Preparing pre-service teachers for e-learning - case study

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Abstract

The rapid integration of ICT in education, accelerated by the COVID-19 pandemic, has exposed gaps in teachers' digital competencies. Despite existing e-learning platforms, many educators struggle with online pedagogy. This study examines pre-service teacher education, emphasizing the need for comprehensive training in digital competencies, technology integration, and online learning design. Focusing on the Electronic Educational Environments (EEE) MA-level course at the University of Zagreb, 37 student-developed courses (2022–2025) were analyzed. Findings show a shift toward student-centered online interactions, a decrease in recorded lectures, and an increased workload in planned courses. Future teachers balance digital and traditional methods, resisting unnecessary digitalization. The study underscores the importance of embedding digital competencies throughout teacher education curricula. By applying structured learning design principles, pre-service teachers can create effective learning environments, ensuring readiness for the evolving demands of modern education.

Keywords: pre-service teacher education; learning design; digital competencies, online pedagogy.

1. Introduction

The rapid advancement of ICT and its integration into different sectors and institutions due to digital transformation inevitably influence the educational environment. Although most universities implemented e-learning platforms years and even decades(s) ago and developed blended learning courses and programs, even before the crisis generated by COVID-19, the teaching staff experienced difficulties in using these platforms and in creating and adapting the course content, as it needed to be quickly adapted to a fast-evolving and complex situation. A review of the literature reveals numerous studies on student satisfaction and attitudes toward digital education, as well as teachers' perspectives on their preparedness for a digital educational environment during formal training. This research is scattered across different scientific fields,

as people are challenged to adapt education in their field to the demands of the digital environment. The main challenge most are struggling with is the need for teachers to update their existing knowledge of digital competencies. Similarly, discussions about the digital transformation of education in the EU have resulted in the Digital Competence Framework (Digicomp 2.2, 2022). This is not the only framework, and there are others, such as the ones proposed by UNESCO and ISTE. The evolving landscape of education demands that future teachers possess digital literacy skills, pedagogical knowledge related to e-learning, and the ability to navigate and harness the potential of educational technologies effectively "...teachers become the key element of imparting digital skills and are therefore required not only to possess these kinds of skills but also to have the necessary technological pedagogical knowledge to teach them" (Dolezal et al, 2025, p.1). The philosophy of a balanced learning design based on learning types and student-centred design was seen in the work of Divjak et al. They argue that the current use of digital technologies in higher education (HE) has not always been effective in supporting learning. (Divjak et al, 2022) They promote innovative pedagogies through the learning design concept and tool called BDP. By adopting a balanced approach, educators can leverage various instructional strategies and technologies to actively engage students, promote critical thinking, and facilitate knowledge construction. The conversational framework provides a structured framework for designing interactive and collaborative learning experiences, ensuring meaningful exchange between learners and content. Using these tools and methods in pre-service teacher education can help create successful teachers in a digital environment capable of responding to their students' educational needs.

2. Digital competencies of teachers

There is a common agreement between researchers and policymakers that digital competence is one of the basic skills that modern teaching staff should possess (Tomczyk & Fedeli, 2022), and that digital competence plays a pivotal role in modern education, serving as a foundational skill set for both teachers and students. (Momidjan et al, 2024) As stated by Zhang et al. (2023) and further explained by Dolezal et al. (2025), "a common thread in the literature on digital skills of teachers is that their digital competence should go beyond the mere use of digital technologies and towards the pedagogical usage of ICT — how educators teach is sometimes even more important than what they teach" (Dolezal et al, 2025, p. 2). Cabero-Almenara (Cabero-Almenara, 2021) identified that the basic-intermediate level of digital competences is no longer sufficient for complex environments. Pongsakdi et al. (2021) showed that educating teachers on developing digital competences lowers their negative perceptions of e-learning.

In our own research (Banek Zorica, 2022), we have observed that both students and teachers see advantages in the implementation of e-learning, but there is a lack of systematic support. From the teachers' perspective, the greatest obstacles are the lack of training to deliver education in an online environment, converting activities and content for use in e-learning, and

authentically assessing students' progress. Tomczyk found that experts in the field of pre-service education emphasise that the "key areas of digital competence today are e-learning and blended learning" and that "the new generations of teachers should be better prepared methodologically to implement this kind of educational form" (Tomczyk, 2024, 9). Velasco (2023) investigating the perspectives of student teachers regarding the effectiveness of their educational program and practicum in enhancing their digital teaching skills revealed that while some pre-service teachers felt confident in their ability to use digital tools, they were less confident in their ability to integrate these tools into teaching and learning processes. (Momdjian, 2024) Newly qualified teachers often do not develop sufficient digital competence to utilize the possibilities for integration, and to critically evaluate the use of digital technologies in the classroom (Gudmundsdottir & Hatlevik, 2018; Tondeur et al., 2018). (Andreasen et al, 2022) In relation to teacher education, Lund et al. (2014, according to Falloon 2020) comment on the unique challenges faced by teacher educators in developing a holistic view of digital competence in their students. They point out that teacher educators are required to educate their students on using present and emerging digital resources in their own professional practice, but also make them, "capable of using technology in productive ways" (Falloon, 2020, p.286).

