2. What is the score of teachers on the knowledge level of TPACK among secondary school teachers?
3. Is there any significant relationship between digital literacy and knowledge of TPACK?

Methodology

This section of the research paper deals with the research design, population, sampling process and instrument of the study. The study was correlational in nature and a survey research design was used to achieve the objectives of the study. The study tried to identify the relationship between digital literacy skills and Technological, Pedagogical and Content Knowledge(TPACK). This target pertains to extensive data collection thus making the survey as an instrument for collecting responses from a large number of samples.

Population, sample and sampling technique

The data was collected from four hundred secondary school teachers working in Lahore. The populace of the study included secondary school teachers of the province of Punjab. There were 205 approximately female secondary schools in Lahore and 195 approximately male secondary schools and the numbers of teachers were 5600 approximately female teachers and 4000 approximately male teachers in the public sector. The targeted population was teachers working at the secondary school level in district Lahore (chosen due to time

and resource constraints). The sample was narrowed down to 400 respondents from previously selected schools.

factors and 19 statements, while the third part of the instrument was the TPACK survey with six factors and 42 statements.

Questionnaire as an Instrument

The data was collected through two survey instruments; the first part of the instrument was composed of demographic information including gender, type of school, qualification, experience and statements related to any kind of digital or pedagogical training. The second part of the instrument was the digital literacy scale with three

Pilot Testing of the Instrument

Though both instruments were adopted, however, owing to changes in context and sample of the study, the reliability value was calculated through the Cronbach alpha value. Below is the detailed table on the reliability value of both instruments and their factors;

Table 1. Reliability value of each factor of the digital literacy questionnaire and TPACK questionnaire

Variables	Factors	Cronbach's Alpha	N of Items
Digital literacy	C TOT	.725	4
	DLSTOT	.835	8
	FTOT	.750	7
TPACK	CKTOT	.834	12
	PKTOT	.814	7
	TKTOT	.704	5
	PCKTOT	.814	4
	TCKTOT	.699	4
	TPKTOT	.798	6
	TPACKTOT	.729	4

Results and Findings

The data was collected from four hundred respondents. The following table presents the

spread of respondents based on demographic variables;

Table 2. Spread of sample based on demographic variables

	Frequency	Percent
Gender		
Male	174	43.5
Female	226	56.5
Qualification		
B.A/B.ed/B.sc	93	23.3
M.A/M.ed/M.sc	136	34.0
M.Phil.	103	25.8
PHD	68	17.0
Type of institution		
Public	194	48.5
Private	206	51.5
Training about the use of technology		
Yes	185	46.3
No	215	53.8

As the first objective of the study was to identify the perceived level of digital literacy among secondary school teachers, so descriptive statistics were used. The following table presents the results;

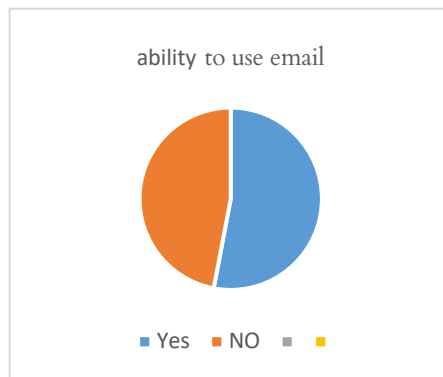
Table 3. Perceived level of digital literacy among secondary school teachers

Factors	Mean	SD	MPI
CTOT	1.7605	.44888	.440
DLSTOT	3.3450	.87790	.418
FTOT	3.2202	.77497	.460

The results indicate that the mean per item of each factor was below one, indicating the low skills of teachers, as most of the teachers responded to disagreement.

In addition to this, the two statements were

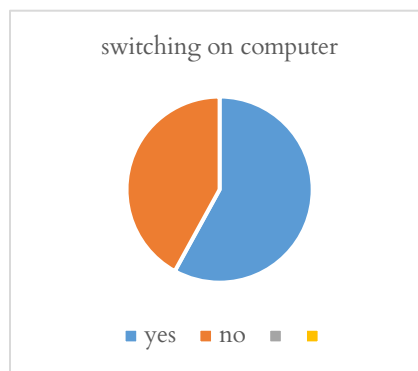
asked in the demographic section to check the basic usage skill of computers, including the ability to switch on/off computers and the ability to send and receive email through internet. The following graphs present the results;



