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ATTITUDES OF SCIENCE TEACHERS TOWARDS CHALLENGES AND BENEFITS OF USING E-LEARNING AS A LEARNING TOOL

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Abstract: This study aims to identify the attitudes of science teachers in relation to the challenges and benefits of using e-learning as a means of acquiring knowledge. The survey was conducted in May and June 2023. The sample included teachers of chemistry, biology, mathematics and physics from Split-Dalmatia County, Croatia (N=117). A questionnaire containing general questions and respondents' attitudes towards the advantages and obstacles of using e-learning was used for this study. Respondents primarily exhibit a positive outlook on e-learning, regardless of gender, age, the subject they teach or the institution where they teach. Male teachers gave a slightly greater advantage to the use of computers for lesson preparation compared to female teachers, while older teachers were less confident about using computers compared to younger colleagues. Chemistry and biology teachers favoured the use of computers in preparing lesson material in contrast to their colleagues who teach mathematics and physics. This research has also shown that primary school teachers find e-learning challenging. In fact, this research has revealed that respondents generally believe that e-learning offers numerous benefits compared to traditional teaching methods, but they also believe that there are certain challenges that could be overcome with additional training in the use of computer technologies. In conclusion, a positive attitude towards e-learning prevails regardless of gender, age, the subject they teach or the institution where they teach.

Keywords: : e-learning, challenges, benefits, knowledge acquisition

Introduction

Plato's definition of knowledge, which usually gives rise to philosophical debate, states that knowledge is a justified true belief. However, there is no universally recognised definition of knowledge.

"Academic knowledge is a matter of memorising what you have read in books and the things taught by the teachers who were trained mostly by memorising the things they have read in books" (Hubbard, 1927).

There is no single definition of knowledge, but there are various interpretations of knowledge, i.e. knowledge is a fact, information or skill gained by an individual through education or practical experience, and can be theoretical or practical, but also a reliable comprehension of a subject and the capability to apply it for a specific purpose. Knowledge

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acquisition includes advanced cognitive functions like perception, learning, correspondence, affiliation and reasoning (Jayashri and Kalaiselvi, 2018).

As mentioned earlier, one of the ways of acquiring knowledge is by learning. In this study, the main focus is on e-learning, which does not exclude other ways of acquiring knowledge, as these are also, to some degree, represented in e-learning.

The progression and application of information technology (IT) has had an extraordinary impact on society, driving the shift from an industrial to an information society and, finally, to a knowledge-based society. Conventional educational models are no longer sufficient to meet the needs of this new society. Information technology has the potential to significantly change the way knowledge is acquired, processed and applied, providing the opportunity for customised learning and continuous improvement. Today, the blended learning model is generally regarded as the most efficient learning tool, since it combines the benefits of traditional learning and e-learning. The blended education model is particularly well suited to the integration of e-learning as it enables a gradual transition from the conventional to the new system. The transition to a knowledge-based society requires continuous improvement and adaptation, and the application of IT in education is key to achieving these goals and ensuring a long-term positive impact on the advancement of the economy and society as a whole. (Sinković and Kaluđerčić, 2006).

According to Krstić and Krstić (2018), e-learning utilises new technologies and innovative teaching methods. The focus is on interaction between students as a central element in the process of acquiring new knowledge. This method of learning represents a new approach as it takes place through conversation, exchange and sharing of material in an open environment. The development of e-learning represents a step forward in the integration of technology into education, focusing on collaboration and interaction between students and supporting their engaged role in knowledge creation. This approach allows students to take an active part in the learning process and achieve better results in a dynamic web environment.

According to Markovic-Blagojević et al. (2017), teachers need to constantly keep up with and apply all upgrades, innovations and technologies so that students can acquire the essential knowledge and skills. As information and communication technologies (ICT) have made knowledge and skills accessible to those who seek them, teachers need to keep track of new changes and adapt their methods and materials accordingly. Otherwise, they may find themselves in a situation where they are no longer able to fulfil their basic task – to transfer knowledge. For e-learning to be of high quality and effective, it requires an appropriate level of interaction. Therefore, key teaching competencies, especially in the context of online teaching, are focused on the communication between teachers and students.

