Received: 5 August 2024, Accepted: 10 February 2025,
Published on-line as Recently Accepted Paper: April 2025 DOI: https://doi.org/10.26529/cepsj.1952

Assessing Student Engagement Pre-, During and Post-COVID-19

Alenka Žerovnik[1]

This study examines the impact of the COVID-19 pandemic on student satisfaction, perceived knowledge usefulness and mentorship ratings in a project-based learning digital competence course over six academic years, divided into pre-COVID, during-COVID and post-COVID periods. Adopting a mixed methods approach, survey data from 201 students were analysed through quantitative Likert-scale responses and a qualitative thematic analysis of open-ended feedback. The results indicate that student satisfaction peaked during COVID-19 and declined post-pandemic, while knowledge usefulness ratings remained consistently high and mentorship ratings remained stable. A positive correlation was found between satisfaction and the perceived usefulness of knowledge. Thematic analysis identified themes such as support and guidance, knowledge and skill acquisition, and course structure feedback. These findings emphasise the importance of continuous teacher support and effective mentorship in sustaining student satisfaction and engagement, and highlight the necessity of ongoing investment in digital literacy professional development for educators to ensure equitable post-pandemic learning experiences.

Keywords: pre-, during and post-COVID-19 education, pre-service teacher's education, student satisfaction, knowledge usefulness, mentorship ratings, project-based learning

1 Faculty of Education, University of Ljubljana, Slovenia; Alenka.Zerovnik@pef.uni-lj.si.

Ocenjevanje vključenosti študentov v učni proces pred obdobjem covida-19, med njim in po njem

Alenka Žerovnik

Raziskava preučuje vpliv pandemije covida-19 na zadovoljstvo študentov, njihovo zaznavanje uporabnosti pridobljenega znanja ter ocene kakovosti mentorstva pri projektnem učenju, s katerim študentje razvijajo digitalne kompetence. V raziskavo so vključeni podatki, zbrani skozi šest študijskih let, ki jih razdelimo na tri obdobja: pred pandemijo covida-19, med njo in po njej. Uporabili smo pristop mešanih metod in analizirali podatke 201 študenta. Kvantitativni podatki so bili pridobljeni z Likertovimi lestvicami, kvalitativni pa s tematsko analizo odprtih vprašanj, v katerih so študentje izražali povratne informacije. Izsledki raziskave kažejo, da je bilo zadovoljstvo študentov najvišje v obdobju pandemije covida-19, nato pa je nekoliko upadlo. Ocene uporabnosti pridobljenega znanja so bile v vseh obdobjih dosledno visoke, ocene kakovosti mentorstva pa so ostale stabilne. Analiza je pokazala pozitivno korelacijo med zadovoljstvom študentov in zaznano uporabnostjo znanja. S kvalitativno analizo smo identificirali naslednje ključne teme: podpora in usmerjanje, pridobivanje znanja in spretnosti ter povratne informacije glede sestave predmeta. Ugotovitve raziskave poudarjajo pomen kontinuirane podpore učiteljev in učinkovitega mentorstva za vzdrževanje zadovoljstva in visoke stopnje vključenosti študentov v učni proces. Prav tako opozarjajo na nujnost sistematičnega vlaganja v profesionalni razvoj digitalne pismenosti izobraževalcev, da bi lahko zagotovili enakopravne in učinkovite učne izkušnje tudi v popandemičnem obdobju.

Ključne besede: izobraževanje pred covidom-19, med njim in po njem, izobraževanje učiteljev pred začetkom dela, zadovoljstvo študentov, uporabnost znanja, ocene mentorstva, projektno učenje

Introduction

Before the COVID-19 pandemic, education systems primarily relied on traditional in-person instruction methods, with digital tools serving as supplementary resources rather than central components of the learning process (Iglesías-Pradas et al., 2021; Maphalala & Ajani, 2023). The COVID-19 pandemic significantly altered education systems globally, necessitating a rapid shift towards online and remote learning (Stecuła & Wolniak, 2022; Zawacki-Richter, 2020). This change underscores the essential nature of digital competencies for both students and educators (Rashid & Yadav, 2020). Digital competencies encompass a range of abilities, including the effective use of digital technologies, critical evaluation of digital content, and the capacity to communicate and collaborate using digital tools (Voogt et al., 2018). As education systems transition to the post-pandemic era, it is vital to understand the consequences of this change on student satisfaction, the perceived usefulness of acquired knowledge, and mentorship experiences within a student-centred project-based learning approach.

Symeonidis et al. (2021) highlight the significance of digital transformation as a key component of the European Union's education policy response to the COVID-19 pandemic, stressing the importance of digital skills in educational recovery. This aligns with the framework guiding the present study, which focuses on digital literacy and competency development through a student-centred approach and project-based learning. The integration of digital skills into education curricula is critical for enhancing student engagement and equipping students for the digital workforce. Digital competencies have become increasingly vital for academic success and future employability (European Commission, 2020a, 2020b; Voogt et al., 2018). These skills are essential for creating meaningful learning experiences and preparing students to meet the evolving demands of the digital workforce (Günay, 2022; Howard et al., 2020; Pažur Aničić et al., 2022; Selwyn, 2020). Therefore, both educators and policymakers emphasise the need to incorporate digital skills into curricula to ensure students are prepared for the rapidly changing digital landscape (Redecker, 2017).

A student-centred project-based learning approach

The use of student-centred project-based learning (PBL) in higher education for pre-service teachers is an effective pedagogical approach that emphasises active student engagement and the development of digital competencies

(Chen & Yang, 2019; Guo et al., 2020). In the student-centred PBL approach, students actively participate in real-world projects that necessitate the use of digital tools and critical thinking skills. This method fosters a learner-centric environment where students take charge of their learning, collaborate with peers and solve problems. Integrating digital competencies is crucial for preparing future teachers to navigate and effectively utilise digital technologies in their professional practice (Chanpet et al., 2020; Kokotsaki et al., 2016). PBL enhances students' conceptual understanding and critical thinking by involving them in active participation in projects or problem-solving activities (Guerra et al., 2017; Maros et al., 2021; Ribeiro et al., 2023). Research demonstrates that PBL increases student motivation and satisfaction, as well as the perceived value of knowledge, all of which are essential for future educators (Al-Busaidi & Al-Seyabi, 2021; Granado-Alcón et al., 2020; Guo et al., 2020). PBL also improves learning outcomes, academic achievement, affective attitudes and thinking skills (Zhang & Ma, 2023).

Effective mentorship and ongoing support are vital to the success of PBL, enhancing students' academic performance and satisfaction (Kokotsaki et al., 2016). The flexibility of PBL allows it to be applied in both online and face-to-face settings, making it particularly relevant in the post-pandemic era, where digital literacy is essential (Koh et al., 2022). Key components of effective mentorship include open communication, goal setting and emotional support, particularly in digital learning environments where students may feel isolated (Dennen & Burner, 2017; Eller et al., 2014). The quality of mentorship during the pandemic varied and was influenced by mentors' familiarity with digital tools and adaptability to online teaching (Mishra et al., 2020).