3. Methodology

An active methodology was employed that combined theoretical instruction on major learning design models and frameworks, including the Balanced Design Planning (BDP) tool, Laurillard's Conversational Framework, and the Digital Competence Framework (DigCompEdu), with practical, hands-on course design and development tasks. Students were introduced to principles of constructive alignment, types of learning activities (acquisition, discussion, investigation, practice, production, assessment), and workload management based on ECTS standards. Students first created draft outlines for an original course using one design model of their choice and received formative feedback from instructors. Following feedback, students developed detailed course plans using the BDP online tool (https://learning-design.eu), specifying learning activities, types, workload estimates for both students and teachers, preferred delivery modes (online, offline, hybrid), collaboration expectations, feedback mechanisms, and assessment strategies. All 37 students enrolled in the Electronic Educational Environments (EEE) course at the MA level at FHSS (Faculty of Humanities and Social Sciences, University of Zagreb, Croatia) during the academic years 2022/23, 2023/24, and 2024/25 participated in this study. The sample consisted primarily of double-major students (approximately 70%), with a smaller proportion of single-major students (30%). Among the participants, 22 identified as female and 15 as male. All participants had at least 3 years of experience using the MOODLE LMS as students at the BA level. The EEE course marked their first teaching/creator experience within an online environment. In this study, we used a mix of quantitative and qualitative approaches through both statistical analysis and course content

analysis, in comparison to different design models. After the introduction of major learning design models and frameworks, each student had to design and develop their own courses guided by one of the design models of their choice. First, they had to prepare a rough draft of the course outline and obtain the initial feedback, after which they were supposed to develop those topics in more detail using the BDP online tool (https://learning-design.eu)[1], where they had to set what activities and of which activity learning type (acquisition, discussion, investigation, practice, production, and assessment) they were going to use, workload, preferred delivery method, whether it is a collaborative activity, who will provide feedback (teacher, automated, peer), and does it include assessment. This tool also provided them with an automatic analysis of their future course (learner workload, learning activity types, ECTS workload vs. course ECTS, constructive alignment, and so on). After the teacher's feedback and final adjustments, they could export their course plan and content as a MOODLE backup that could be imported into FHSS LMS called Omega, where they completed the course by uploading content and configuring activity settings. This sped up the process of course deployment and reaffirmed the notion of the value of using such pedagogical tools, enabling them to focus on pedagogy and fine-tune the activities to the intended goals. Data collection consisted of course content exported from MOODLE (number and types of activities and resources), analytic reports generated by the BDP tool, draft course plans submitted by students, peer evaluation done by other students, and student reflections collected through feedback.

4. Results and discussion

All courses were created in MOODLE LMS, which differentiates between activities and resources: Activity is something students use to interact with their peers or teachers, like forum, quiz, chat, usually it can be graded and/or given feedback for, while resources are used solely for presenting information, such as pages, files, links, and so on. The sample of courses had 37 courses in it (created by the same number of students) from the academic years 2022/23, 2023/24, and 2024/25, with activity totals and percentage ratios shown in Tables 1 and 2. We analysed the number of activities and resources on actual courses developed by future teachers, their BDP online tool analysis data including workload, and their draft plans (in which they stated their audience, goals, topics, and planned activities). For 19 courses in the last two academic years (2023/24 and 2024/25), we have data from BDP online tool analysis, while for 18 courses from academic year 2022/23, data are available only for some courses (because most of the students have removed their accounts and courses because they have graduated in the meantime). We opted to analyse those courses without the BDP analysis data.

Table 1. Number of activities

Acad. year	H5P	Glossary	Wiki	Quiz	Lesson	Assignment	Chat	Choice	Big Blue Button	Forum	Total
2024/25 total no.	23	1	2	24	1	43	2	5	27	46	174
2024/25 average	1.64	0.07	0.14	1.71	0.07	3.07	0.14	0.36	1.93	3.29	12.43
2023/24 total no.	3	4	0	4	0	11	0	2	5	10	39
2023/24 average	0.6	0.8	0	0.8	0	2.2	0	0.4	1	2	7.8
2022/23 total no.	6	0	2	33	14	52	1	10	48	34	200
2022/23 average	0.33	0.00	0.11	1.83	0.78	2.89	0.06	0.56	2.67	1.89	11.11
Total	**32**	**5**	**4**	**61**	**15**	**106**	**3**	**17**	**80**	**90**	**413**
Average	**0.86**	**0.14**	**0.11**	**1.65**	**0.41**	**2.86**	**0.08**	**0.46**	**2.16**	**2.43**	**11.16**

We can observe that, when analyzed on an annual basis (Table 3), there was an overall decrease in the percentage of activities from ac. year 2022/2023 to ac. year 2024/25 of 5.48% (49.75% to 44.27%). The largest drop in activity was in video lecture participation (BigBlueButton activity) from 48 to 27, which can also contribute to students' experience during emergency remote teaching from 2020 to early 2022 and the need at that time to record all the lectures and classes (in the actual educational context they were in) which they have mirrored in their design process and decisions on what type of activities are most suitable for their intended course. There was also a decrease in the number of lesson activities from 14 to just 1, but this student choice can be partly explained by a similar increase in the number of H5P interactive activities. There was a notable increase in the number of forum activities, from 34 to 46, mainly used not as a discussion tool but as an open assignment grading solution, providing all the course participants with insight into grading practices and feedback given to their peers.