Nowadays, it is impossible to ignore the role of ICT and its inevitable use, as digital literacy has become as important as basic reading and writing skills. Students are extremely adept and bold when it comes to exploring new technologies and their endless possibilities.

Therefore, it is extremely important to build collaboration between teachers and students and to continuously exchange new ideas and learning opportunities, because knowledge acquisition is a lifelong process. Today, e-learning occupies one of the leading positions in the area of ICT. Therefore, it is important to recognise its capabilities and benefits and make the best use of them (Smiljčić et al., 2017).

According to Klinar et al. (2012), learning and education have evolved into a lifelong process, and it is believed that part of these educational needs can be met through the use of ICT. With the introduction of technology, attempts are being made to improve the educational process and ensure better quality educational outcomes. Online teaching enables interactive learning that can be adapted according to one's dynamics and timetable, regardless of physical location. The constant availability of teachers or mentors via e-mail, forum or chat improves communication, which enhances the effectiveness of the learning process.

In line with the accelerated development of IT and the need for mobile and lifelong education, e-learning is increasingly emphasised as a form of online education. E-learning is user-based and enables interaction with the help of multimedia elements that contribute to interactivity during lectures. This educational approach is becoming increasingly popular due to its flexibility. The constant availability of information and the rapid exchange of ideas further improve the quality of knowledge acquisition. In any case, e-learning has the potential to improve educational processes by offering adaptability, a personalised approach and the possibility of continuous learning (Perić, 2017).

In their research, Huffaker and Calvert (2003), observed the adoption of e-learning, or the provision of education through electronic media, and examined how e-learning can promote important learning concepts such as active learning, reflective thinking and knowledge application. This type of education knows no spatial or temporal restrictions and enables repeated use. The e-learning approach places the learner at the centre and is characterised by interactivity, independence, repetition and adaptability. An additional focus on entertainment features may improve student motivation, focus and knowledge gain through a combination of engaging material and interesting production elements. Through collaboration, students learn how to communicate and distribute knowledge and resources on a local and global scale.

Challenges of e-learning

An extremely important trend is the increasing emphasis on the individualisation and personalisation of information (Aroyo and Dicheva, 2004). Given the large amount of information from different sources, it is becoming necessary to customise this information to the individual needs, objectives, roles and tasks of each user. This trend reflects the desire to provide users with the best possible learning and teaching experience and represents a promising step towards better knowledge transfer or acquisition, allowing users to access information and resources that are relevant to their needs and goals.

According to the research conducted by Shahmoradi et al. (2018), the e-learning system represents a significant approach to knowledge management and educational needs, but at the same time, it also poses certain challenges. To overcome these challenges, certain rules need to be established for both teachers and students. These rules allow for a smooth transition from a traditional teacher-student relationship model to interactions in cyberspace that not only help solve challenges but also promote student success. The first important step is for teachers and students to accept the change and move from traditional teaching methods to e-learning methods. This includes creating a safe online environment that facilitates collaboration and provides the opportunity to explore different technologies. In addition, maintaining contact between teachers and students is of paramount importance. This includes providing access to information and confirming students' technological literacy to ensure everyone is ready for the online environment. In this regard, it is necessary to take into account the different abilities of students when interacting with teachers in e-learning.

Benefits of e-learning

The difference between conventional learning environments and e-learning lies in the utilization of ICT as a learning tool (Wan et al., 2008). By using the web infrastructure, learning becomes available globally and utilises a variety of resources. This change underscores the importance of the interplay between IT, teaching strategy, students' psychological processes and contextual factors for e-learning outcomes. E-learning enables the integration of innovative strategies to improve student performance. Previous experience with ICT and virtual literacy have been identified as key factors that influence e-learning outcomes and support its successful delivery. Important individual internal factors such as previous experience with computers, self-efficacy in using computers and motivation influence e-learning outcomes.