The adoption of a student-centred PBL approach in pre-service teacher education not only enhances digital competencies but also significantly improves student satisfaction, recognition of mentorship and the perceived usefulness of knowledge, equipping future educators to effectively integrate technology into their teaching practices.

The impact of COVID-19 on education

The COVID-19 pandemic forced a rapid transition to online learning, creating both opportunities and challenges. This shift required significant changes in educational delivery, with Anderson (2021) noting the improvisational nature of Emergency Remote Teaching (ERT), which caused stress among educators due to a lack of preparedness. The pandemic led to school closures, decreased learning and increased student debt (Sinha, 2020), while

inadequate infrastructure and digital skills further widened the digital divide (Onyema et al., 2020; Kamrujjaman et al., 2024; Liu, 2021; Maguraushe et al., 2022; Tate & Warschauer, 2022). However, it also accelerated higher education digitisation with varying readiness (Tadesse & Muluye, 2020).

Opportunities and challenges of online learning

The transition to online learning presents both opportunities and challenges. Benefits include improved quality of education through the integration of traditional and online methods, increased accessibility for students in remote locations, and the utilisation of digital tools for specialised learning (Mina-Raiu & Oprea, 2023; Thane, 2022). However, online learning also poses significant challenges, such as the need for adequate technical infrastructure, self-discipline among students and teachers, and the potential exacerbation of inequalities due to disparities in access to technology (Huang, 2023; Kotrikadze & Zharkova, 2021). The effectiveness of online learning is contingent on students' digital competencies and the quality of their online instructional designs (Bao, 2020; Hodges et al., 2020).

In order to address these challenges, it is crucial to consider strategies for "humanising" online learning. This concept involves creating connections between learners and instructors despite the physical distance inherent in virtual environments. One extensively used framework in online teaching and learning is the Community of Inquiry (CoI) model (Castellanos-Reyes, 2020), which emphasises three core elements: teaching presence, social presence and cognitive presence (Akyol & Garrison, 2013; Arbaugh et al., 2010; Garrison et al., 2000; Garrison et al., 2001; Rourke et al., 1999). Teaching presence involves clear course design and facilitation, ensuring transparent learning expectations and providing prompt, constructive feedback (Garrison et al., 2000). Social presence focuses on fostering a sense of community among learners and helping them to perceive themselves and others as active participants. Cognitive presence encourages deep learning through reflection and critical thinking (Garrison et al., 2000). It involves designing activities that prompt students to reflect on their learning experiences and share insights (Swan & Ice, 2010). By focusing on these elements, educators can create a more engaging and supportive online learning environment, mitigating feelings of isolation and enhancing the overall learning experience.

Long-term implications for higher education

The COVID-19 pandemic significantly impacted higher education worldwide, leading to a widespread shift towards online teaching (Abdulkareem & Eidan, 2021; Muftahu, 2020; Musa & Adamu, 2023; Riadi et al., 2022). This transition prompted a reassessment of traditional education models, exposing vulnerabilities and offering an opportunity for reform (Inciso, 2021; Muftahu, 2020; Musa & Adamu, 2023). As institutions adapt to the post-pandemic landscape, there is growing consensus on adopting hybrid learning models that combine online and in-person instruction (Means et al., 2009). These models enhance adaptability and resilience, better preparing institutions for future disruptions (Hodges et al., 2020). The focus on digital competencies will likely continue, aiming to equip students and educators with the skills needed in digital learning environments (Trust & Whalen, 2020). Student satisfaction, which is a key indicator of the effectiveness of education programmes, was heavily influenced by the quality of online instruction, resource availability and instructor support during the pandemic (Rapanta et al., 2020). Research suggests that students' satisfaction with online learning is closely tied to their digital skills and the support they receive from educators (Alqurashi, 2019). The pandemic's long-term implications for higher education are expected to include the continued integration of online learning, the development of more adaptable educational models, and a heightened focus on addressing digital inequality and ensuring quality education.

Research gaps and study objectives

While extensive research exists on the impact of digital competencies and online learning on student outcomes, limited empirical evidence is available on how these factors evolved from the pre-COVID to post-COVID periods. The present study aims to fill this gap by analysing data from a digital competency development course over six academic years, encompassing the pre-COVID, during-COVID and post-COVID periods.

The research problem addressed by this study is a longitudinal investigation spanning six years, comprising three distinct two-year periods: pre-, during and post-COVID-19. The study focuses on final-year pre-service teachers. In the current era of digitisation, it is crucial for aspiring educators to possess advanced digital literacy skills. In Slovenia, compulsory courses in computer science and informatics are taught only during the first year of secondary education. Although educators incorporate digital competencies into their

subjects, this is done inconsistently, as there is no formal assessment of these skills. During the pandemic, both educators and students were forced to adapt rapidly to exceptional circumstances, which, for some students, resulted in a disinclination towards technology and the digital world, thereby intensifying the differences between them.

The present study aims to investigate whether these conditions have a specific impact on student satisfaction, perceived usefulness of knowledge and quality of mentorship in a student-centred project-based learning digital competency development course before, during and after the pandemic. Considering the pre-COVID, during-COVID and post-COVID periods, we aim to answer the following research questions:

RQ1: How did student satisfaction ratings and the perceived usefulness of knowledge evolve longitudinally across the pre-COVID, during-COVID and post-COVID periods?

RQ2: How do student evaluations of mentorship quality differ between the pre-COVID, during-COVID and post-COVID periods?

RQ3: What are the relationships between mentorship quality, student satisfaction and perceived knowledge usefulness, and to what extent do these factors predict student satisfaction and knowledge usefulness?

RQ4: What recurring themes and insights emerge from student feedback in open-ended inquiries conducted across the three distinct periods?

The study elucidates the evolving educational landscape post-COVID-19 and offers practical recommendations for enhancing student satisfaction, knowledge usefulness and the quality of mentorship. By analysing data from a digital competency development course over six academic years, the study aims to provide actionable insights into the future of education.

Method

The research adopts a mixed-methods approach, combining both quantitative and qualitative methods, in order to offer comprehensive insights into the effect of the COVID-19 pandemic on student satisfaction, the perceived usefulness of knowledge, and mentorship ratings in the context of a digital competency development course. The study spans six academic years, divided into three phases: pre-COVID (2018/19 and 2019/20), during-COVID (2020/21 and 2021/22), and post-COVID (2022/23 and 2023/24).

Participants

The study included 201 students enrolled in a digital competency development course at a higher education institution, distributed across six academic years as follows: pre-COVID (2018/19, 34 students; 2019/20, 33 students), during-COVID (2020/21, 34 students; 2021/22, 34 students), and post-COVID (2022/23, 33 students; 2023/24, 33 students). The participants were selected using a targeted sampling method, focusing on students enrolled in a digital competency development course across specified academic years. This approach ensured the inclusion of students who experienced the transition during the pre-COVID, during-COVID and post-COVID periods, thus providing a robust dataset for longitudinal analysis. The sample size of 201 students was considered adequate to detect significant differences and trends across the periods, based on prior studies of similar scope and context.

