



## Implementation of Information and Communication Technologies in Teaching: Differences in Teachers' Perspectives

*Original scientific paper*

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### Abstract

*In addition to the advantages of using ICT in teaching, such as greater student engagement, easier access to educational resources, the possibility of self-regulated learning and better monitoring of student progress, there are certain obstacles that can discourage and make it difficult for teachers to implement ICT in teaching. This research aimed to identify how teachers of different ages perceive, use and accept information and communication technologies in teaching, and what are the key reasons and challenges for implementing these technologies in teaching. The data was collected using an online questionnaire on a sample of 104 teachers of the subject class. The results of the research indicate that teachers show interest in applying ICT in teaching, but that they encounter certain obstacles in this process, such as insufficient technical support in schools, poor internet access, and insufficient training.*

**Keywords:** *Information and Communication Technologies (Ict), Teaching, Challenges in the Implementation of Ict in Teaching*

Computerization and informatization of society inevitably lead to the implementation of information and communication technologies (ICT) in teaching. According to Bruck and Piriija (2016), this implementation will become increasingly important as technology develops and the educational system adapts to the new demands and opportunities offered by the digital environment. However, it is difficult to accurately measure the extent to which the educational system enables the

application of ICT in teaching and what real problems teachers and educational institutions face in this process. The implementation of ICT in teaching has great potential to increase student motivation, connect students to different sources of information, support collaborative learning, and allow teachers more time for facilitation in classrooms (Wang and Woo, 2007, as cited in Tayaban, 2022). The advantages of using information and communication technologies in teaching, as stated by Fu (2013), include:

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helping students to effectively access digital information, facilitating the process of acquiring knowledge and solving problems, supporting student-centered learning and independent learning from various resources, creating a creative environment for learning by providing innovative specially designed applications, encouraging collaborative learning, providing more opportunities for the development of critical thinking, improving the quality of teaching and learning by encouraging student autonomy and creativity, changing the traditional teacher-centered approach to a more creative and flexible approach. Factors influencing the implementation of ICT in teaching can be divided into external factors, such as the availability of ICT equipment, the time needed for lesson planning, curriculum, technical and administrative support, and internal factors, such as attitudes towards the implementation of ICT in teaching, including perception, intention or motivation for using ICT. Rogosic et al. (2021) investigated the attitudes of teachers and students of secondary vocational schools in Zagreb and Zagreb County on the use of ICT in general education subjects and its role in supporting modern educational practice. Through qualitative methods, such as individual interviews with teachers and focus groups with students, the researchers found that despite recognizing the benefits, teachers face challenges such as lack of training, technical problems and limited resources that make it difficult to implement ICT in teaching. Muslem et al. (2018) on a sample of 26 English language teachers from 16 public secondary schools in Banda Aceh found that teachers have three main challenges in using ICT. Limited ICT tools and weak internet connection in schools are dominant challenges. Teachers have to share tools with other teachers and waiting for their turn to use ICT wastes time. Ghavifekr et al. (2016) conducted a study to determine teachers' perceptions of the challenges they face when using ICT in teaching. Data were collected from 100 teachers working in secondary schools in Malaysia (Melaka). The key problems and challenges identified in the use of information and communication technologies by teachers are: limited availability and network connectivity, limited technical support, lack of effective education, limited time and

lack of teacher expertise. Internal obstacles, including negative opinions, attitudes and lack of self-confidence of teachers towards technology, are identified by Ardiç (2021) as key challenges in the implementation of information and communication technologies in teaching. In this regard, internal obstacles are more challenging to overcome compared to external obstacles and have a significant impact on the very process of technology implementation in teaching activities. Istifanus (2023), states that the successful implementation of information and communication technologies in teaching largely depends on the beliefs of teachers, where there is a lower probability that teachers who perceive information and communication technologies as not meeting their needs or the needs of their students will implement ICT technology into their teaching and learning. Research conducted by Sang et al. (2009) on a sample of 873 primary school teachers from 11 Chinese provinces and municipalities shows that teachers' positive attitudes, awareness of the successful and effective implementation of ICT in teaching and their positive perceptions of the benefits of using ICT are determinants that contribute to the implementation of ICT in teaching. The Schiller 2003 study (as cited in Buabeng-Andoh, 2012) states that personal characteristics such as level of education, age, gender and work experience can also influence the implementation of ICT in teaching. Research by Krumsvik et al. (2016) on the use of ICT in secondary schools in Norway found differences in regard to the age of teachers. It has been shown that older teachers (50 years and older) have less digital competences in contrast to their younger colleagues. Moreover, a survey of teachers in 16 primary schools in Ankara conducted by Usluel et al. (2007) found that younger teachers use ICT more often and have better competencies in contrast to their older colleagues. However, research (Mahdi and Al-Dera, 2013, Semerci and Aydın, 2018, Kerzic et al., 2021) showed that demographic variables are not a predictor of ICT implementation in teaching. Mahdi and Al-Dera (2013) investigated the influence of teachers' age, experience and gender on the implementation of ICT in language teaching. The results showed that there is no significant difference in the use of ICT between the two groups of teachers according to their age