According to Roffe (2002), e-learning exerts a considerable influence on the educational process. Not only does it provide improved access to educational resources, but it also increases engagement, enhances the learning process, expands research opportunities, and empowers students to take control of their own mode of knowledge acquisition. Roffe argues that these effects assume that students already possess the skills to use the technology and the ability to integrate and apply content to create and learn new knowledge. Roffe also emphasises that e-learning is considered a cost-effective approach to facilitating learning for large groups through the use of ICT. This technology allows for wide availability and adaptability, making e-learning an attractive educational pathway for different user groups.

E-learning provides numerous advantages for teachers, institutions and students. The benefits include, inter alia, lower overall costs, faster mastery of material, availability of materials to all students anytime and anywhere, adaptable pace for different types of students, reduced stress and increased satisfaction. In addition, e-learning allows direct communication with teachers for the purpose of solving problems and dilemmas and

provides access to fresh and relevant information by facilitating learning. In short, e-learning offers many benefits, including financial efficiency, adaptability, quick access and the opportunity for interaction. These benefits have a positive impact on students and their success in learning and knowledge acquisition (Gautam and Tiwari, 2016).

Research objective

This research seeks to explore and analyse the influence of some socio-demographic variables (gender, age) on educators' perspectives on the challenges and benefits of e-learning and new ways of knowledge acquisition. At the same time, the authors aim to assess if a statistically significant difference exists in towards the challenges and benefits of e-learning between teachers of different subjects and to investigate whether there are differences in attitudes depending on the institution in which teaching takes place. Furthermore, this study also tends to examine whether there is a correlation between the scales *Challenges of e-learning* and *Benefits of e-learning*.

Research methodology

In accordance with the research objective, the following hypotheses were formulated:

H1: There is no statistically significant difference in teachers' attitudes towards the challenges and benefits of e-learning with respect to gender.

H2: There is no statistically significant difference in teachers' attitudes towards the challenges and benefits of e-learning with respect to age.

H3: There is no statistically significant difference in teachers' attitudes towards the challenges and benefits of e-learning in relation to the subject they teach.

H4: There is no statistically significant difference in teachers' attitudes towards the challenges and benefits of e-learning in relation to the institution where they teach.

H5: There is no correlation between teachers' attitudes towards the challenges of e-learning and the benefits of e-learning.

Respondents

A total of N=117 respondents participated in the study, of which F=103 and M=14. This included teachers from Split-Dalmatia County who teach chemistry (C=53), biology (B=25), mathematics (M=30) and physics (P=9). There were 23 teachers under the age of 35, 31 aged 36-45, 42 teachers aged 46-55 and 21 teachers older than 56. The number of respondents according to the institution where they teach: primary school (PS = 40), secondary school (SS = 43), higher education (HE = 34). The sample was not random.

Data collection

For this study, we used a verified measurement tool – a questionnaire that we converted to the online version using Google Forms and sent as such to various addresses of institutions, headmasters of individual schools, the president of the chemistry teachers` association of Split-Dalmatia County, former and current colleagues, teachers' groups on Facebook. The questionnaire was submitted and approved by the ethics committees. The survey lasted from 16 May 2023 to 28 June 2023.

Measurement instrument

The implemented questionnaire was composed of two parts. The first section contained questions about the socio-demographic characteristics of the respondent, namely gender, age, institution where the respondent teaches, and the subject the respondent teaches. In the second part of the questionnaire, the original measurement instrument *Test of e-Learning Related Attitudes* (TeLRA) Scale (Kisanga and Ireson, 2016) was used. This measurement instrument is used to assess educators' perspectives on e-learning.

For the purpose of this study, two scales of this measurement tool were used. The first scale labelled *Challenges of e-learning* consisted of 12 items and the second scale labelled *Benefits of e-learning* consisted of 9 items. Each of the above items was a Likert-type item with the following response options: 1 – strongly disagree, 2 – disagree, 3 – agree, 4 – strongly agree.

The data were gathered through an online questionnaire via Google Forms. Quantitative data were collected in the study using Likert-type scales.

Results and discussion

Results

After the study was completed, the data were exported as an Excel file spreadsheet and processed in IBM SPSS (version 26).

For the analysis, the reliability of each scale was first checked using Cronbach's alpha confidence test, which showed satisfactory results, i.e. $\alpha > 0.7$ in both scales. The reliability of the first scale labelled *Challenges of e-learning* was thus $\alpha = 0.837$ and that of the second scale labelled *Benefits of e-learning* was $\alpha = 0.869$.