Instruments

Data were collected through pre-service teacher feedback surveys administered at the end of the winter semester of each academic year. The survey comprised both Likert-scale and open-ended questions to capture quantitative and qualitative data, respectively. The quantitative components to answer RQ1, RQ2 and RQ3 included measures of satisfaction (using a 5-point Likert scale where 1 = very dissatisfied and 5 = very satisfied), knowledge usefulness (5-point Likert scale where 1 = not useful at all and 5 = very useful) and quality of mentorship (5-point Likert scale where 1 = very poor and 5 = excellent). In order to address RQ4, qualitative data were obtained through open-ended inquiries such as, "Kindly elaborate on the rationale behind your rating of the course's usefulness, providing specific details", "Could you identify the most valuable aspects of the course that you encountered?" and "In your opinion, what adjustments would be appropriate for enhancing future editions of the course?"

The reliability and validity of the instruments were confirmed through several measures. Reliability was assessed by calculating Cronbach's alpha for Likert-scale questions, resulting in an alpha value of 0.732 for satisfaction, knowledge usefulness and mentorship ratings, indicating acceptable reliability. Validity was ensured through content validity, established by subject matter experts, who evaluated the survey items for relevance and comprehensiveness, and construct validity, assessed by correlating the survey items with related constructs from existing validated instruments.

Research design

As part of a one-year second-cycle master's study programme, the one-semester long elective course ICT in Education focuses on developing pre-service teachers' digital competencies. Learning outcomes include mastering digital tools for teaching, fostering critical thinking and problem-solving, creating rich media open educational resources (OER), and reflecting on the role of technology in education. Key topics are digital literacy, project-based learning principles, integrating digital tools in pedagogy and addressing ethical challenges.

As part of the course, students are required to develop a comprehensive website-based course with media-rich content, including interactive video lectures and formative assessments with detailed feedback tailored to the students' knowledge levels.

The students worked in small groups on projects of designing digital learning modules using Arnes Splet (WordPress), H5P and other applications for the creation of interactive content. They designed and developed their own website, and created video lectures and interactive assignments for primary school students, incorporating formative assessment and feedback. These tasks combined technical and pedagogical knowledge with collaboration and critical thinking. The list of final projects can be openly accessed as a website collection of projects (Žerovnik, 2024).

Descriptive and inferential statistical methods were used to analyse the quantitative data. Descriptive statistics, including means and standard deviations, were calculated for each construct to summarise the data. Normality of data distribution was assessed using the Shapiro-Wilk test and homogeneity of variances was evaluated using Levene's test. The Shapiro-Wilk test indicated that all variables across all periods deviated significantly from normality ($p < 0.05$). The Levene's test showed homogeneous variances for satisfaction ($F = .993$, $p = .423$) and knowledge usefulness ($F = 1.241$, $p = .291$), but heterogeneous variances for mentorship ratings ($F = 2.704$, $p = .022$). Given the non-normal data distribution, the Kruskal-Wallis H-test was used to compare ratings across the pre-COVID, during-COVID and post-COVID periods, with post-hoc pairwise comparisons performed using Mann-Whitney U tests with Bonferroni correction.

For inferential analysis, Pearson correlation coefficients were calculated to examine the strength and direction of the relationships between mentorship quality, student satisfaction and perceived usefulness of knowledge. Simple linear regression analysis was performed to explore the predictive relationships

between these variables. Regression models were developed to quantify the extent to which mentorship quality predicts student satisfaction and knowledge usefulness, as well as the extent to which student satisfaction predicts knowledge usefulness. These analyses were performed using SPSS software to ensure rigorous statistical processing and accuracy in the interpretation of results.

Qualitative data were analysed using thematic analysis (Braun & Clarke, 2020) and data processing was conducted using Microsoft Excel. Open-ended responses were coded to capture meaningful text segments and related codes were grouped into broader themes that were reviewed for coherence and distinctness. Representative quotes were identified to support each theme and a peer debriefing was conducted to ensure the credibility of the thematic analysis.

The study adhered to ethical guidelines for research involving human participants. Informed consent was obtained from all of the participants to ensure that they were aware of the study's purpose and their right to withdraw at any time. Data were collected in an anonymised form to protect participants' privacy.

Results

The following section presents findings from both quantitative and qualitative analyses, exploring the effects of the COVID-19 pandemic on student satisfaction, perceived usefulness of knowledge and mentorship ratings in a student-centred project-based learning course focused on digital competency development.

Longitudinal analysis of student satisfaction, perceived knowledge usefulness and mentorship quality across the pre-COVID, during-COVID and post-COVID periods

Table 1 presents the descriptive statistics for student satisfaction, perceived knowledge usefulness and mentorship ratings across the six academic years, categorised into pre-COVID (2018/19, 2019/20), during-COVID (2020/21, 2021/22) and post-COVID (2022/23, 2023/24) periods.

Table 1

Descriptive statistics for student satisfaction, perceived knowledge usefulness and mentorship ratings across the six academic years

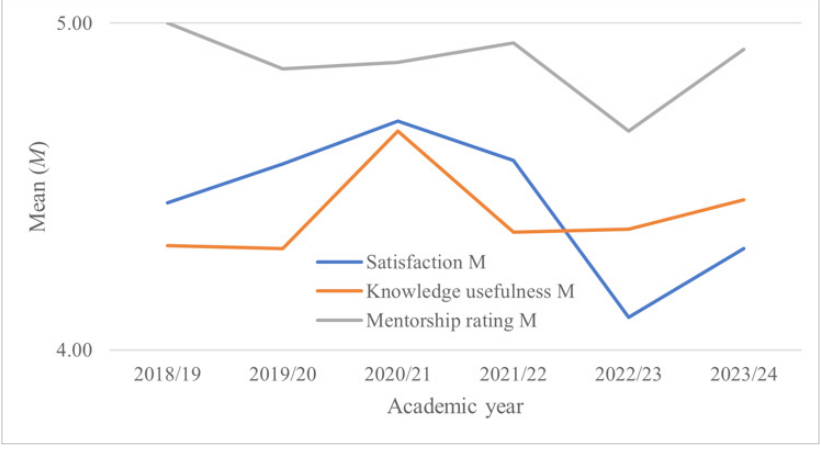
Category	Academic year	Satisfaction		Knowledge usefulness		Mentorship rating	
		M	*SD*	*M*	*SD*	*M*	*SD*
Pre-COVID	2018/19	4.45	.57	4.32	.65	5.00	.00
	2019/20	4.57	.65	4.31	.72	4.86	.35
During-COVID	2020/21	4.70	.64	4.67	.54	4.88	.41
	2021/22	4.58	.66	4.36	.70	4.94	.34
Post-COVID	2022/23	4.10	.76	4.37	.81	4.67	.65
	2023/24	4.31	.73	4.46	.55	4.92	.27
Overall	2018/19–2023/24	4.45	.69	4.42	.67	4.88	.39

Note. *M* = mean; *SD* = standard deviation.

Across the six academic years, student satisfaction, knowledge usefulness and mentorship ratings displayed notable trends. Satisfaction and knowledge usefulness peaked in 2020/21, while mentorship ratings remained consistently high (Table 1, Figure 1).