and experience, but that there is a gender difference where female teachers use less ICT in teaching than male teachers. Research by Kerzic et al. (2021) on the use of ICT by teachers at the University of Ljubljana in Slovenia did not reveal any significant differences between teachers in terms of age. Likewise, in a survey of secondary school teachers in Ankara, Semerci and Aydın (2018) found no differences between teachers' readiness to implement ICT in teaching according to age. Therefore, the aim of this research was to determine how different teachers perceive, use and accept information and communication technologies in teaching, as well as what are the key challenges and factors that influence the implementation of this technology in teaching.

### Method

In order to answer the research goal, the following research questions were asked:

- Are there differences in the frequency of inclusion of information and communication technologies in teaching among teachers of different ages?
- How do teachers of different ages perceive the benefits of information and communication technologies in teaching?
- What challenges do teachers face when implementing information and communication technologies in teaching, and how do these challenges vary depending on the age of teachers?
- How do teachers of different ages assess the importance of preparation and training in the implementation of information and communication technologies in teaching?

The research was conducted in 7 elementary schools in Tuzla. 104 respondents of both sexes participated in the research, 24% of male respondents and 76% of female respondents. The smallest percentage of respondents, more precisely 15.4%, belongs to the younger age group (under 35 years of age).

On the other hand, a significant number of respondents, 48.1%, are in the age range of 35 to 50 years, making that age group the most numerous. Respondents older than 50 years of age make up 36.5% of the total sample, which represents a significant part of the population. For the purposes of this research, a questionnaire consisting of four parts was constructed. The first part referred to claims related to the frequency of using communication channels in the service of teaching and information and communication technologies in the preparation of teaching content. The second part refers to the statements related to the attitude of teachers towards the use of ICT. The third part refers to the assessment of challenges in the implementation of ICT. The last part refers to the assessment of the preparation and training of teachers for the use of ICT. Questions were formulated using the Likert Scale to assess frequency, rounding the degrees ranging from 1 (always) to 5 (never).

### Results

The processing of the obtained data was carried out in the SPSS program (Statistical Program for Social Scientists 20). In addition to descriptive analysis, the Kruskal-Wallis test was used to determine the significance of differences by age. Table 1 shows the results of descriptive statistics for the assessment of differences in teachers' perspectives on the implementation of information and communication technologies in teaching. The obtained results of the Cronbach alpha coefficient above 0.70, shown in Table 1, confirmed the reliability of the measurement scales used to measure the differences in teachers' perspectives. An irregular distribution is noticeable for most of the analyzed variables ( $p < 0.05$ ), and the non-parametric Kruskal-Wallis test was applied to determine the differences between the age-defined groups of teachers (under 35 years of age, 35 to 50, over 50 years).

**Table 1.***Descriptive Statistics*

	N	M	SD	K <sup>2</sup>	p	Cronbach's Alpha
The frequency of using communication channels in the service of teaching and preparation of teaching content	104	28.39	7.11	0.078	0.133	0.859
The attitude of teachers towards the use of ICT	104	44.38	13.07	0.116	0.002	0.957
Challenges in ICT implementation	104	28.47	9.44	0.087	0.048	0.939
Preparedness and training for the use of ICT	104	45.47	11.06	0.093	0.028	0.940

*Legend: N – number of respondents, M – arithmetic mean, SD – standard deviation, KS – Kolmogorov-Smirnov test*