Since the study aimed to examine teachers' perspectives on the challenges and benefits of e-learning, a descriptive analysis was conducted, the results of which show that science teachers generally do not perceive any particular challenges and that e-learning has benefits over other learning methods.

Inferential statistical analyses were conducted to test the hypotheses.

Teachers' attitudes towards the challenges and benefits of e-learning with respect to gender

The Mann-Whitney U test for independent samples (Table 1) was used to identify differences in teachers' perspectives on the challenges and benefits of e-learning for all items on both scales in terms of gender.

Table 1. Mann-Whitney U test results for items p<0.05

	Benefits of e-learning [I prefer to use a computer for lesson preparation]
Mann-Whitney U	516.000
Wilcoxon W	5872.000
Z	-2.015
p	.044

The results show a statistically significant difference for the scale item "I prefer to use the computer for lesson preparation" (p=0.044) with respect to gender.

Table 2 shows the mean results for the specified items.

Table 2. Analysis of mean values for specified items

	Gender	N	Mean range	Sum of ranges
Benefits of e-learning [I prefer to use a computer for lesson preparation]	Female	103	57.01	5872.00
	Male	14	73.64	1031.00
	Total	117		

An analysis of the mean values for the specified item (Table 2) shows that male teachers prefer to use a computer for lesson preparation more than female teachers.

Teachers' attitudes towards the challenges and benefits of e-learning with respect to age

The Kruskal-Wallis test for independent samples was employed to assess differences in teachers' perspectives on the challenges and benefits of e-learning in relation to age (Table 3).

Table 3. Kruskal-Wallis test results for items p<0.05

	Challenges of e-learning [Discussions via e-learning technologies are uninteresting]	Challenges of e-learning [Using computer systems requires a lot of mental effort]	Challenges of e-learning [E-learning technologies are difficult to use]
Kruskal-Wallis H	10.215	8.284	9.014
df	3	3	3
p	.017	.040	.029

The results indicate a statistically significant difference in attitudes towards the challenges of e-learning across the three items, "Discussions via e-learning technologies are uninteresting" (p=0.017), "Using computer systems requires a lot of mental effort" (p=0.040) and "E-learning technologies are difficult to use" (p=0.029), with respect to age.

The Kruskal-Wallis post-hoc test (Table 4) and descriptive statistics by cross-tabulations (Tables 5, 6 and 7) were used to determine the difference in younger and older teachers' perspectives towards e-learning for all items on the scale.

Table 4. Pairwise comparisons for age

Sample 1-Sample 2	Sig.: *"Discussions via e-learning technologies are uninteresting."*	Sig.: *"Using computer systems requires a lot of mental effort."*	Sig.: *"E-learning technologies are difficult to use"*
36-45-46-55	.139	.983	.276
36-45-≤ 35	.081	.075	.736
36-45-≥ 56	.002	.191	.011

46-55-≤ 35	.617	.061	.177
46-55-≥ 56	.043	.161	.084
≤ 35-≥ 56	.174	.004	.007

Table 5: Cross-tabulation for age with respect to the item "Discussions via e-learning technologies are uninteresting"

		1	2	3	4	Total
≤ 35	Count	1	16	4	2	23
	Expected Count	2.0	15.1	5.1	.8	23.0
36-45	Count	6	21		2	31
	Expected Count	2.6	20.4	6.9	1.1	31.0
46-55	Count	3	29	10	0	42
	Expected Count	3.6	27.6	9.3	1.4	42.0
≥ 56	Count	0	11	10	0	21
	Expected Count	1.8	13.8	4.7	.7	21.0
Total	Count	10	77	26	4	117
	Expected Count	10.0	77.0	26.0	4.0	117.0

The results reveal statistically significant differences among teachers aged 36-45 and teachers older than 56 and between teachers aged 46-55 and teachers older than 56 for the item "Discussions via e-learning technologies are uninteresting", i.e. it can be noted that older teachers consider discussions via e-technologies to be uninteresting.

