# Teachers' Perception on the use of Computer in Teaching and Learning: A Case of Secondary Schools in Nyagatare District, Rwanda

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**Abstract**: The study sought to establish teachers' perception on the use of computers to facilitate teaching and learning in Nyagatare District, Rwanda. The study was descriptive in nature. The target population was 74 teachers from which 53 participated in the study through filling a questionnaire. The study revealed that participating teachers appreciated the role of computer in facilitating learning. Teachers rated themselves as moderately computer-literate but schools did not have equipped computer laboratories and therefore access to computers was limited. As a result, teachers used their personal computers to facilitate the teaching and learning process. Based on the conclusions, the study recommends that schools should work hard together with the Ministry of Education and other stakeholders towards attainment of equipped computer laboratories. To enhance teachers' computer literacy and positive attitude towards computer use, continuous professional development is highly recommended.

## Introduction

Computers have influenced human activities in various aspects of life including countries' education structures. An increasing adoption of technology-enhanced services has become the new trends in the global perspective. Computer-mediated teaching and learning exemplifies potentials towards creative and innovative instructional delivery (Bakar, 2016; Leow & Neo, 2014; Rensmann & Markovits, 2010; Toven-Lindsey et al., 2015).

The government of Rwanda has invested much effort in promoting integration of technology in education through One Laptop per Child Program whose implementation has been considered as a way that can be used to integrate ICT in education (Munyengabe et al., 2017). The promotion of ICT in education is one of pillars for Education Sector Strategic Plan (ESSP) as implemented in the Rwanda education system (Mugiraneza, 2021). The

2020/2021 report of the ministry of education showed that there has been an increasing integration of ICT in teaching and learning in general secondary schools with 1187 (33.7 %) schools in 2019 and 1356 (38.7 %) schools in 2020. In order to enhance the use of ICT tools in Rwandan general secondary schools, the program of smart classroom was initiated to increase schools' access to technological tools.

Teachers' computer literacy is crucial towards realization of ICT vision. Expansion of infrastructure, accelerated integration of ICT in education and creation of new links with regional and international organizations will enhance the utilization of ICT tools. Moreover, strong partnership with private sectors as core educational stakeholder would improve performance. Despite the progress of teachers' acceptance of computer utilization in the preparation of instructional materials and delivery

of instructions in a creative, innovative and visual format (Donner, 2007; Tateo, 2008), there are still difficulties encountered by teachers in schools in terms of inadequate infrastructure.

In the Rwandan education context, teachers in remote areas often do not use tech-enabled teaching strategies. This could be the result of inadequate infrastructure to support the use of technological tools. The use technological including computers is vital for teachers' daily tasks' effective accomplishment. For instance, the use of ICT in teaching and learning has been proven as effective strategy to boost creativity and innovation. This study sought to establish the role of computer and difficulties encountered in teaching among secondary Schools in Rwanda.

## Literature Review

### Computers and Implications in Education

A general truth known about the use of computer in education is its impact on productivity and teaching activities. Studies on computer usage has revolutionized teachers' creativity and innovation about instructional methods in education, making instruction delivery aligned with required skill transfer and acquisition of the 21st century. The meaningful and productive integration of computers in teaching and learning entails combined effort of stakeholders in education. Literature reveals that there exist external and internal factors obstructing fully integration of information communication technology. There is a consensus among previous scholars (Denuga & Nkengbeza, 2022; Hašková & Záhorec, 2022; Muzari et al., 2022) that continuous professional development and training of pre- and in- service teachers in the matters regarding information technology incorporation is essential.

Various studies (Aparicio Gómez, 2020; Harris et al. 2009) investigated on the rationale of adopting ICT in education and revealed that the use of computers support effective teaching and learning. A body of literatures shows that instructional use of computers plays a crucial role in advancing self-learning (Srisawasdi, 2012; Stein et al.,2020). The use of simulated instructional design and visual objects to enrich subject content has been linked with the development in computer-assisted teaching and learning (Ahmed et al., 2020). Similarly, digital-based videos, operational models and portable technological devices have been lately integrated in the classroom instruction provision (Jong et al., 2020). In education, computers have supported blended learning approaches that mix the use of e-learning platforms and old-fashioned face-to-face interaction either between teacher and students or among students, the content and among students themselves (Dziuban, et al.,2018). Improvement of teaching practices is a key indicator of fruitful learning outcome, and this can be achieved through teachers' continuous educational research to find out up-to-date information.