Figure 1

Mean satisfaction, knowledge usefulness and mentorship ratings across the six academic years



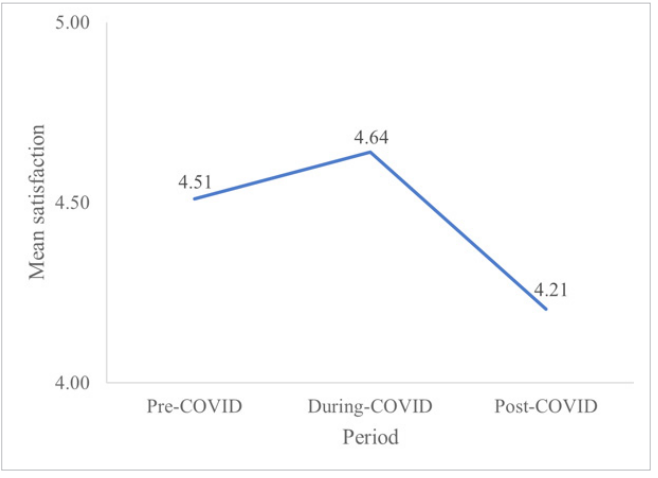
Student satisfaction ratings

The Kruskal-Wallis H-test revealed significant differences in satisfaction ratings across the three periods ($\chi^2 = 14.650$, $p = .001$), with the highest ratings during-COVID and the lowest post-COVID. Post-hoc pairwise comparisons using the Mann-Whitney U test with Bonferroni correction showed no significant difference between the pre- and during-COVID periods (corrected $p = .404$) or between the pre- and post-COVID periods (corrected $p = .051$). However, there was a significant difference between the during-COVID and post-COVID periods (corrected $p = .001$).

These results show that satisfaction ratings remained stable from the pre-COVID period to the during-COVID period, but decreased significantly in the post-COVID period compared to the during-COVID period (Figure 2).

Figure 2

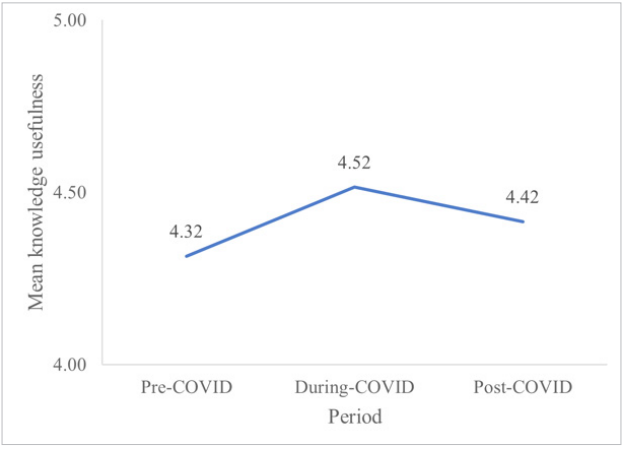
Mean satisfaction ratings across the pre-COVID, during-COVID and post-COVID periods



Knowledge usefulness

The Kruskal-Wallis H test ($\chi^2 = 3.140$, $p = .208$) showed no significant differences in knowledge usefulness ratings across the three periods. This indicates that perceived knowledge usefulness remained consistently high throughout all three periods, reflecting an enduring recognition of the value of the acquired knowledge (Figure 3).

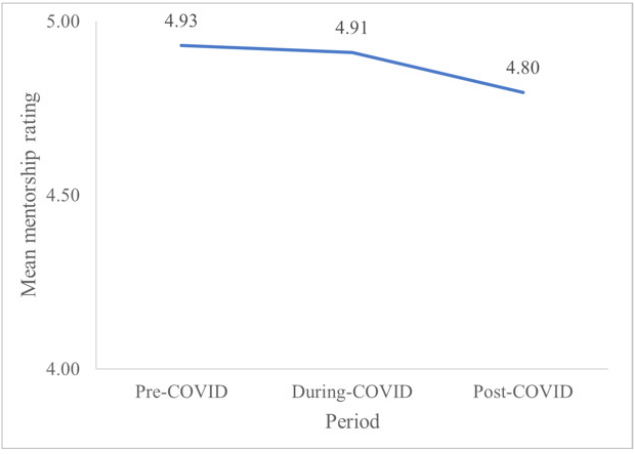
Figure 3
Mean knowledge usefulness ratings across the pre-COVID, during-COVID and post-COVID periods



Mentorship ratings

The Kruskal-Wallis H test results for mentorship ratings ($\chi^2 = 3.213$, $p = .201$) indicated no significant differences across the three periods. This stability suggests that the quality of mentorship was consistently perceived as high, despite the challenges posed by the pandemic (Figure 4).

Figure 4
Mean mentorship ratings across the pre-COVID, during-COVID and post-COVID periods



The quantitative results revealed that student satisfaction ratings were highest during the COVID period and decreased significantly in the post-COVID period, while perceived knowledge usefulness and mentorship ratings remained consistently high across all three periods. These findings highlight the dynamic nature of student satisfaction and the enduring value of acquired knowledge and mentorship quality despite the challenges posed by the pandemic.

Relationships between mentorship quality, satisfaction and knowledge usefulness in predicting student satisfaction and knowledge usefulness

Pearson's correlation analysis revealed moderately positive relationships between the studied variables. Specifically, mentorship quality and student satisfaction had a correlation coefficient of $r = .345$ ($p < .001$), indicating a moderately positive correlation. Similarly, mentorship quality was moderately correlated with the perceived usefulness of knowledge ($r = .324$, $p < .001$), and student satisfaction had a similar correlation with knowledge usefulness ($r = .411$, $p < .001$). A simple linear regression analysis was used to further elucidate these relationships. The regression equation for predicting student satisfaction based on mentorship quality was as follows: student satisfaction = 1.495 + .606 × mentorship quality ($R^2 = .119$, $p < .001$), indicating that mentorship quality explains 11.9% of the variance in student satisfaction. The equation used to predict knowledge usefulness was: knowledge usefulness = 1.748 + .547 × mentorship quality ($R^2 = .105$, $p < .001$), accounting for 10.5% of the variance. Finally, the prediction of knowledge usefulness based on student satisfaction was described by the following equation: knowledge usefulness = 2.653 + .396 × student satisfaction ($R^2 = .169$, $p < .001$), explaining 16.9% of the variance. These findings highlight the significant role of mentorship quality and student satisfaction in influencing students' perceived usefulness of knowledge.

Recurring themes and insights from student feedback across the pre-COVID, during-COVID and post-COVID periods

A thematic analysis of the open-ended responses identified five key themes: support and guidance, knowledge and skills, achievement and quality, innovation in learning, and feedback on course structure (Table 2).