Table 6. Cross-tabulation for age with respect to the item "Using computer systems requires a lot of mental effort"

		1	2	3	4	Total
≤ 35	Count	6	11	5	1	23
	Expected Count	2.8	9.6	9.4	1.2	23.0
36-45	Count	5	11	12	3	31
	Expected Count	3.7	13.0	12.7	1.6	31.0
46-55	Count	3	19	20	0	42
	Expected Count	5.0	17.6	17.2	2.2	42.0
≥ 56	Count	0	8	11	2	21
	Expected Count	2.5	8.8	8.6	1.1	21.0
Total	Count	14	49	48	6	117
	Expected Count	14.0	49.0	48.0	6.0	117.0

The results reveal that there are statistically significant differences between the youngest and the oldest teachers in the item "Using computer systems requires a lot of mental effort", i.e. it can be noted that older teachers believe that using computer systems demands considerable mental effort.

Table 7. Cross-tabulation for gender with respect to the item "E-learning technologies are difficult to use"

		1	2	3	4	Total
≤ 35	Count	7	13	3	0	23
	Expected Count	3.7	15.7	3.3	.2	23.0
36-45	Count	6	23	1	1	31
	Expected Count	5.0	21.2	4.5	.3	31.0
46-55	Count	6	29	7	0	42
	Expected Count	6.8	28.7	6.1	.4	42.0
≥ 56	Count	0	15	6	0	21
	Expected Count	3.4	14.4	3.1	.2	21.0
Total	Count	19	80	17	1	117
	Expected Count	19.0	80.0	17.0	1.0	117.0

The results show that the item "E-learning technologies are difficult to use" has statistically significant differences between the youngest and the oldest teachers as well as between teachers aged 36-45 and teachers older than 56, i.e. it can be noted that older teachers consider e-learning technologies difficult to use.

Based on the obtained and expected frequencies, older teachers perceive e-learning as more difficult compared to younger teachers, i.e. they consider discussions via e-learning technologies uninteresting and believe that using computer systems demands considerable mental effort and that e-learning technologies are difficult to use.

Teachers' attitudes towards the challenges and benefits of e-learning with respect to the subject they teach

The Kruskal-Wallis test for independent samples was employed to determine the differences between teachers' perspectives on the challenges and benefits of e-learning in relation to the subject they teach. The results are shown in Table 8.

Table 8. Results of the Kruskal-Wallis test concerning teachers' attitudes towards the challenges and benefits of e-learning with regard to the subject they teach

	Benefits of e-learning [E-learning is very economical for educational institutions to adopt]	Benefits of e-learning [I prefer using a computer for lesson preparation]
Kruskal-Wallis H	8.069	7.919
df	3	3
p	.045	.048

The results demonstrate that there is a statistically significant difference (p>0.05) between the two items on the *Benefits of e-learning* scale in relation to the subject they teach.

The Kruskal-Wallis post hoc test (Table 9) and descriptive statistics by cross-tabulations (Tables 10 and 11) were used to determine the difference in attitudes of chemistry, biology, mathematics or physics teachers about e-learning for all items on the scale.

Table 9. Pairwise comparisons for subject

Sample 1 – Sample 2	Sig.: *"E-learning is very economical for educational institutions to adopt"*	Sig.: *"I prefer using a computer for lesson preparation"*
Physics – Mathematics	.970	.681
Physics – Biology	.296	.193
Physics – Chemistry	.091	.050

Mathematics – Biology	.148	.196
Mathematics – Chemistry	.009	.016
Biology – Chemistry	.404	.412

Table 10. Cross-tabulation for the subject with respect to the item "E-learning is very economical for educational institutions to adopt"

		1	2	3	4	Total
Chemistry	Count	4	20	25	4	53
	Expected Count	7.2	22.6	19.9	3.2	53.0
Biology	Count	3	11	9	2	25
	Expected Count	3.4	10.7	9.4	1.5	25.0
Mathematics	Count	7	14	9	0	30
	Expected Count	4.1	12.8	11.3	1.8	30.0
Physics	Count	2	5	1	1	9
	Expected Count	1.2	3.8	3.4	.5	9.0
Total	Count	16	50	44	7	117
	Expected Count	16.0	50.0	44.0	7.0	117.0

The results demonstrate that there are statistically significant differences in the item *E-learning is very economical for educational institutions to adopt* between teachers who teach chemistry and teachers who teach mathematics, i.e. it shows that teachers who teach chemistry believe that e-learning is not a financial expense for educational institutions compared to mathematics teachers.