When it comes to the frequency of using different ICT channels for communication in teaching and preparation of teaching content, the results show that the most frequently used channels of communication are online communication through applications such as Viber, WhatsApp, Messenger (M=2.10, SD=.971) and e-mail (M=2.27, SD=.978), while forums and blogs are used the least (M=3.62, SD=1.24). In the preparation of teaching content, the preparation of pictures, illustrations, graphs, maps etc. is mostly used (M=2.25, SD=.773), while interactive learning through applications is less frequently used (M=3.13, SD=1.08). An analysis was carried out using the Kruskal-Wallis test (Table 2) in order to investigate potential differences among age-defined groups of teachers (under 35 years of age, 35 to 50, over 50 years) in terms of the frequency of using communication channels in the service of teaching and the

preparation of teaching content. The results of the Kruskal-Wallis test presented in Table 3 show that the significance of the test is less than 5%, i.e.  $p < 0.05$ , with a confidence level of 95%, which indicates that there is a statistically significant difference in the frequency of using communication channels among teachers of different ages. Those younger than 35 years of age have the lowest arithmetic mean of ranks (33.06) which indicates that this group uses communication channels in teaching and preparing materials less often compared to older groups. Teachers aged 35 to 50 have a higher arithmetic mean of ranks (56.60) which indicates that they use communication channels more often than their younger colleagues. Teachers older than 50 years of age also have a high arithmetic mean of ranks (55.29) indicating a similar frequency of using communication channels as the group aged 35-50.

**Table 2.**

*Frequency of Using Communication Channels in the Service of Teaching and Preparation of Teaching Content Among Teachers of Different Ages*

Age group	N	The arithmetic mean of ranks	Chi-Square	df	Asymp. Sig.
Under 35 years old	16	33.06	7.911	2	0.019
35 to 50	50	56.60			
Older than 50 years	38	55.29			
In total	104				

Most teachers express a proactive approach to improving their skills in using ICT in teaching. Most teachers often look for new ways to improve their ICT skills (M=2.33, SD=1.22) and use ICT to support the educational process (M=2.35, SD=1.01). However, relatively fewer teachers involve students in creating digital content (M=2.69, SD=.976) or actively seek feedback on the effectiveness of ICT (M=2.78, SD=1.12). They see the greatest benefits of using ICT in facilitating cooperation among students (M=2.06, SD=.890), easier memorization of material (M=2.08, SD=.772), and

improving the atmosphere in the classroom (M=2.11, SD=.799). Moreover, the use of ICT enables adaptation to different learning styles (M=2.13, SD=.832) and encourages the development of students' digital skills (M=2.11, SD=.799). The results of the Kruskal-Wallis test (Table 3) show that there are no statistically significant differences in the perception of ICT benefits among teachers of different ages ( $p > 0.05$ ). The obtained p-value of 0.141 is higher than the conventional statistical significance threshold of 0.05.

**Table 3.**

*Attitude and Perceived Benefits of Teachers of Different Ages Towards the use of Information and Communication Technologies in Teaching*

Age group	N	The arithmetic mean of ranks	Chi-Square	df	Asymp. Sig.
Under 35 years of age	16	39.13	3.919	2	0.141
35 to 50	50	56.15			
Older than 50 years	38	53.33			
In total	104				

Based on these results, we cannot conclude that younger teachers are more or less inclined to use ICT compared to their older colleagues. Therefore, we cannot claim that the age of teachers affects their attitude towards the use of information and communication technologies in teaching. The most pronounced challenges that teachers face when implementing ICT in teaching are of technical nature, such as the lack of a sufficient number of interactive whiteboards (M=1.55, SD=.605), faulty or outdated computers (M=1.51, SD=.638), and slow internet access (M=1.71, SD=.746). Other significant problems include lack of technical (M=1.83, SD=.781) and

pedagogical support (M=2.07, SD=.968) as well as lack of adequate digital content (M=1.92, SD=.962). Social and cultural challenges, such as hostile attitudes of other teachers (M=2.49, SD=1.03) and fear of losing traditional methods (M=2.63, SD=1.12), are also present but less pronounced.

It is interesting to note that the research did not reveal statistically significant differences among teachers of different ages in the perception of these challenges (Table 4). The obtained p-value of 0.657 indicates that the challenges of implementing information and communication technology that teachers perceive do not differ depending on their age.