Table 2
Theme frequencies across the pre-COVID, during-COVID and post-COVID periods

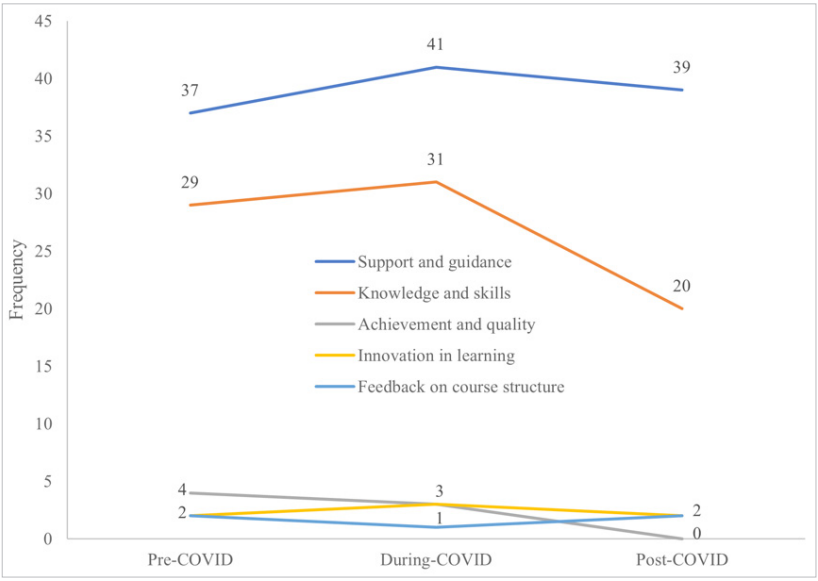
Theme	Pre-COVID frequency	During-COVID frequency	Post-COVID frequency
Support and guidance	37	41	39
Knowledge and skills	29	31	20
Achievement and quality	4	3	0
Innovation in learning	2	3	2
Feedback on course structure	2	1	2

The analysis conducted on data collected prior to the COVID-19 pandemic revealed that the theme of "Support and guidance" was most frequently mentioned, with 37 instances. This was followed by "Knowledge and skills", mentioned 29 times. Themes related to "Achievement and quality" (four mentions) and "Innovation in learning" and "Feedback on course structure" (two mentions each) were less frequent, suggesting that these areas were less central to the students' feedback at that time (Table 2).

The findings indicate that during the COVID-19 pandemic, "Support and guidance" emerged as the most recurrent theme, with 41 mentions, highlighting the significance of the availability and responsiveness of mentors and instructors. Additionally, "Knowledge and skills" also gained prominence, with 31 mentions, emphasising the continuing need for practical knowledge and skills acquisition through remote learning. However, "Achievement and quality" and "Innovation in learning" were mentioned only three times each, suggesting minimal focus on these aspects. Moreover, there was only one mention of concern regarding the course structure (Figure 5).

Figure 5

Theme frequencies in the pre-COVID, during-COVID and post-COVID periods



In the post-COVID period, "Support and guidance" remained a key theme, with 39 mentions indicating its enduring importance. However, the "Knowledge and skills" theme experienced a noticeable drop, with only 20 mentions. This finding suggests a potential shift in students' priorities and satisfaction with this aspect of their education. The themes "Innovation in learning" and "Feedback on course structure" were mentioned twice, indicating persistent yet lower concerns in these areas. Interestingly, the theme "Achievement and quality" was not mentioned in this period, suggesting a possible reduction in its emphasis after the pandemic.

The analysis of the frequency of themes across the three periods demonstrated several trends. The theme "Support and guidance" consistently ranked highly, indicating its ongoing significance to students. The sentiment for this theme was consistently positive. Students praised the helpful and solution-oriented nature of the support they received, highlighting clear presentations and the availability of guidance. In contrast, the theme "Knowledge and skills" exhibited a decline in the post-COVID period compared to the pre- and during-COVID periods, potentially indicating shifts in students' experiences or expectations. The overall sentiment for this theme was still positive, with a smaller proportion of answers indicating a need for more explicit instructions. Students

mentioned satisfaction with the acquired knowledge and skills and their practical future applications.

The theme "Achievement and quality" was mentioned in the pre- and during-COVID periods only, while the theme "Innovation in learning" received consistently few mentions throughout all three periods. The sentiment for "Achievement and quality" was highly positive. Students mentioned pride in their work and achievements, valuing the professional and high-quality execution of project-based learning. The sentiment for "Innovation in learning" was also highly positive. Students praised student-centred project-based learning methods, while a few of them mentioned that the quality of the course would increase if more work were explicitly conducted during face-to-face meetings.

Lastly, the theme "Feedback on course structure" was the least frequently mentioned theme in all three periods, with mostly negative sentiments expressing the heavy workload and the need for better synchronisation with other course requirements. Students stated that the project work was too complex for the credits earned within the subject. Suggestions included more frequent and detailed checkpoints, clearer deadlines and more structured guidance during seminars. The positive sentiments suggested that students found the lectures well organised and the tasks systematically designed to progressively build their skills.

Discussion

The present study investigated the impact of the COVID-19 pandemic on student satisfaction, perceived knowledge usefulness and mentorship ratings in a student-centred project-based learning digital competency development course over six academic years. The findings provide valuable insights into how these educational outcomes evolved across the pre-COVID, during-COVID and post-COVID periods.

The main findings showed that satisfaction ratings were highest during the COVID period and decreased significantly in the post-COVID period, highlighting the challenges faced by students as they transitioned back to in-person learning. This drop in ratings during 2022/23, coinciding with instructors' absence, underscores the importance of continuous teacher support, a view reflected in previous research emphasising the critical role of teacher presence in maintaining student engagement and satisfaction during remote learning (Rapanta et al., 2020; Trust & Whalen, 2020). The stability of satisfaction ratings from the pre-COVID period to the during-COVID period suggests that students initially adapted well to the transition to online learning, a finding

that supports the adaptability of digital competencies in various learning environments (Dhawan, 2020; Hodges et al., 2020).

Knowledge usefulness ratings remained stable and high across all three periods, suggesting that students valued the digital competencies they had acquired regardless of the learning environment. This supports the idea that digital skills are essential in contemporary educational and professional contexts regardless of the learning environment (Selwyn, 2020; Voogt et al., 2018). High and consistent ratings for knowledge usefulness align with the broader recognition of the importance of integrating digital skills into educational curricula to enhance student engagement and prepare students for the digital workforce (European Commission, 2020a; Howard et al., 2020; Voogt et al., 2018).

Mentorship quality was also perceived to be consistently high, with no significant differences across the three periods. This stability in mentorship ratings indicates that effective mentorship can be maintained, even during disruptions, supporting the idea that continuous and responsive mentorship is crucial for student success (Kokotsaki et al., 2016; Mishra et al., 2020). However, it is important to note that maintaining these high ratings, especially during significant changes such as the COVID-19 pandemic, requires additional effort from both mentors and students. Qualitative data further highlight the importance and quality of mentorship, especially during times of transition, which underscores the multifaceted role of mentors in providing both academic and emotional support (Dennen & Burner, 2017).

Thematic analysis identified key themes, such as support and guidance, knowledge and skills, achievement and quality, innovation in learning, and feedback on course structure. A comparative analysis across the three periods revealed notable shifts in the students' experiences and perceptions. In the pre-COVID period, there was a strong focus on the acquisition of practical skills directly applicable to future careers, reflecting the broader trend of emphasising digital competencies for academic success and employability (Günay, 2022; Pažur Aničić et al., 2022). Students praised the accessibility and helpfulness of their mentors, indicating a high level of satisfaction with the support they received. Additionally, well-organised and structured seminars were highly appreciated, contributing to a positive learning environment.