Table 11. Cross-tabulation for the subject with respect to the item "I prefer using the computer for lesson preparation"

		1	2	3	4	Total
Chemistry	Count	2	5	36	10	53
	Expected Count	3.2	8.6	34.0	7.2	53.0
Biology	Count	0	4	19	2	25
	Expected Count	1.5	4.1	16.0	3.4	25.0
Mathematics	Count	3	9	14	4	30
	Expected Count	1.8	4.9	19.2	4.1	30.0
Physics	Count	2	1	6	0	9
	Expected Count	.5	1.5	5.8	1.2	9.0
Total	Count	7	19	75	16	117
	Expected Count	7.0	19.0	75.0	16.0	117.0

The results indicate that there are statistically significant differences in the item "I prefer to use a computer for lesson preparation" between teachers who teach chemistry and teachers who teach mathematics, i.e. it can be noted that chemistry teachers use a computer for lesson preparation more frequently than mathematics teachers.

Based on the obtained and expected frequencies, it can be noted that chemistry teachers believe that e-learning has advantages, i.e. they prefer using a computer for lesson

preparation and believe that e-learning does not impose financial expenses on educational institutions compared to mathematics teachers.

Teachers' attitudes towards the challenges and benefits of e-learning with respect to the institution where they teach

The Kruskal-Wallis test for independent samples was used (Table 12) to determine the variations in the attitudes of teachers working in different institutions towards the challenges and benefits of e-learning.

Table 12. Kruskal-Wallis test results for all items depending on the institution

	Challenges of e-learning [Using computer systems requires a lot of mental effort]	Challenges of e-learning [The face-to-face method is more student-centred than e-learning]
Kruskal-Wallis H	8.570	6.372
df	2	2
p	.014	.041

The results show that there is a statistically significant difference between the two items on the scale *Challenges of e-learning* ["The use of computer systems requires a lot of mental effort"] (p=0.014) and ["The face-to-face method is more student-centred than e-learning"] (p=0.041).

The Kruskal-Wallis post-hoc test (Table 13) and descriptive statistics by cross-tabulations (Tables 14 and 15) were used to determine the difference in attitudes of primary, secondary and higher education teachers towards e-learning for all items on the scale.

Table 13. Pairwise comparisons for the institution where they teach

Sample 1 – Sample 2	Sig.: *"Using computer systems requires a lot of mental effort"*	*" A face-to-face method is more student-centred than e-learning"*
Higher education institution – Secondary school	.133	.056
Higher education institution – Primary school	.003	.739

Secondary school – Primary school	.124	.019

Table 14. Cross-tabulation for the institution with respect to the item "Using computer systems requires a lot of mental effort"

		1	2	3	4	Total
Primary school	Count	3	13	19	5	40
	Expected Count	4.8	16.8	16.4	2.1	40.0
Secondary school	Count	5	18	19	1	43
	Expected Count	5.1	18.0	17.6	2.2	43.0
Higher education institution	Count	6	18	10	0	34
	Expected Count	4.1	14.2	13.9	1.7	34.0
Total	Count	14	49	48	6	117
	Expected Count	14.0	49.0	48.0	6.0	117.0

The results indicate that there are statistically significant differences in the item "The use of computer systems demands considerable mental effort" between primary school teachers and higher education teachers, i.e. it can be noted that primary school teachers believe that the use of computer systems requires a lot of mental effort compared to higher education teachers.