The use of simulation in teaching and learning dates back to 1980s and has since then been regarded as technology advancement for enhancing students' conceptual understanding and interpretation of daily scientific projects requiring high cognitive abilities (Bayraktar, 2001; Greca et al., 2014). Empirical studies have exposed unquestionable implications of computers and their accessories not only in the education sector but also in other various aspects of social development (Demirbag & Bahcivan, 2021; Howard & Gutworth, 2020; Ke & Schwarz, 2021; Louca & Zacharia, 2012).

A recent work in China by Clark et al. (2021) reported effectiveness of online teaching during COVID-19 through accessing online recorded lessons from external qualified teachers. The findings further revealed that students treated with high quality recorded lessons from external hired qualified teachers experienced academic score improvement contrary to students without special academic support. A study in the United Kingdom by de Winter et al. (2010) showed that social construction, assessment, differentiation and personalization of students' learning are reinforced by integrating technology and consequently result into promising learning outcomes. Sipilä (2010) in Finland examined whether there is difference in attitudes of teachers having own computers provided by their institutions and those without owned computers. The study revealed a significant correlation between teachers having own laptops and the attitude developed toward using the computers in the teaching and learning process. A more recent study by Okyere (2022) in Kenya revealed that provision of free internet significantly increased students' internet use in learning. Furthermore, the findings revealed that easy access

to internet services in schools significantly increased computer and internet skills among the learners.

As the COVID-19 pandemic has affected the modes of instructional delivery, Rwanda, one of the Easter African countries adopted the use of e-learning platforms to continue teaching and learning activities despite the spread of the COVID-19. After the COVID 19 was controlled, the use of such platforms become a normal way of delivering instructions. Rwanda Basic Education Board (REB) and the Ministry of education (MINEDUC) played a central role in advancing the use of ICT tools in the education sector (Jonathan & Andala, 2022). Their findings further indicate that despite the pandemic, the Rwandan government managed to ensure continuous students' learning using broadcasted lessons and learning materials uploaded and accessible at the official YouTube channel of the REB. It is worth noting that computer facilitates secondary school activities. Although, difficulties still exist, progress toward integrating computer use in teaching and learning is remarkable in the education sector.

## Computer as a Catalyst for Educational Transformation

Successful integration of computer use in classrooms has been a concern for researchers as it accelerates the achievement of sustainable development goals (Matzen & Edmunds, 2007). Computer use in education has existed for many years as a transformational strategy in the education sector. Since 1970s, literacy in technology and the use of computers in particular, has become one of key indicators for the 21st century needed skills (Bruce, 2003). In response, educational systems have developed educational platforms for easing access to information and promoting accelerated students' learning even in the absence of the instructor.

## Difficulties Associated with Computer Use in Education

Some studies explored difficulties that teachers encounter during the process of technology integration in teaching and learning (Bereczki & Kárpáti, 2021; Shagiakhmetova et al., 2022). Teachers' resistance to change and continued negative attitude towards computer use hold back the effective use of computers during lessons delivery. The frequently cited barrier in the literature about teachers' enhancement of teaching using computers was lack of continuing professional development (CPD) programs.

Findings in studies by Amuko et al. (2015) and Mingaine (2013) revealed that lack of training opportunities among teachers potentially hindered the integration of computer in the teaching and learning process. Therefore, it is crucial to foster the culture of planned workshops to enhance teachers' ability to use computers when delivering instructions (Wolff et al., 2017).

A study by Buabeng-Andoh (2012) reported lack of training in digital literacy and lack of pedagogic and didactic training as major constraints that hindered teachers to benefit from computer-mediated teaching and learning benefits. In the context of Rwanda, difficulties encountered by teachers include lack of equipped computer labs and limited electricity and internet connection in schools (Rubagiza et al., 2011). Furthermore, inadequate computer literacy skills have been identified as hindrances for teachers to use technology in the teaching and learning processes (Harerimana et al., 2016; Mukama & Andersson, 2008).

# Methodology
## Design
This study was descriptive in nature. The descriptive design was chosen because the study demanded a description of teachers' perspectives on computer use and difficulties encountered in using computers in the teaching and learning process.

## Population and Sampling
The target population for this study was 74 teachers from five secondary schools in Matimba Sector in Nyagatare District in Rwanda. From 99 male teachers and 36 female teachers, the researcher sampled 44 male teachers and 9 female teachers, which made 53 teachers as respondents.