Graph 1

The number of respondents who could use email was 212, while other 188 were unable to use this service. On the contrary, the 232 respondents were

able to switch on the computer as shown by the following graph;



Graph 2

The second objective of the study was to identify the knowledge of TPACK through TPACK survey, the

following table present the results;

Table 4. Descriptive statistics on knowledge of TPACK

	Mean	SD
TKTOT	3.2097	.80525
CKTOT	3.4516	.73048
PKTOT	3.4846	.84987
PCKTOT	3.2781	.91834
TCKTOT	2.6138	.83917
TPKTOT	3.4704	.87257
TPACKTOT	3.2781	.91834

The result here again shows that the responses of teachers were prone to disagreement with respect to technological pedagogical content knowledge.

The third objective of the study was to identify the relationship between digital literacy and knowledge of TPACK. The following table presents the results;

Table 5. Correlation between digital literacy and knowledge of TPACK

Variables	Mean	SD	R	Sig.
DLS	3.3450	.87790		
TPACK	3.2781	.91834	.587**	.000

The results indicate a positively strong relationship between TPACK and digital literacy ($r = .587, p < .001$).

Discussions

This research study aimed to explore the digital skills of secondary school teachers and their knowledge about TPACK. The major findings of this research study highlight the significant relationship between DLS and TPACK. The teachers who have DLS can easily integrate technology into the curriculum. TPACK highlights the knowledge that teachers require for the effective assimilation of technology in the educational classrooms. The advantage of using TPACK knowledge in the classrooms will help teachers in planning effective teaching strategies that will help teachers in enhancing their skills regarding the use of technologies in the schoolrooms. The finding of this study shows that the DLS of the secondary school teachers helps teachers in enhancing their knowledge about TPACK. There is a very small ratio of the teachers who are using TPACK in their teaching, while there is a number of researchers who are using TPACK framework in their research.

TPACK in most of schools is used for the teacher's professional learning needs. TPACK needs to be built and collaboratively distributed among the teachers. We cannot observe teachers' abilities may be one teacher has more content knowledge and the other teacher have pedagogical knowledge. It's also possible that another teacher has technological knowledge. Maybe another teacher has abilities in all three knowledge areas. TPACK is addressing more important issues of teaching and learning. TPACK framework covers a lot of things TPACK is not making any claims on the goals of learning. If a teacher wants to use a card, he can use it to make the teaching and learning effective. It depends on the educators to use TPACK correctly but they can't use it for non-pedagogical goals. Teachers have not designed a system in which they can engage the learners in the teaching and learning process. That's the reason students get bored in classrooms. Teachers are responsible for not engaging the students in the classrooms because

they have not attracted their attention by using digital gadgets.

Recommendations and Future Research

The results of the study lead towards a recommendation to officials to arrange professional

development courses both on digital pedagogy and literacy. Keeping in view the limitations of study, future research with a better sample size, mix method approach and the addition of respondents from other cities may be conducted for deeper understanding.