Table 15. Cross-tabulation for the institution with respect to the item "The face-to-face method is more student-centred than e-learning"

		1	2	3	4	Total
Primary school	Count	0	4	19	17	40
	Expected Count	.7	5.8	19.8	13.7	40.0
Secondary school	Count	2	8	24	9	43
	Expected Count	.7	6.2	21.3	14.7	43.0
Higher education institution	Count	0	5	15	14	34
	Expected Count	.6	4.9	16.9	11.6	34.0
Total	Count	2	17	58	40	117
	Expected Count	2.0	17.0	58.0	40.0	117.0

The results indicate that there are statistically significant differences in the item "The face-to-face method is more student-centred than e-learning" between primary school teachers and secondary school teachers, i.e. it can be noted that primary school teachers, compared to secondary school teachers, believe that face-to-face e-learning is more focused on the student than e-learning.

Based on the identified and expected frequencies, it can be noted that primary school teachers compared to secondary and higher education teachers perceive e-learning as more demanding, i.e. they believe that computer systems demands considerable mental effort and that face-to-face learning is more student-centred than e-learning.

Correlation in teachers' attitudes towards the challenges and benefits of e-learning

The Spearman correlation (Table 16) was used to determine the correlation between teachers' attitudes towards the challenges and benefits of e-learning.

Table 16. Spearman correlation of teachers' attitudes towards the challenges and benefits of e-learning

			Challenges of e-learning	Benefits of e-learning
Spearman's rho	Challenges of e-learning	Correlation coefficient	1.000	-.294[**]
		significance	.	.001
		N	117	117
	Benefits of e-learning	Correlation coefficient	-.294[**]	1.000
		significance	.001	.
		N	117	117

The correlation between teachers' perspectives on the challenges of e-learning and the advantages of e-learning was examined using the Spearman correlation coefficient, and a weak negative correlation was found between these two variables.

Discussion

This study investigated the attitudes of science teachers in Split-Dalmatia County, who teach at three levels of education, towards the challenges and benefits of e-learning.

The non-parametric Mann-Whitney U test for independent samples was employed to test the first hypothesis "There is no statistically significant difference in teachers' attitudes towards the challenges and benefits of e-learning with respect to gender". The analysis of the responses showed a statistically significant difference for one item, namely "I prefer using a computer for lesson preparation". Thus, the results show that male teachers prefer to use a computer to prepare lessons compared to female teachers. Therefore, H1 is partially accepted. The results provide an interesting insight into the perception and acceptance of e-learning among different genders. On the one hand, a survey conducted by Ramírez-Correa et al. (2015) provides results indicate that women have a greater use of and intention to use e-learning platforms. This is interesting because it suggests the narrowing of the traditional gender gap in technology use as women show a greater interest in using these forms of learning, which contradicts the findings of this research. In contrast, a survey conducted by Albert and Johnson (2011) on students` attitudes towards e-learning systems shows consistency with the findings of this research. Their results show that the differences between genders are not significant, suggesting that gender does not play a

crucial role in students' perceptions of e-learning. However, Agboola (2006) provides a different perspective and emphasises that gender can have a significant impact on the perception of confidence in e-learning. His research suggests that teachers place more confidence in e-learning in comparison to female teachers. These conclusions form the basis for considering the social factors that may shape perceptions of e-learning among different genders. They show the importance of further research to better understand and explain these dynamics and to provide clues for designing inclusive approaches to e-learning that take into account the different gender perspectives.

The non-parametric Kruskal-Wallis test for independent samples and the post hoc Kruskal-Wallis test were employed to test the second hypothesis "There is no statistically significant difference in teachers' attitudes towards the challenges and benefits of e-learning with respect to age". The response analysis revealed a statistically significant difference in the *Challenges of e-learning* scale. The results indicate that older teachers perceive e-learning as more challenging, which derives that H2 is partially accepted. A study by Murphy and Greenwood (1998) also fits in with these results. In this study, it was pointed out that younger lecturers show significantly higher confidence in the use of computers in teaching and have a greater tendency to use ICT in their teaching activities than their older colleagues. However, the research found that despite their confidence in ICT, younger lecturers still do not feel well-trained and are not sufficiently familiar with the various ICT tools. This finding highlights the importance of providing support and training so that all teachers, regardless of age, feel that they are competent and confident enough to use technology in an educational context.