During the COVID period, students emphasised the importance of hands-on learning and adaptation to remote platforms. The transition to remote learning posed significant challenges, making strong mentorship crucial for success. The Pearson correlation analysis conducted in this study revealed a moderate positive relationship between mentorship quality and student satisfaction ($r = .345$, $p < .001$), as well as between mentorship quality and perceived

usefulness of knowledge (r = .324, p < .001). These findings underscore the critical role of mentorship in enhancing student experiences, particularly during times of disruption. Despite the challenges during the COVID-19 period, students continued to appreciate the support from their mentors. However, organisational and structural challenges increased, such as heightened workload and the need for better coordination, highlighting the need for adaptive and resilient educational models (Muftahu, 2020; Musa & Adamu, 2023).

In the post-COVID period, students maintained a focus on the practical application of skills, underscoring the enduring importance of practical knowledge. There is an ongoing appreciation for responsive and helpful mentors, reflecting the sustained value of mentorship. An interesting development during this period was the emergence of greater self-reliance and independence among the students. However, there is also a recognised need for improved organisation, clearer deadlines and more structured guidance, in order to better manage workloads and course integration. These findings suggest that while digital competencies remain crucial, there is a need for better structural support and coordination in hybrid learning environments (Dhawan, 2020; Singh et al., 2021).

These findings underscore the dynamic nature of student needs and perceptions and provide valuable insights for educators to refine their teaching strategies and support mechanisms to align with evolving student expectations.

Conclusions

The present study provides a comprehensive analysis of the impact of the COVID-19 pandemic on educational outcomes. The findings emphasise the importance of continuous support, effective mentorship and the integration of digital competencies in maintaining student satisfaction and engagement. These insights offer practical recommendations for enhancing educational practices in the post-pandemic landscape, ensuring that students are well-prepared for future challenges in a rapidly evolving digital world (Dhawan, 2020; Hodges et al., 2020; Redecker, 2017).

Educational institutions should develop robust support systems and invest in professional development to enhance students' satisfaction and engagement. The adoption of flexible learning models combining online and in-person instruction can ensure adaptability and resilience in education.

Practical recommendations and future research

Based on the findings of this study, several recommendations can be made to improve students' satisfaction and engagement in post-pandemic education. First, teachers must continue to provide consistent and responsive support, even during the transition back to in-person learning, in order to maintain high levels of student satisfaction. The decline in satisfaction ratings after the COVID-19 pandemic demonstrates the challenges students face during such transitions (Rapanta et al., 2020; Trust & Whalen, 2020). Second, it is essential to effectively integrate digital competencies into educational curricula, in order to enhance student engagement and prepare them for the digital workforce. The consistently high ratings for knowledge usefulness across all three periods suggest that digital competencies are perceived as valuable regardless of the learning environment (Selwyn, 2020; Voogt et al., 2018). Third, it is crucial to invest in educators' professional development. Providing educators with the necessary skills to support students in both online and in-person learning environments can help maintain effective mentorship even during disruptions (Voogt et al., 2018). Fourth, institutions should establish robust support systems to ensure equitable and effective learning experiences and address both the technical and emotional needs of students. Qualitative feedback highlights the need for better technical guidance and collaborative support (Al-Fraihat et al., 2020; Omidire & Maroga, 2022; Van Dijk, 2020). Finally, adopting hybrid learning models that combine the strengths of online and in-person instruction can enhance adaptability and resilience in educational delivery (Dhawan, 2020; Eissa, 2022; Singh et al., 2021).

Several future research directions can be proposed in order to further understand and improve student satisfaction, knowledge usefulness and the quality of mentorship in student-centred project-based learning approaches. One area of interest is differentiated support mechanisms that focus on identifying and implementing tailored support programmes that address the diverse academic, technical and emotional needs of students in the post-pandemic educational landscape. This could involve developing and testing support initiatives specifically designed for different student groups, such as first-year students, international students and those from underprivileged populations, in order to evaluate their effectiveness. Another important research direction is professional development, which involves investigating the most effective professional development interventions to equip educators with the skills required to support students in hybrid and online learning environments. This could be achieved by implementing and comparing various professional development

programmes that focus on digital pedagogy, mentorship and student engagement strategies, while measuring their impact on teaching effectiveness and student outcomes.

Additionally, exploring the role of mentorship in digital educational learning environments is crucial. Future research could identify the key characteristics of effective mentorship in these contexts and assess how they impact student satisfaction and academic achievement through qualitative studies involving in-depth interviews and focus groups of students and mentors. Finally, there is a need to investigate how educational institutions can better prepare for future disruptions, in order to ensure continuity in student satisfaction and learning outcomes. This could involve developing and testing contingency plans and adaptive strategies across multiple institutions, and simulating various disruption scenarios to evaluate their efficacy in maintaining educational quality and student satisfaction. These research directions aim to enhance the quality and effectiveness of student-centred project-based learning in a rapidly evolving educational landscape.

Limitations of the study

Although the present study was comprehensive, several limitations must be acknowledged. First, the sample consisted of students enrolled in a higher education institution and a specific digital competency development course, which may limit the generalisability of the findings to other institutions or courses with different demographics or structures. Second, there is a potential for response bias, as students who were particularly satisfied or dissatisfied might have been more inclined to complete the surveys, potentially skewing the results. Finally, reliance on self-reported data introduces the possibility that personal interpretation and recall biases affect the accuracy of the responses.

Ethical statement

Ethical approval for this study was granted by the Ethics Commission of the Faculty of Education, University of Ljubljana.

Disclosure statement

The author has no conflict of interest to declare.

References

Abdulkareem, T. A., & Eidan, S. M. (2021). Online learning for higher education continuity (during Covid-19 pandemic): The challenges, advantages, disadvantages, and how to overcome: Recent advancement. *Modern Perspectives in Economics, Business and Management, 1*, 148–154. https://doi.org/10.9734/bpi/mpebm/v1/2793F

Akyol, Z., & Garrison, D. R. (2013). Educational communities of inquiry: Theoretical framework, research and practice. *IGI Global*. https://doi.org/10.4018/978-1-4666-2110-7

Al-Busaidi, S., & Al-Seyabi, F. (2021). Project-based learning as a tool for student-teachers' professional development: A study in an Omani EFL teacher education program. *International Journal of Learning, Teaching and Educational Research*, *20*(4), 116–136. https://doi.org/10.26803/ijlter.20.4.7

Al-Fraihat, D., Joy, M., Masa'deh, R., & Sinclair, J. (2020). Evaluating e-learning system success: An empirical study. *Computers in Human Behavior*, *102*(1), 67–86. https://doi.org/10.1016/j.chb.2019.08.004

Alqurashi, E. (2019). Predicting student satisfaction and perceived learning in online learning environments. *Distance Education*, *40*(1), 133–148. https://doi.org/10.1080/01587919.2018.1553562

Anderson, L. W. (2021). Schooling interrupted: Educating children and youth in the Covid-19 era. *Center for Educational Policy Studies Journal, 11*(Special Issue), 17–36. https://doi.org/10.26529/cepsj.11.Sp.Issue