## Instruments
A questionnaire was used as the research instrument in this study to collect data from participants. The instrument was designed in google form and it comprised 15 statements from which 12 were found reliable and were used in the field. Data was analyzed using the descriptive statistics in terms of frequencies and percentages.

## Validity and Reliability

Validity is the assurance that the research instrument measures what it intends to measure. To ensure validity of the instrument, a preliminary test was conducted by seeking views from experts. The views of experts were employed to improve the content of the questionnaire before its actual use in the field. The reliability test yielded the Cronbach's Alpha of 0.774 before the instrument was used in the field for data collection.

## Ethical Considerations

Prior to conducting this study, a permission was sought from education officers and head teachers of schools where data was collected. Participants were given a consent to indicate their willingness to participate in the study.

## Results and Discussion

The analysis of data begins with the presentation of demographic characteristics of respondents as appears in table 1.

## Teaching Level

The teaching level of participants comprised the lower, upper secondary and both levels. The lower secondary teachers constituted 47% with the frequency of 25 while the upper secondary school teachers constituted 38% with the frequency of 20 and those who taught at both levels constituted 15% with the frequency of eight. Therefore, the majority of participants taught at the lower level of secondary education.

**Table 2: Description of Participants' Demographic Information**

| Teaching Level | Frequency | Percentage | Qualification | Frequency | Percentage |
|---|---|---|---|---|---|
| Lower secondary | 25 | 47 | A2 | 6 | 11 |
| Upper secondary | 20 | 38 | A1 | 10 | 19 |
| Both levels | 8 | 15 | A0 | 37 | 70 |
| Total | 53 | 100 | Total | 53 | 100 |
| Gender | | | Age Category | | |
| Male | 44 | 83 | 20-25 | 4 | 8 |
| Female | 9 | 17 | 26-30 | 19 | 36 |
| Total | 53 | 100 | 31-35 | 9 | 17 |
| Work Experience | | | 36-40 | 15 | 28 |
| Less than 5 years | 27 | 51 | 41-45 | 1 | 2 |
| 5-10 years | 11 | 21 | Above 45 | 5 | 9 |
| 11-15 years | 8 | 15 | Total | 53 | 100 |
| 16-20 years | 3 | 6 | School Location | | |
| Above 20 years | 4 | 7 | Rural area | 45 | 85 |
| Total | 53 | 100 | Urban | 8 | 15 |
| | | | Total | 53 | 100 |

## Gender

In terms of gender, males were 44(83%) while females were nine (17%). Therefore, the majority of respondents were male teachers.

## Work Experience

Work experience was another factor where 27 (50.94%) participants had less than 5 years, 11 (20.75%) had between 5 and 10 years, 8 (15.10%) had between 11 and 15 years, three (5.66%) had 16 to 20 years and four (7.54%) had more than 20 years of work experience in the education field.

**Research Question 1**: How do secondary school teachers perceive the role of computer-use in the teaching practices?

Results in table 2 show that all participants agreed that the use of computers makes the preparation of pedagogical documents easier. Furthermore, the majority of respondents agreed that computer-mediated learning environment increases teachers' effectiveness, that computers enable teachers to carry out academic research and that the use of computers increases students' learning motivation. These findings suggest that the teachers considered computers as effective tools in supporting the teaching and learning effectiveness. Therefore, the teachers had positive attitude toward the use of computer in teaching and learning. Positive attitude toward the use of computer in facilitating learning is commended by previous studies. For instance, Huang and Liaw (2005) argued that teachers' positive attitudes towards computer use will affect how they deliver knowledge to the learners in a positive way.

**Research Question 2:** To what extent are teachers under investigation able to access computers?

This research question sought to establish the extent to which teachers under investigation are able to access computers. To reach this goal, respondents were exposed to five items in the questionnaire to agree or disagree, based on their personal experiences.

As seen in table 3, while the majority of teachers agreed to have their own computers, the majority disagreed that the schools have equipped computer labs. While the personal computers can support teachers' endeavor to impart knowledge to the learners, the lack of equipped computer laboratories would affect the students' use of computer technology in the learning process. While the schools had accessibility to electricity, teachers disagreed that the schools have free internet access. They also disagreed that the schools provide professional development programs to enhance the use of computers in the teaching and learning process. Therefore, while teachers had accessibility to computers, the schools did not provide conducive environments to support the use of computers in the teaching and learning process. The lack of school support is indicated by lack of equipped computer laboratories and free internet and lack of professional development to support teachers' use of computers.