**Table 4.**

*Differences in the Perceived Challenges of Implementing Information and Communication Technology in Teaching According to the age of Teachers*

Age group	N	The arithmetic mean of ranks	Chi-Square	df	Asymp. Sig.
Under 35 years of age	16	53.47	0.441	2	0.802
35 to 50	50	54.14			
Older than 50 years	38	49.93			
In total	104				

The most frequently used resources to support learning and improve skills in the use of ICT are online courses and materials ( $M=2.68$ ,  $SD=.988$ ) and interactive learning platforms ( $M=2.73$ ,  $SD=1.04$ ) while educational workshops ( $M=2.87$ ,  $SD=.976$ ) and video materials ( $M=2.86$ ,  $SD=1.04$ ) are used somewhat less often. The largest percentage of teachers assess that the school rarely organizes trainings and workshops ( $M=3.29$ ,  $SD=1.05$ ) and that there is a lack of technical support ( $M=3.27$ ,  $SD=.927$ ). Stable Internet access and technical

equipment are also insufficiently supported ( $M=3.29$ ,  $SD=.942$ ;  $M=3.13$ ,  $SD=.825$ ). Table 5 shows the differences in the preparedness and training of teachers for the effective use of information and communication technologies in teaching with regard to age. The results of the Kruskal-Wallis test show that there are no statistically significant differences between the ages of teachers in their perceptions of the importance of various aspects of preparedness and training for working with ICT (Table 5).

**Table 5.**

*Analysis of the Preparedness and Training of Teachers for the Effective use of Information and Communication Technologies in Teaching: Differences with Regard to the age of Teachers*

Age group	N	The arithmetic mean of ranks	Chi-Square	df	Asymp. Sig.
Under 35 years of age	16	53.47	0.441	2	0.802
35 to 50	50	54.14			
Older than 50 years	38	49.93			
In total	104				

The significance of 0.802, which is higher than the conventional threshold of statistical significance of 0.05, shows the absence of statistically significant differences. This may indicate that, despite different age groups, teachers generally share similar views on the importance of preparedness and training for the implementation of ICT in teaching.

### Discussion

This research showed that teachers positively perceive the application of ICT and recognize the potential of ICT in improving teaching, however, this does not necessarily mean that they implement ICT in teaching. Lack of technical support in schools and poor access to the Internet prevent teachers from using ICT in teaching. Lack of training in how to use ICT is another obstacle that prevents teachers from implementing ICT in teaching. In order for ICT to be implemented in teaching, schools must provide appropriate and sufficient support to teachers. On the other hand, teachers must be aware of what is happening in the classroom and the changes that are taking place and work on their own improvement in that area. From the obtained results, it can be concluded that teachers most often use simple and fast forms of communication,

such as Viber, WhatsApp and e-mail for the purpose of teaching. Less use of forums and blogs may be due to their complexity or lack of time for in-depth discussion on these platforms. In the preparation of teaching contents, visual materials such as pictures and graphs are the most common, which reflects the need to visualize the contents, while less use of interactive applications may indicate insufficient technical training or resources for their application in teaching. Such results partially coincide with the results of research conducted by Rogosic et al. (2021). The results of that research show that applications such as WhatsApp are common in communication between teachers and students, as they enable faster daily interaction and coordination. Online learning platforms (e.g. Google Drive, Google classroom...) and video conferences (e.g. Zoom, Microsoft Teams, Skype) have a growing but smaller presence compared to applications that enable free calls and sending free text messages. Moreover, the results show that social networks, forums and blogs show the lowest rate of use among teachers, leaving room for some future research that could point to the reasons for obtaining such results. The results of the research, based on the answers of the respondents, indicate that the teachers of subject classes

when preparing teaching content most often use PowerPoint presentations and visual elements such as pictures, illustrations and graphics. In addition to that, the results of the research indicate that YouTube is an important source of audiovisual materials, while applications for interactive learning, although present, are still in the development phase, which is in line with previous research by Rogosic, et al. (2021). The results of this research showed that teachers most often use computer programs for creating presentations when preparing content for classes, and that a smaller number of teachers use specialized programs. The results show that there is a difference in the frequency of using communication channels among different age groups of teachers. Although teachers (aged 35 to 50 and older than 50) use communication channels more often than their younger colleagues, the difference between these two groups is smaller. In this way, we can reject the assumption that older teachers use ICT communication channels less often and with less confidence compared to their younger colleagues. The obtained results do not agree with the findings of earlier research, according to which there are differences in the use of ICT in teaching with regard to age but these differences are manifested in the way that older teachers have fewer digital competencies and use ICT less often, unlike their younger colleagues. The last result, however, should be taken with reservations due to the small number of teachers who belonged to the group under 35 years of age. Such results do not exclude the possibility of the existence of other factors that could influence the frequency of using communication channels among different age groups of teachers, which requires further research. The obtained results of the research indicate that teachers recognize the positive impact of ICT on students, and as the reason for this they cited greater student engagement, understanding of material, encouragement of critical thinking and logical reasoning in students. These results correlate with relevant research on the benefits of ICT for students (Valverde-Berrocoso et al., 2022, Timotheou et al., 2023) such as better academic performance, individualized learning, increased attention and student motivation. According to the results of this research, no statistically significant difference was found in the