References

- Anderson, S. E., & Maninger, R. M. (2007). Preservice teachers' abilities, beliefs, and intentions regarding technology integration. *Journal of Educational Computing Research*, 37(2), 151–172. <https://doi.org/10.2190/H1M8-562W-18J1-634P>
- Altun, D., & Tantekin-Erden, F. (2018). *Digital profiles of pre-service preschool teachers*. 17th International Primary Teaching Education Symposium. Ankara, Turkey.
- Baek, Y. G., Jong, J., & Kim, H. (2008). What makes teachers use technology in the classroom? Exploring the factors affecting facilitation of technology with a Korean sample. *Computers & Education*, 50(1), 224–234. <https://doi.org/10.1016/j.compedu.2006.05.002>
- Calvani, A., Fini, A., Ranieri, M., & Picci, P. (2012). Are young generations in secondary school digitally competent? A study on Italian teenagers. *Computers & Education*, 58(2), 797–807. <https://doi.org/10.1016/j.compedu.2011.10.004>
- Cohen, J. (1988): *Statistical Power Analysis for the Behavioral Sciences*(2nd ed).Magwah,N.J,Lawrence Erlbaum Associates.
- Creswell, J.W., & Plano, C. V. L.(2011).*Designing and conducting mixed method research*(2nd ed).Thousand Oaks,CA:Sage.
- Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological Pedagogical Content Knowledge (TPACK). *Journal of Research on Technology in Education*, 42(2), 123–149. <https://doi.org/10.1080/15391523.2009.10782544>
- Dong, Y., Chai, C. S., Sang, G. Y., Koh, J. H. L., & Tsai, C. C. (2015). Exploring the profiles and interplays of pre-service and in-service teachers' technological pedagogical content knowledge (TPACK) in China. *Educational Technology & Society*, 18(1), 158–169.
- Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, 42(3), 255–284. <http://www.iste.org>
- Ellis, R. A., Goodyear, P., Bliuc, A.-M., & Ellis, M. (2011). High school students' experiences of learning through research on the Internet. *Journal of Computer Assisted Learning*, 27(6), 503–515. Retrieved from <http://www.wiley.com/WileyCDA/WileyTitle/productCd-JCAL.html>
- Fahser-Herro, D., & Steinkuehler, C. (2009). Web 2.0 literacy and secondary teacher education. *Journal of Computing in Teacher Education*, 26(2), 55–62. <http://iste@iste.org>
- Gilster, P. (1997). *Digital literacy*. New York: Wiley Computer Pub.
- Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education*, 57, 1953–1969. <https://doi.org/10.1016/j.compedu.2011.04.010>
- Gunes, E., & Bahcivan, E. (2018). A mixed research-based model for pre-service science teachers' digital literacy: Responses to “which beliefs” and “how and why they interact” questions. *Computers & Education*, 118, 96–101. <http://doi.org/10.1016/j.compedu.2017.11.012>
- Henderson, R. (2011). Classroom pedagogies, digital literacies and the home-school digital

- divide. *International Journal of Pedagogies and Learning*, 6(2), 152–161. <https://doi.org/10.5172/ijpl.2011.152>
- Helsper, E., & Eynon, R. (2010). Digital natives: where is the evidence? *British Educational Research Journal*, 36(3), 503–520. <https://doi.org/10.1080/01411920902989227>
- Jang, S. J. (2010). Integrating the interactive whiteboard and peer coaching to develop the TPACK of secondary science teachers. *Computers & Education*, 55(4), 1744–1751. <https://doi.org/10.1016/j.compedu.2010.07.020>
- Joo, Y. J., Park, S., & Lim, E. (2018). Factors Influencing Preservice Teachers' Intention to Use Technology:TPACK, Teacher Self-efficacy, and Technology Acceptance Model. *Educational Technology & Society*, 21(3), 48–59.
- Kabakci-Yurdakul, I., & Coklar, A. N. (2014) Modeling preservice teachers' TPACK competencies based on ICT usage. *Journal of Computer Assisted Learning*, 30(4), 363–376. <https://doi.org/10.1111/jcal.12049>
- Koehler, M.J., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical and content knowledge. *Journal of Educational Computing Research*, 32(2), 131–152.
- Koehler, M.J., Mishra, P., & Yahya, K. (2007). Tracing the development of teachers knowledge in a design seminar: Integrating content, Pedagogy, & technology. *Computers and Education*, 49(3), 740–762
- Koehler, M. J., Mishra, P., Kereluik, K., Shin, T. S., & Graham, C. R. (2014). The Technological Pedagogical Content Knowledge Framework. In M. J. Spector, D. M. Merrill, J. Elen & J. M. Bishop (Eds.), *Handbook of Research on Educational Communications and Technology* (pp. 101–111). New York: Springer. https://doi.org/10.1007/978-1-4614-3185-5_9
- Lee, M. H., & Tsai, C. C. (2008). Exploring teachers' perceived self efficacy and technological pedagogical content knowledge with respect to educational use of the World Wide Web. *Instructional Science*, 38(1), 1–21. <https://doi.org/10.1007/s11251-008-9075-4>
- Leu, D. J., Kinzer, C. K., Coiro, J., Castek, J., & Henry, L. A. (2017). New literacies: A dual-level theory of the changing nature of literacy, instruction, and assessment. *Journal of Education*, 197(2), 1–18. <https://doi.org/10.1177/002205741719700202>
- Liang, J. C., Chai, C., Koh, J., Yang, C. J., & Tsai, C. C. (2013). Surveying in-service preschool teachers' technological pedagogical content knowledge. *Australasian Journal of Educational Technology*, 29(4), 581–594. <https://doi.org/10.14742/ajet.299>
- Mishra, P. & Koehler, M.J. (2006): Technological pedagogical and content knowledge: A framework for integrating technology in Teachers Knowledge. *Teachers College Record*, 108(6), 1017–1054.
- Naaz, S., & Khan, Z. (2018). Measuring the Technological Pedagogical and Content Knowledge (TPACK) of pre-service Teachers in relation to their gender and streams. *American International Journal of Research in Humanities, Arts and Social sciences*, 50–55.
- Niess, M. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education*, 21(5), 509–523. <https://doi.org/10.1016/j.tate.2005.03.006>