**Table 2: The Role of Computer Use in Education**

| SN | Item in the Questionnaire | Disagree | | Agree | |
|----|---------------------------|----------|------|-------|------|
| | | f | % | f | % |
| 1 | The use of computers makes the preparation of pedagogical documents easier | 0 | 0 | 53 | 100 |
| 2 | Computer-mediated learning environment increases teachers' effectiveness | 10 | 18.87 | 43 | 81.13 |
| 3 | The Use of computers promotes interactive learning | 11 | 20.75 | 42 | 79.24 |
| 4 | Computers enable teachers to carry out academic research | 11 | 20.75 | 42 | 79.24 |
| 5 | The use of computers increases students' motivation | 13 | 24.53 | 40 | 75.47 |

**Table 3: Accessibility to Computer**

| SN | Item in the Questionnaire | Disagree | | Agree | |
|----|---------------------------|----------|-----|-------|-----|
| | | f | % | f | % |
| 1 | I have own computer and its accessories | 17 | 32 | 38 | 68 |
| 2 | The school has equipped computer lab | 36 | 68 | 17 | 32 |
| 3 | The school has free internet connection | 41 | 77 | 12 | 23 |
| 4 | The school has electricity | - | - | 53 | 100 |
| 5 | There are professional development programs | 42 | 79 | 11 | 21 |

**Table 4. Teachers' self-rated computer literacy skills**

| Computer Literacy | Low | Moderate | Intermediate | High |
|-------------------|-----|----------|--------------|------|
| Teachers' Computer Literacy | | 35 (66) | 11 (21) | 7 (13) |

According to Muchui et al. (2022), schools should ensure that computer laboratories are well-equipped with necessary hardware, software and infrastructure. This includes ensuring sufficient number of computers, printers, projectors and other relevant equipment that support effective learning. A study by Müller and Mildenberger (2021) emphasized that access to Internet is vital for computer laboratories to facilitate research, online learning resources and collaboration in the teaching and learning process. Schools should therefore provide high-speed and reliable internet connectivity to support learning effectiveness.

**Research Question 3:** What is teachers' self-rated computer literacy?

This research question sought to establish teachers' self-rated computer literacy. A recent study showed that teachers' computer literacy plays an important role in facilitating teaching and learning activities (Quaicoe & Pata, 2020). In addition, teachers with computer literacy can easily prepare teaching content and pedagogical documents (Voogt & McKenney, 2017). In responding to this question, 35 (66%) teachers considered themselves having moderate computer literacy, 11 (21%) considered themselves having intermediate computer literacy

while seven (13%) considered themselves having high computer literacy.

The findings indicate that the majority of teachers' hade moderate computer literacy. Therefore, the use of computer technology to support learning would be affected by teachers' limited computer literacy. Similarly, Alakrash and Abdul (2021) reported that computer literacy for teachers is moderate due to the lack of school support in terms of teacher training. This experience may affect the quality of teaching and learning (Wasserman & Migdal, 2019).

# Conclusions and recommendations
## Conclusions
Participating teachers had positive perception toward computer use. They appreciated the role of computer use in facilitating learning. Teachers rated themselves as moderately computer-literate, hence revealing literacy gap that demands serious attention. Schools did not have equipped computer laboratories and access to computers was limited. As a result, teachers used their personal computers to facilitate the teaching and learning process.

## Recommendations
Based on the conclusions, the study recommends that schools should work hard together with the Ministry of Education and other stakeholders towards attainment of equipped computer laboratories. To enhance teachers' computer literacy and positive attitude towards computer use, continuous professional development is highly recommended.

# References

Ahmed, S. T. S., Qasem, B. T., & Pawar, S. V. (2020). Computer-Assisted Language Instruction in South Yemeni Context: A Study of Teachers' Attitudes, ICT Uses and Challenges. International Journal of Language Education, 4(1), 59-73.

Alakrash, H. M., & Abdul R. N. (2021). Technology-based language learning: Investigation of digital technology and digital literacy. *Sustainability*, *13*(21), 12304.