perception of the use of ICT in teaching among teachers of different ages, which suggests that age does not play a key role in their attitude towards ICT. Moreover, the results show that age does not affect the perception of challenges faced by teachers when implementing ICT in teaching. Based on these results, it is clear that, although on the one hand teachers clearly recognize the positive effects of ICT on various aspects of learning and teaching, they associate the impossibility of its implementation with the lack of adequate equipment, problems with the Internet, lack of technical and pedagogical support, inadequate digital skills. These results are consistent with previous research that identified similar challenges in the use of ICT in teaching (Rogosic et al., 2021, Muslem et al., 2018, Ghavifekr et al., 2016, Yildirim, 2007). Research findings by Ghavifekr et al. (2016) suggest that the key challenges teachers face are limited availability and network connectivity, technical support, lack of training, limited time and lack of teachers' skills. These results suggest that, although there is a recognition of the importance of ICT by teachers, they often face practical challenges that limit its full implementation in the teaching process, which on the other hand indicates insufficient familiarity with the many possibilities of using ICT in teaching. Parallel to this, Muslem et al. (2018) research on a sample of English language teachers in Banda Aceh draws similar conclusions. Positive perceptions of teachers about the application of ICT in teaching are accompanied by technical challenges such as limited tools and poor Internet access, which indicates a uniform perception of teachers about the challenges that arise when implementing ICT in teaching, regardless of age. Also, from the results of the research, it is concluded that teachers use different resources to support learning and improve skills in the use of ICT, with online courses and educational materials being the most represented while educational workshops and group discussions are less present. Despite significant insights, the research revealed certain limitations that indicate the need for further research in order to obtain a more comprehensive picture of the differences in teachers' perspectives in the implementation of information and communication technologies in teaching. One of the main limitations relates to the

representativeness of the sample and its specificity and thus the impossibility of general conclusions based on the results obtained. Future research should include a larger number of teachers in order to obtain a relevant and representative picture of their experiences and challenges related to the implementation of ICT in teaching.

### Conclusion

This research showed that, although teachers recognize the importance of implementing information and communication technology in teaching and strive to improve their knowledge and skills, in the process they face a number of technical, pedagogical and infrastructural challenges. Considering the obtained data, the assumption of this research - that older teachers will use communication channels and information and communication technologies less often and with less confidence in teaching compared to younger colleagues - can only be accepted in the part that refers to the frequency of using communication channels while differences in perceived benefits, challenges, preparedness and training in the use of ICT were not statistically confirmed. The research showed that, although younger teachers use information and communication technologies less in teaching, age has no effect on attitudes towards ICT, difficulties with implementation or the perception of the need for additional training. Given that no statistically significant differences were shown in the context of teachers' age regarding difficulties with implementation or perception of the need for additional training in the use of ICT, it would be important to take into account teachers' beliefs about the effectiveness of ICT, because their experiences can provide significant insights into how the use of ICT in teaching affects student knowledge acquisition. Given the findings, it is concluded that incorporating ICT into teaching requires time, a change in the work program at the school level, and a greater degree of education and support in the adoption of the necessary teacher competencies for their application. It seems particularly useful to educate about the specific potential of each of the ICT tools in relation to the goals and objectives of each subject, and the benefits that they can bring

if applied correctly. Through this approach, a common goal would be developed about the importance of using ICT, that is, it would become an integral part of the everyday learning experience. This shows that for the implementation of information and communication technology in teaching, it is necessary to ensure universal support by focusing on the specific needs of each group, regardless of the age of teachers. Therefore, this research provides useful insights into the common challenges and needs of teachers in relation to the implementation of ICT in teaching and it can serve as a starting point for further research of specific aspects that affect the success of the implementation of ICT in teaching. The combination of different predictors is likely to influence differences in the use of information and communication technologies among teachers, and these differences should be explored in future research.