Table 2 shows the resource totals and percentage ratios for these courses. While the percentage of activities decreased as stated before, there was an overall increase in the percentage of resources from ac. year 2022/23 to ac. year 2024/25 of 5.48% (50.25% to 55.73%). As shown in Table 3, the resource type with the largest number increase was text and media area (former label resource) from 38 to 67 (mainly used to explain to course participants what is expected of them in a certain section, even before they open the activities in question). There was also a moderate increase in the number of file resources, mainly at the expense of link resources (files

were uploaded to the LMS directly, not linked as an external resource). Decreases in numbers were notable for link (73 to 62), book (8 to 1), and page (42 to 35) resources. When compared for all courses, the percentage of resources versus activities stands at 52.91% vs. 48.38% and can be considered somewhat balanced, but given that some of the subject matters / topics covered by the future teachers were best covered with offline activities or a smaller number of more complex activities, we can say that those courses are using the technology to support underlying pedagogical models and goals that pre-service teachers have used to develop them.

Table 2. Number of resources

Acad. year	File	Map	Link	Book	Page	Text & media area	Total
2024/25 total no.	53	1	62	1	35	67	**219**
2024/25 average	3.79	0.07	4.43	0.07	2.50	4.79	**15.64**
2023/24 total no.	25	0	12	0	1	5	**43**
2023/24 average	5	0	2.4	0	0.2	1	**8.6**
2022/23 total no.	40	1	73	8	42	38	**202**
2022/23 average	2.22	0.06	4.06	0.44	2.33	2.11	**11.22**
Total	**118**	**2**	**147**	**9**	**78**	**110**	**464**
Average	**3.19**	**0.05**	**3.97**	**0.24**	**2.11**	**2.97**	**12.54**

Table 3. Total number of resources and activities, workload

Acad. year	Resources	Activities	Total res. and activities	Resource %	Activity %	Workload in hours
2024/25 average	15.64	12.43	28.07	55.73	44.27	24.89
2023/24 average	8.6	7.8	16.4	52.44	47.56	16.76
2022/23 average	11.22	11.11	22.33	50.25	49.75	-
Average	**12.54**	**11.16**	**23.70**	**52.91**	**48.38**	**20.83**

In their draft plans for course development, they stated their intended audience, and out of 37 courses, 23 were developed for higher education level, five for middle and three for elementary school, and six for life-long learning programs. The increased number of planned and created activities closely followed the complexity or higher level of education. Given all the plans,

workload, and topics, as well as the ratio of activities that could be used or delivered offline, it can be observed that future teachers have taken into consideration both the pedagogical needs of their intended audience while respecting their inevitable socio-economic state and educational context at present. It is also evident that there is present fatigue among students for using and designing fully online courses without explicit need or benefit, especially when it comes to the number of recorded video lectures they have planned in 2022/23 vs. 2024/25. While they all agree during the discussions on video-recorded lectures that those recordings have great impact and value when it comes to studying and revisiting some topics, when it comes to planning their own courses, they tend to record fewer video lecture activities than their colleagues a few years ago, as shown in the tables before.

5. Conclusion

The evaluation of the EEE course and the students' course outputs demonstrates the effectiveness of an active, design-based methodology in building digital pedagogical competence among pre-service teachers. Qualitative reflections highlighted that exposure to structured course planning frameworks improved students' attitudes toward the use of digital teaching tools, emphasizing greater confidence and intentionality in course design. These findings show that structured teacher education programs positively impact future educators' readiness to integrate technology into pedagogy. In summary, a balanced learning design approach that combines Laurillard's conversational framework, recognition of different learning types, and student-centered and active learning methodologies can enhance teaching and learning experiences in both physical and digital environments. However, findings indicate that systematic training in workload estimation, course alignment, and meaningful integration of technologies is crucial. Curricular reforms should therefore emphasize not just digital literacy, but also pedagogical strategies for e-learning, course design analytics, and evidence-based refinement of teaching practices. By doing so, we can ensure that future teachers are equipped to navigate the challenges and opportunities of the digital world, while delivering high-quality, context-sensitive education. Ultimately, integrating structured design methodologies in pre-service training can enhance future teachers' adaptability, technological confidence, and alignment of pedagogical goals with digital learning environments.

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