Amuko, S., Miheso, M., & Ndeuthi, S. (2015). Opportunities and Challenges: Integration of ICT in Teaching and Learning Mathematics in Secondary Schools, Nairobi, Kenya. Journal of Education and Practice, 6(24), 1-6.

Aparicio Gómez, O. Y. (2020). The education of desire and the use of ICT. In Desire and Human Flourishing (pp. 325-337): Springer.

Bakar, A. Y. A. (2016). "Digital Classroom": An Innovative Teaching and Learning Technique for Gifted Learners Using ICT. Creative education, 7(1), 55-61.

Bayraktar, S. (2001). A meta-analysis of the effectiveness of computer-assisted instruction in science education. Journal of research on technology in education, 34(2), 173-188.

Bereczki, E. O., & Kárpáti, A. (2021). Technology-enhanced creativity: A multiple case study of digital technology-integration expert teachers' beliefs and practices. Thinking Skills and Creativity, 39, 100791.

Bruce, C. (2003). Information literacy as a catalyst for educational change: A background paper. Paper presented at the International information literacy conferences and meetings.

Buabeng-Andoh, C. (2012). Factors influencing teachersâ adoption and integration of information and communication technology into teaching: A review of the literature. International Journal of Education and Development using ICT, 8(1).

Clark, A. E., Nong, H., Zhu, H., & Zhu, R. (2021). Compensating for academic loss: Online learning and student performance during the COVID-19 pandemic. China Economic Review, 68, 101629.

de Winter, J., Winterbottom, M., & Wilson, E. (2010). Developing a user guide to integrating new technologies in science teaching and learning: Teachers' and pupils' perceptions of their affordances. Technology, Pedagogy and Education, 19(2), 261-267.

Demirbag, M., & Bahcivan, E. (2021). Comprehensive exploration of digital literacy: Embedded with self-regulation and epistemological beliefs. Journal of science education and technology, 30(3), 448-459.

Denuga, D. D., & Nkengbeza, D. (2022). Pre-Service Teachers Experience in Project-Based Learning Approach: A Case Study of Two Campuses of the University of A (UNA). Open Journal of Social Sciences, 10(4), 121-132.

Donner, J. (2007). The rules of beeping: Exchanging messages via intentional "missed calls" on mobile phones. Journal of computer-mediated communication, 13(1), 1-22.

Dziuban, C., Graham, C. R., Moskal, P. D., Norberg, A., & Sicilia, N. (2018). Blended learning: the new normal and emerging technologies. International journal of educational technology in Higher education, 15(1), 1-16.

Greca, I. M., Seoane, E., & Arriassecq, I. (2014). Epistemological issues concerning computer simulations in science and their implications for science education. Science & Education, 23(4), 897-921.

Harerimana, A., Mtshali, N. G., Hewing, H., Maniriho, F., Borauzima-Kyamusoke, E., & Mukankaka, A. (2016). E-learning in nursing education in Rwanda: Benefits and challenges. An exploration of participants' perceptives. IOSR J Nurs & Health Sci, 5(2), 29.

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. Journal of research on technology in education, 41(4), 393-416.

Hašková, A., & Záhorec, J. (2022). Analysis of Teachers' Needs Related to Their Professional Digital Skills: Reflection on the pre-Corona State in Slovakia and Impact of the First Wave of the Pandemic on These Needs. In Digital Literacy for Teachers (pp. 463-493): Springer.

Howard, M. C., & Gutworth, M. B. (2020). A meta-analysis of virtual reality training programs for social skill development. Computers & education, 144, 103707.

Huang, H. M. & Liaw, S. S. (2005). Exploring user's attitudes and intentions toward the web as a survey tool. Computers in Human Behavior, 21(5), 729-743.

Jonathan, B., & Andala, H. O. (2022). E-Learning Instructional Strategies and Students' Academic Performance in Public Secondary Schools in Rwanda. Journal of Education, 5(1).

Jong, M. S. Y., Tsai, C. C., Xie, H., & Kwan-Kit Wong, F. (2020). Integrating interactive learner-immersed video-based virtual reality into learning and teaching of physical geography. British Journal of Educational Technology, 51(6), 2064-2079.

Ke, L., & Schwarz, C. V. (2021). Supporting students' meaningful engagement in scientific modeling through epistemological messages: A case study of contrasting teaching approaches. Journal of research in science teaching, 58(3), 335-365.