The non-parametric Kruskal-Wallis test with independent samples was used to test the third hypothesis "There is no statistically significant difference in teachers' attitudes towards the challenges and benefits of e-learning with respect to the subject they teach", which showed that there are statistically significant differences on the *Benefits of e-learning* scale. In particular, it was shown that chemistry and biology teachers rate the benefits of e-learning more positively than mathematics and physics teachers. Based on the above, H3 is partially accepted. In contrast, the results of a survey conducted by Bawaneh (2021) in Saudi Arabia, which analysed students' perspectives on the use of e-learning and virtual teaching, contradict the above findings. Interestingly, the results of the survey indicated that there were no statistically significant differences in attitudes towards the use of e-learning among students in different disciplines. This finding suggests that the specific discipline or subject area that students are studying does not have a major influence on their perspectives towards technological learning methods. The results of both studies show that perceptions of e-learning can vary significantly depending on the characteristics of the respondents. Said study by Bawaneh (2021) can further contribute to the understanding of the various factors that influence students' attitudes towards technological aspects of learning, as it emphasises the importance of population specificity in interpreting research findings.

After conducting the non-parametric Kruskal-Wallis test for independent samples and the post-hoc Kruskal-Wallis test for H4 "There is no statistically significant difference in teachers' attitudes towards the challenges and benefits of e-learning with respect to the institution where they teach", it can be noted that H4 is also partially accepted. The results showed that there is a statistically significant difference in the *Challenges of e-learning* scale, as the teachers who teach in primary schools perceive e-learning as more challenging than teachers who teach in secondary schools or higher education institutions. As far as we know, there is no adequate research in the literature with which to compare this hypothesis.

Spearman correlation was used to test the fifth hypothesis "There is no correlation between teachers' attitudes towards the challenges of e-learning and the benefits of e-learning". The results indicate that there is a weak negative relationship between these two variables. Therefore, H5 is rejected. These findings align with the study conducted by Alzahrani (2020). He conducted a comprehensive review of the research literature analysing the use of augmented reality (AR) in e-learning, focusing specifically on the key advantages and obstacles associated with its adoption and integration. The main benefits of using AR in e-learning include supporting tactical learning, encouraging collaboration between students, customising learning to the needs of the individual, encouraging creative thinking, and increasing student motivation, focus and knowledge retention. However, despite these benefits, the review also identified challenges when using AR within the framework of e-learning. These challenges include information overload and cognitive overload, lack of user familiarity with the technology, teacher resistance, complexity of technology, high costs and technical issues. This comprehensive review of research highlights that training and professional development are sustainable solutions to the main problems linked to the adoption of AR in e-learning. Despite the challenges, this area remains focused on technological progress.

Conclusion

This study provides important insights into teachers' attitudes towards e-learning compared to conventional teaching methods. The results unequivocally show that most respondents recognise many of the benefits of e-learning compared to conventional methods. This indicates a growing awareness of the importance of technological advancement in education and the ability of technology to advance the process of knowledge acquisition through this method. Interestingly, despite the recognised benefits, teachers also recognise the challenges associated with e-learning. These challenges could be overcome with additional training in the use of computer technologies. This points to the need for ongoing professional development for teachers to ensure the effective integration of e-learning into classrooms. An optimistic outlook on e-learning, which is prevalent among different demographic groups such as gender, age, subject they teach and the institution where they teach, indicates that this perception is based on a broad acceptance among different groups of teachers. This points to an overall acceptance of e-learning as an enriching teaching tool.

In particular, it was found that older teachers may feel less confident using computers compared to younger colleagues. This suggests that older generations of teachers need tailored training and support to feel confident in integrating technology into their teaching methods. One of the interesting findings includes different teachers' perspectives on e-learning across various subjects. This suggests that targeted support and resources are needed for different subjects in order to take appropriate advantage of the specific benefits of e-learning in different teaching areas. Furthermore, it is worth noting that this study also sought to compare the perspectives of primary, secondary and higher education teachers, which is an important contribution as such comparisons are scarce in the literature. This research thus contributes to a more profound understanding of the different perspectives and challenges faced by these teachers.

Overall, this study contributes to a more comprehensive insight into teachers' perspectives on e-learning by highlighting their perceptions, challenges and needs for support. Understanding these aspects is essential for the continued advancement of e-learning and the effective integration of technology into the educational process.

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