- Ng, W. (2012a). Can we teach digital natives digital literacy? *Computers & Education*, 59(3), 1065–1078. <https://doi.org/10.1016/j.compedu.2012.04.016>
- Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the Horizon*, 9(5), 1–6. <https://doi.org/10.1108/10748120110424816>
- Rahman, A. S. A., & Harun, R. N. S. R. (2018). Tesl Pre-Service Teachers' Tpack: A Review. *International Journal of Academic Research in Business and Social Sciences*, 8(2), 780–789.
- Rahman, F., Hussain, A., Khalid, S. (2018). Technological Pedagogical Content Knowledge (TPACK) and Preparedness of Tutors in Open and Distance Learning (ODL) for New Teacher Education Programs, *Journal of Educational Research, Dept. of Education, IUB*, 21(2) Pakistan, 147–161.
- Rogers, E.M.(1995). *Diffusion of innovation*, 4th edition. The Free press, New York.
- Shulman, L. S. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher*, 15(2), 4–14. <https://doi.org/10.3102/0013189x015002004>
- Schmidt, D.A., Baran, E., Thompson, A.D., Mishra, P., Koehler, M.J., & Shin, T.S. (2009). Technological Pedagogical and Content Knowledge (TPACK): The development and Validation of an assessment Instrument for pre-service teachers. *Journal of Research on Technology in Education*, 42(2), 123–149.
- Shulman L.S. (1987). Knowledge & Teaching: Foundations of new reform. *Harvard Educational Review* 57 (1), 1–23. <https://doi.org/10.17763/haer.57.1.j463w79r56455411>
- Teo, T., & Noyes, J. (2011). An assessment of the influence of perceived enjoyment and attitude on the intention to use technology among pre-service teachers: A structural equation modelling approach. *Computers & Education*, 57(2), 1645–1653. <https://doi.org/10.1016/j.compedu.2011.03.02>
- Thompson, A., & Mishra, P. (2007–2008). Breaking news: TPACK becomes TPACK! *Journal of computing in teacher education*, 24(2), 34–64.
- Tondeur, J., Van Braak, J., Fisser, P., & Voogt, J., & Ottenbreit-Leftwich, A. (2012). Preparing pre service teachers to integrate technology into the education: *A synthesis of computer and education*, 59(1), 134–144.
- Tondeur, J., Pareja R. N., van Braak, J., Fisser, P., & Voogt, J. (2013). Technological pedagogical content knowledge in teacher education: In search of a new curriculum. *Educational Studies*, 39, 239–243. <https://doi.org/10.1080/03055698.2012.713548>
- Ustundag, M. T., Gunes, E., & Bahcivan, E. (2017). Turkish adaptation of digital literacy scale and in-vestigating pre-service science teachers' digital literacy. *Journal of Education and Future*, 12, 19–29.
- Verloop N., Van Driel J.H & Meijier P.C. (2001) Teacher knowledge and knowledge base of Teaching. *International Journal of Educational Research* 35, 441–461.
- Voogt, J., Westbroek H., (2011b) Teacher learning in collaborative curriculum design. *Teaching and Teacher Education* 27, 1235–1244.
- Voogt, J., Fisser, P., Robin, N.P., & Tondeur, J. (2012). Technological pedagogical content knowledge—a review of the literature. *Journal of Computer Assisted Learning*, 1–13.
- Voogt, J., & McKenney, S. (2017). TPACK in teacher education: are we preparing teachers to use technology for early literacy? *Technology, Pedagogy and Education*, 26(1), 69–83.

<https://doi.org/10.1080/1475939X.2016.1174730>

Webb, M., & Cox, M. (2004) A review of Pedagogy related to information and

communication technology. *Technology, Pedagogy and Education* 13,235-286.