Leow, F.-T., & Neo, M. (2014). Interactive multimedia learning: Innovating classroom education in a Malaysian university. Turkish Online Journal of Educational Technology-TOJET, 13(2), 99-110.

Louca, L. T., & Zacharia, Z. C. (2012). Modeling-based learning in science education: cognitive, metacognitive, social, material and epistemological contributions. Educational Review, 64(4), 471-492.

Matzen, N. J., & Edmunds, J. A. (2007). Technology as a catalyst for change: The role of professional development. Journal of research on technology in education, 39(4), 417-430.

Mingaine, L. (2013). Leadership Challenges in the Implementation of ICT in Public Secondary Schools, Kenya. Journal of education and learning, 2(1), 32-43.

Muchui, M., Ngaruiya, B., Ganira, L., & Kinyua, G. (2022). ICT Infrastructure and Implementation of Digital Literacy Programme in Public Primary Schools in Isiolo County, Kenya. *Journal of Pedagogy, Andragogy and Heutagogy in Academic Practice/ISSN: 2708-261X*, *3*(2), 26-35.

Mugiraneza, J. P. (2021). Digitalization in teaching and education in Rwanda. The Report, 28.

Mukama, E., & Andersson, S. B. (2008). Coping with change in ICT-based learning environments: Newly qualified Rwandan teachers' reflections. Journal of Computer Assisted Learning, 24(2), 156-166.

Müller, C., & Mildenberger, T. (2021). Facilitating flexible learning by replacing classroom time with an online learning environment: A systematic review of blended learning in higher education. *Educational Research Review*, *34*, 100394.

Munyengabe, S., Yiyi, Z., Haiyan, H., & Hitimana, S. (2017). Primary teachers' perceptions on ICT integration for enhancing teaching and learning through the implementation of one laptop per child program in primary schools of Rwanda. Eurasia Journal of Mathematics, Science and Technology Education, 13(11), 7193-7204.

Muzari, T., Chasokela, D., & Sithole, A. (2022). Computer Integrated Manufacturing Sub-Systems in Technical and Vocational Education and Training: A Bewilderment for Stakeholders in Polytechnics in

Zimbabwe. Indiana Journal of Humanities and Social Sciences, 3(3), 45-53.

Okyere, C. Y. (2022). The effect of internet services on child education outcomes: evidence from poa! Internet in Kenya. Journal of Development Effectiveness, 14(1), 4-18.

Quaicoe, J. S., & Pata, K. (2020). Teachers' digital literacy and digital activity as digital divide components among basic schools in Ghana. *Education and Information Technologies*, *25*, 4077-4095.

Rensmann, L., & Markovits, A. S. (2010). Gaming the World: How Sports Are Reshaping Global Politics and Culture: Princeton University Press.

Rubagiza, J., Were, E., & Sutherland, R. (2011). Introducing ICT into schools in Rwanda: Educational challenges and opportunities. International Journal of Educational Development, 31(1), 37-43.

Shagiakhmetova, M. N., Bystritskaya, E. V., Demir, S., Stepanov, R. A., Grishnova, E. E., & Kryukova, N. I. (2022). Primary Teachers Difficulties Related to Compulsory Distance Education During COVID-19. Contemporary Educational Technology, 14(2), ep357.

Sipilä, K. (2010). The impact of laptop provision on teacher attitudes towards ICT. Technology, Pedagogy and Education, 19(1), 3-16.

Srisawasdi, N. (2012). Student teachers' perceptions of computerized laboratory practice for science teaching: a comparative analysis. Procedia-Social and Behavioral Sciences, 46, 4031-4038.

Stein, H., Gurevich, I., & Gorev, D. (2020). Integration of technology by novice mathematics teachers–what facilitates such integration and what makes it difficult? Education and information technologies, 25(1), 141-161.

Tateo, L. (2008). The" fascist" discourse in computer mediated communication: the" dual strategy" model of the Italian Extreme Right. Psicologia & Sociedade, 20, 287-296.

Toven-Lindsey, B., Rhoads, R. A., & Lozano, J. B. (2015). Virtually unlimited classrooms: Pedagogical practices in massive open online courses. The Internet and Higher Education, 24, 1-12.

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.

Wolff, L.-A., Sjöblom, P., Hofman-Bergholm, M., & Palmberg, I. (2017). High performance education fails in sustainability?—A reflection on Finnish primary teacher education. Education Sciences, 7(1), 32.