Arbaugh, J. B., Bangert, A., & Cleveland-Innes, M. (2010). Subject matter effects and the Community of Inquiry (CoI) framework: An exploratory study. *The Internet and Higher Education*, *13*(1–2), 37–44. https://doi.org/10.1016/j.iheduc.2009.10.006

Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies, 2*(2), 113–115. https://doi.org/10.1002/hbe2.191

Braun, V., & Clarke, V. (2020). One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qualitative Research in Psychology*, *18*(3), 328–352. https://doi.org/10.1080/14780887.2020.1769238

Castellanos-Reyes, D. (2020). 20 years of the community of inquiry framework. *TechTrends, 64*, 557–560. https://doi.org/10.1007/s11528-020-00491-7

Chanpet, P., Chomsuwan, K., & Murphy, E. (2020). Online project-based learning and formative assessment. *Technology, Knowledge and Learning*, *25*, 685–705. https://doi.org/10.1007/s10758-018-9363-2

Chen, C.-H., & Yang, Y.-C. (2019). Revisiting the effects of project-based learning on students' academic achievement: A meta-analysis investigating moderators. *Educational Research Review*, *26*(26), 71–81. https://doi.org/10.1016/j.edurev.2018.11.001

Dennen, V. P., & Burner, K. J. (2017). The cognitive apprenticeship model in educational practice. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of research on educational communications and technology* (pp. 484–495). Springer. https://doi.org/10.1007/978-1-4614-3185-5_39

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educa-*

tional Technology Systems, *49*(1), 5–22. https://doi.org/10.1177/0047239520934018

Eissa, E. (2022). Role of the learning management system in resilience during the COVID-19 pandemic. *International Journal of Information and Education Technology*, *12*(12), 1399–1406. https://doi.org/10.18178/ijiet.2022.12.12.1764

Eller, L. S., Lev, E. L., & Feurer, A. (2014). Key components of an effective mentoring relationship: A qualitative study. *Nurse Education Today*, *34*(5), 815–820. https://doi.org/10.1016/j.nedt.2013.07.020

European Commission. (2020a). *Digital education action plan*. https://education.ec.europa.eu/focus-topics/digital-education/action-plan

European Commission. (2020b). *European skills agenda for sustainable competitiveness, social fairness and resilience*. https://ec.europa.eu/social/main.jsp?catId=1223&langId=en

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*(2–3), 87–105. https://doi.org/10.1016/S1096-7516(00)00016-6

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education, 15*(1), 7–23. https://doi.org/10.1080/08923640109527071

Granado-Alcón, M. d. C., Gómez-Baya, D., Herrera-Gutiérrez, E., Vélez-Toral, M., Alonso-Martín, P., & Martínez-Frutos, M. T. (2020). Project-based learning and the acquisition of competencies and knowledge transfer in higher education. *Sustainability*, *12*(23), Article 10062. https://doi.org/10.3390/su122310062

Guerra, A., Ulseth, R., & Kolmos, A. (Eds.). (2017). *PBL in engineering education: International perspectives on curriculum change*. Sense Publishers. https://doi.org/10.1007/978-94-6300-905-8

Günay, A. (2022). Equipping higher education students with digital skills for the post-pandemic world. *Advances in Business Strategy and Competitive Advantage Book Series*, 65–84. https://doi.org/10.4018/978-1-7998-8626-6.ch004

Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, *102*(1). https://doi.org/10.1016/j.ijer.2020.101586

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020, March 27). *The difference between emergency remote teaching and online learning.* Educause Review. https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning

Howard, S. K., Tondeur, J., Siddiq, F., & Scherer, R. (2020). Ready, set, go! Profiling teachers' readiness for online teaching in secondary education. *Technology, Pedagogy and Education*, *30*(1), 1–18. https://doi.org/10.1080/1475939x.2020.1839543

Huang, Y. (2023). Analysis of the disadvantages and advantages of online education during the COVID-19 pandemic. *Lecture Notes in Education Psychology and Public Media*, *8*(1), 299–305. https://doi.org/10.54254/2753-7048/8/20230164

Iglesias-Pradas, S., Hernández-García, Á., Chaparro-Peláez, J., & Luis Prieto, J. (2021). Emergency

remote teaching and students' academic performance in higher education during the Covid-19 pandemic: A case study. *Computers in Human Behavior*, *119*, Article 106713. https://doi.org/10.1016/j.chb.2021.106713

Inciso, A. A. C. (2021). Higher education during COVID-19 pandemic: Distance education and online learning. *International Journal of Research Publications*, *70*(1). https://doi.org/10.47119/ijrp100701220211746

Kamrujjaman, M., Sinje, S. S., Nandi, T. R., Islam, F., Rahman, M. A., Akhi, A. A., Tasnim, F., & Alam, M. S. (2024). The impact of the COVID-19 pandemic on education in Bangladesh and its mitigation. *Bulletin of Biomathematics, 2*(1), 57–84. https://doi.org/10.59292/bulletinbiomath.2024003

Koh, K., Kusnadi, Y., Pan, G., & Shankararaman, V. (2022). Making virtual project-based learning work during the Covid-19 pandemic. *International Journal of Education (IJE)*, *10*(02), 1–14. https://doi.org/10.5121/ije.2022.10201

Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools*, *19*(3), 267–277. https://doi.org/10.1177/1365480216659733

Kotrikadze, E. V., & Zharkova, L. I. (2021). Advantages and disadvantages of distance learning in universities. *Propósitos Y Representaciones*, *9*(spe3), Article e1184. https://doi.org/10.20511/pyr2021.v9nspe3.1184

Liu, J. (2021). Bridging digital divide amidst educational change for socially inclusive learning during the COVID-19 pandemic. *SAGE Open*, *11*(4), 1–8. https://doi.org/10.1177/21582440211060810

Maguraushe, K., Masimba, F., & Muderedzwa, M. (2022). Shrinking the digital divide in online learning beyond the COVID-19 pandemic: A systematic literature review. In D. Singh Jat, K. Zvarevashe, F. Masimba, & T. Masamha (Eds.), *2022 1st Zimbabwe Conference of Information and Communication Technologies (ZCICT)* (pp. 1–7). IEEE. https://doi.org/10.1109/ZCICT55726.2022.10046024

Maphalala, M. C., & Ajani, O. A. (2023). The Covid-19 pandemic: Shifting from conventional classroom learning to online learning in south Africa's higher education. *International Journal of Innovative Technologies in Social Science*, *2(38)*. https://doi.org/10.31435/rsglobal_ijitss/30062023/8002

Maros, M., Korenkova, M., Fila, M., Levicky, M., & Schoberova, M. (2021). Project-based learning and its effectiveness: Evidence from Slovakia. *Interactive Learning Environments*, *31*(7), 1–9. https://doi.org/10.1080/10494820.2021.1954036

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies*. US Department of Education. https://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf

Mina-Raiu, L., & Oprea, C. V. (2023). Online education: Challenges and opportunities during the COVID-19 pandemic. Study on public administration students' and teachers' perception. *Applied Research in Administrative Sciences*, *4*(1), 25–34. https://doi.org/10.24818/aras/2023/4/1.04