### References

- Ardıç, M. A. (2021). Three Internal Barriers to Technology Integration in Education: Opinion, Attitude and Self-Confidence. *Shanlax International Journal of Education*, 9(S1-May), 81–96. <https://doi.org/10.34293/education.v9iS1-May.4004>
- Bruck, Z., Pirija, A. (2016). *Information and communication technologies in teaching and extracurricular activities*. Sarajevo: Center for educational initiatives Step by Step.
- Buabeng-Andoh, C. (2012). Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 8(1), 136-155.
- Fu, J. S. (2013). ICT in Education: A Critical Literature Review and Its Implications. *International Journal of Education and Development Using Information and Communication Technology*, 9(1), 112–125. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1182651.pdf>
- Ghavifekr, S., Kunjappan, T., Ramasamy, L., & Anthony, A. (2016). Teaching and Learning with ICT Tools: Issues and Challenges from Teachers' Perceptions. *MOJET Online Journal of Educational Technology*, 4, 38-57.



- Istifanus, J. (2023). Teachers' factors influencing adoption and integration of information and communication technology into teaching and learning. In Proceedings of the Emerging Educational Innovation, Creativity and Research for Transformation of Teaching and Learning in the New Global Realities (Conference held at Ahmadu Bello University, Zaria, Nigeria). Retrieved from [https://www.researchgate.net/publication/373171460\\_TEACHERS\\_FACTORS\\_INFLUENCING\\_ADOPTION\\_AND\\_INTEGRATION\\_OF\\_INFORMATION\\_AND\\_COMMUNICATION\\_TECHNOLOGY\\_INTO\\_TEACHING\\_AND\\_LEARNING](https://www.researchgate.net/publication/373171460_TEACHERS_FACTORS_INFLUENCING_ADOPTION_AND_INTEGRATION_OF_INFORMATION_AND_COMMUNICATION_TECHNOLOGY_INTO_TEACHING_AND_LEARNING)
- Kerzic, D., Danko, M., Zorko, V., & Decman, M. (2021). The effect of age on higher education teachers' ICT use. *Knowledge Management & E-Learning an International Journal*, 13(2), 182–193. <https://doi.org/10.34105/j.kmel.2021.13.010>
- Krumsvik, R. J., Jones, L. Ø., Øfstegaard, M., & Eikeland, O. J. (2016). Upper secondary school teachers' digital competence: Analysed by demographic, personal and professional characteristics. *Nordic Journal of Digital Literacy*, 11(3), 143–164.
- Mahdi, H. S., & Al-Dera, A. S. (2013). The Impact of Teachers' Age, Gender and Experience on the Use of Information and Communication Technology in EFL Teaching. *English Language Teaching*, 6(6), 57-67. <https://doi.org/10.5539/elt.v6n6p57>
- Muslem, A., Yusuf, Y. Q., & Juliana, R. (2018). Perceptions and Barriers to ICT Use among English Teachers in Indonesia. *Teaching English with Technology*, 18, 3-23.
- Rogosic, S., Baranovic, B. i Sabic, J. (2021). Application of ICT in the process of learning, teaching and evaluation in secondary vocational schools: Qualitative analysis. *Methodological trials*, 28(1), 63-88.
- Sang, G., Valcke, M., Van Braak, J., & Tondeur, J. (2009). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education*, 54(1), 103-112.
- Semerci, A., Aydın, M. K. (2018). Examining High School Teachers' Attitudes towards ICT Use in Education. *International Journal of Progressive Education*, 14(2), 93–105. <https://doi.org/10.29329/ijpe.2018.139.7>
- Tayaban, A. D. (2022). Students' And Teachers' Perspectives on ICT Integration in Learning Process During Pandemic. *International Journal of Multidisciplinary Applied Business and Education Research*, 3(12), 2622–2630. <https://doi.org/10.11594/ijmaber.03.12.15>
- Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., Monés, A. M., & Ioannou, A. (2023). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Education and information technologies*, 28(6), 6695–6726. <https://doi.org/10.1007/s10639-022-11431-8>
- Usluel, Y. K., Mumcu, F. K., & Demiraslan, Y. (2007). Information and Communication Technologies in the Teaching-Learning Process: Teachers' Views on the Integration Process and Its Obstacles. *Hacettepe University Journal of Education*, 32(32), 164–178.
- Valverde-Berrocoso, J., Acevedo-Borrega, J., & Cerezo-Pizarro, M. (2022). Educational Technology and Student Performance: A Systematic Review. *Frontiers in Education*, 7, 1-12. <https://doi.org/10.3389/educ.2022.916502>
- Yildirim, S. (2007). Current utilization of ICT in Turkish basic education schools: a review of teacher's ICT use and barriers to integration. *International Journal of Instructional Media*, 34(2), 171-186.