Mishra, L., Gupta, T., & Shree, A. (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *International Journal of Educational Research Open*, 1, Article 100012. https://doi.org/10.1016/j.ijedro.2020.100012

Muftahu, M. (2020). Higher education and Covid-19 pandemic: Matters arising and the challenges

of sustaining academic programs in developing African universities. *International Journal of Educational Research Review, 5*(4), 417–423. https://doi.org/10.24331/ijere.776470

Musa, R. M., & Adamu, H. (2023). Imperatives of online learning in tertiary institutions during COVID-19 pandemic. *Journal of Institute of Africa Higher Education Research and Innovation (IAHERI)*, *1*(001). https://doi.org/10.59479/jiaheri.v1i001.10

Omidire, M. F., & Maroga, M. J. (2022). E-learning for student support, inclusion and equity in diverse post-pandemic teaching contexts. *Reimagining African Teacher Education through Distance for a Post-Pandemic Future*, *3*(1). https://doi.org/10.35293/tetfle.v3i1.4109

Onyema, E. M., Eucheria, N. C., Obafemi, F. A., Sen, S., Atonye, F. G., Sharma, A., & Alsayed, A. O. (2020). Impact of coronavirus pandemic on education. *Journal of Education and Practice*, *11*(13), 108–121. https://doi.org/10.7176/jep/11-13-12

Pažur Aničić, K., Gusić Munđar, J., & Šimić, D. (2022). Generic and digital competences for employability – Results of a Croatian national graduates survey. *Higher Education, 86*, 407–427. https://doi.org/10.1007/s10734-022-00940-7

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online university teaching during and after the Covid-19 crisis: Refocusing teacher presence and learning activity. *Postdigital Science and Education*, *2*(3), 923–945. https://doi.org/10.1007/s42438-020-00155-y

Rashid, S., & Yadav, S. S. (2020). Impact of Covid-19 pandemic on higher education and research. *Indian Journal of Human Development*, *14*(2), 340–343. https://doi.org/10.1177/0973703020946700

Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu.* Publications Office of the European Union. https://doi.org/10.2760/159770

Riadi, B., Prasetya, R. A., Maydiantoro, A., Winatha, I. K., Putrawan, G. E., & Dzakiria, H. (2022). Perceptions of students in Indonesian higher education institutions regarding Internet access for online (remote) learning during the COVID-19 pandemic. *International Journal of Information and Education Technology*, *12*(6), 571–577. https://doi.org/10.18178/ijiet.2022.12.6.1655

Ribeiro, S., Tavares, C., Lopes, C., & Chorão, G. (2023). Competence development strategies after COVID-19: Using PBL in translation courses. *Education Sciences*, *13*(3), 283–283. https://doi.org/10.3390/educsci13030283

Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (1999). Assessing social presence in asynchronous text-based computer conferencing. *International Journal of E-Learning & Distance Education, 14*(2), 50–71. https://www.ijede.ca/index.php/jde/article/view/153

Selwyn, N. (2020). *Digital education: Opportunities for social collaboration*. Palgrave Macmillan. https://doi.org/10.1007/978-3-030-38788-4

Singh, J., Steele, K., & Singh, L. (2021). Combining the best of online and face-to-face learning: Hybrid and blended learning approach for COVID-19, post vaccine, & post-pandemic world. *Journal of Educational Technology Systems*, *50*(2), 140–171. https://doi.org/10.1177/00472395211047865

Sinha, B. (2020). Post-COVID challenges and opportunities in the education sector. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3710846

Stecuła, K., & Wolniak, R. (2022). Influence of Covid-19 pandemic on dissemination of innovative

e-learning tools in higher education in Poland. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(2), 89. https://doi.org/10.3390/joitmc8020089

Swan, K., & Ice, P. (2010). The community of inquiry framework ten years later: Introduction to the special issue. *The Internet and Higher Education, 13*(1–2), 1–4. https://doi.org/10.1016/j.iheduc.2009.11.003

Symeonidis, V., Francesconi, D., & Agostini, E. (2021). The EU's education policy response to the COVID-19 pandemic: A discourse and content analysis. *Center for Educational Policy Studies Journal, 11*(Special Issue), 89–115. https://doi.org/10.26529/cepsj.11.Sp.Issue

Tadesse, S., & Muluye, W. (2020). The impact of COVID-19 pandemic on education system in developing countries: A review. *Open Journal of Social Sciences*, *08*(10), 159–170. https://doi.org/10.4236/jss.2020.810011

Tate, T., & Warschauer, M. (2022). Equity in online learning. *Educational Psychologist*, *57*(3), 1–15. https://doi.org/10.1080/00461520.2022.2062597

Thane, S. (2022). The benefits and drawbacks of learning English online. *Pakistan Journal of Multidisciplinary Innovation*, *1*(2), 16–35. https://doi.org/10.59075/pjmi.v1i2.110

Trust, T., & Whalen, J. (2020). Should teachers be trained in emergency remote teaching? Lessons learned from the COVID-19 pandemic. *Journal of Technology and Teacher Education, 28*(2), 189–199. https://www.learntechlib.org/primary/p/215995/

Van Dijk, J. A. (2020). Digital divide research, achievements, and shortcomings. *Poetics, 73*, 101–198. https://doi.org/10.1016/j.poetic.2019.101198

Voogt, J., Knezek, G., Cox, M., Knezek, D., & ten Brummelhuis, A. (2018). Under which conditions does ICT have a positive effect on teaching and learning? A Call to Action. *Journal of Computer Assisted Learning, 29*(1), 4–14. https://doi.org/10.1111/j.1365-2729.2011.00453.x

Zawacki-Richter, O. (2020). The current state and impact of Covid-19 on digital higher education in Germany. *Human Behavior and Emerging Technologies*, *3*(1). https://doi.org/10.1002/hbe2.238

Zhang, L., & Ma, Y. (2023). A study of the impact of project-based learning on student learning effects: A meta-analysis study. *Frontiers in Psychology*, *14*(1). https://doi.org/10.3389/fpsyg.2023.1202728

Žerovnik, A. (2024). *Zbirka gradiv, ki so nastala v okviru pedagoškega dela in projektov. Uporabne povezave za delo z IKT in računalništvo za učitelje, starše* [A collection of materials produced through teaching work and projects. Useful links for ICT and computing for teachers, parents.] Racunikt. splet.arnes.si. https://racunikt.splet.arnes.si/zbirka-gradiv-ki-so-nastala-v-okviru-pedagoskega-dela/#mag

Biographical note

Alenka Žerovnik, PhD, is a teaching assistant in computer science in education and computer science didactics at the Faculty of Education at the University of Ljubljana, with extensive teaching and research experience. She integrates innovative technologies, such as generative AI, into learning processes, emphasising project-based learning, computational thinking, and open educational resources. She utilises formative assessment and multimodal feedback to support teachers and students, and explores the ethical and pedagogical implications of AI. By contributing to digital transformation strategies and promoting digital literacy, she strives to help shape a fairer, more flexible, and more effective education system for the future.