Book of Abstracts

Mini-Symposium on Use of Digital Technology in Teaching

12-13 July 2024, Split, Croatia

organised as an associated event to the CEEPUS Network SI-1312
Summer School in Split, Croatia (7-13 July 2024)

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Introduction

Digitalization has revolutionized the landscape of education, particularly in the realm of online courses and international collaboration. The integration of digital technologies into education systems has not only enhanced the accessibility and quality of learning but also fostered global connections among students and teachers.

One of the most significant advantages of digitalization in education is the increased accessibility it offers. Online courses break down geographical barriers, allowing students from different parts of the world to access high-quality education without the need to relocate. Digital platforms enable learners to access course materials, participate in discussions, and complete assignments at their own pace, making education more inclusive and adaptable to diverse needs. We can say that digital tools and resources have transformed the way knowledge is delivered.

Digitalization has also played a crucial role in fostering international collaboration in education. Virtual exchange programs and online collaborative projects enable students and teachers from different countries to work together, share ideas, and learn from each other. This cross-cultural interaction enriches the educational experience, broadening perspectives and promoting global citizenship. For instance, students can participate in joint research projects, attend virtual guest lectures from international experts, and engage in cultural exchange activities, all facilitated by digital platforms.

Digitalization supports the exchange of teachers and students by providing platforms for virtual mobility. Teachers can conduct online classes for students in different countries, bringing diverse teaching methods and perspectives into the classroom. Similarly, students can enroll in courses offered by foreign institutions without leaving their home country. This virtual exchange not only enhances the quality of education but also prepares students for a globalized workforce by exposing them to different cultures and educational systems.

While digitalization offers numerous benefits, it also presents challenges that need to be addressed. Ensuring equitable access to digital resources is crucial to avoid widening the digital divide. Institutions must invest in reliable internet infrastructure and provide necessary training for both teachers and students to effectively use digital tools. Additionally, maintaining academic integrity in online courses and protecting the privacy and security of users are essential considerations.

With this in mind, we, the teachers participating in the CEEPUS Network SI-1312 Summer School in Split in July 2024, have decided to organize a mini-symposium on the use of digital technologies in teaching in parallel with the Summer School in order to share our knowledge and experience regarding online teaching, which is essential in modern international education.

Janez Cerar, Coordinator of the CEEPUS Network SI-1312 Split, July 2024

Digitalization Journey at University of Novi Sad, Faculty of Technology Novi Sad, Serbia

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University of Novi Sad, Serbia is composed of 14 faculties and 3 research institutes. Each of the university members is a separate legal entity, while the University (the rectorate) is also a separate legal entity. Therefore, each of the members has its own budget and is, among other things, responsible for developing its own digital infrastructure (student service software, software for finances, specialized research software etc.). Only basic digital infrastructure (communication lines, ICT hub etc.) is owned, developed and maintained by the University itself, and is shared with the University members. Center for Information Technologies (CIT) is an organization unit of the University responsible for the shared ICT infrastructure. CIT provides some digital services to University members. In pre-corona times this was, more or less, just the University webmail, while in recent years there are more centralized and shared digital service such as cloud storage and repositorium, some software licenses e.g. Microsoft 365 online and MATLAB [1], and open access education platform Moodle [2].

Faculty of Technology Novi Sad is one of the smallest faculties at the University in terms of number of students with limited budget for developing its own digital infrastructure. At the same time there is an urgent need to digitalize as much as possible administration processes as well as educational and research processes. Thus, there is an ever-increasing need for using specialized software in all areas of the Faculty's activities, and consequently the costs of using licensed software increases exponentially year after year. The lack of competent and qualified ICT personnel is also an issue. Centralization of all major digital technologies/services at the University level is seen as a logical and cost-effective solution to these issues. Thus, it is hoped that we will see in near future a dynamic increase in centralization of digital infrastructure at the University level.

Keywords: ICT, MATLAB, Moodle.

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Challenges in Digitalization Process at University of Tuzla

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University of Tuzla is second largest public university in Bosnia and Herzegovina. It is integrated university, consisted of 12 faculties and Academy of Dramatic Arts. Considering the integrated status of University and its organizational scheme, process of digitalization is also carried out at university level, through development of its digital infrastructure and budget planning for equipment and all procedures related to digitalization. University units (faculties and academy) are secondary users in this scheme, where equipment and its maintenance is provided by University and shared among all units.

However, digitalization process at University of Tuzla started relatively late, compared to universities in region, and it was mainly induced by global pandemic situation, although in previous period, some study programs already used online educational platforms (e.g. at Faculty of sport). Also, the repository of the University of Tuzla has existed since 2014.

The global pandemic imposed requirements for expanding the use of digital educational tools at other university units as well. During this period, some challenges arose. Proper theoretical and practical support for both, teachers and students, regarding online teaching, learning, and assessment methods, was expected from University. The main challenge was the acquisition of modern equipment, given the financial limitations of the University's budget.

In fact, international projects funded by the European Union have become the main source of funding for digitalization. Currently, the University of Tuzla is implementing an ERASMUS project entitled: "Strengthening capacities and digital competences in biomedical education through internationalization at home (BIOSINT)", whose main goal is to improve education and development of students of biomedical sciences, as well as teachers and administrative staff at University. The intention is to strengthen digital capacities, literacy and competencies as well as intercultural skills and attitudes at individual and institutional levels. The most valuable results are expected to be reflected through improvements in the digital literacy of teachers and students, cultural competences and readiness for future work in global health within the era of the "new normal" of the digital society during and after the COVID-19 pandemic. A special focus is placed on the activities of the students, in order to achieve the long-term effects of the project. So far, audio-visual equipment for digital teaching has already been created and successfully implemented.

The project has the ambition to permanently increase the capacity of the higher education institutions of the World Bank's partners, as well as the professionalism and competences for management according to internationalization at home and integrated virtual strategies of biomedical education.

Athough online teaching was used with more or less success during the lockdown, with the application of a unique university platform, no significant progress was made after that period.

Center for information technologies was only recently established at the University, with educated staff and modern equipment necessary to serve most university units (faculties).

Keywords: digitalization, educational platforms, virtual strategies for education.

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Experiences with the Potential of Digitalization in Contemporary Higher Education

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We begin by defining digitalization, a term widely discussed in academic and professional circles. Digitalization refers to the integration of digital technologies into everyday life through the digitization of everything that can be converted into digital form. Etymologically, the term originates from the Latin word "digitus," meaning "finger" or "toe." This is also the root of the English word "digit," which refers to numbers, as fingers were often used for counting, and can also refer to fingers or toes in certain contexts. In the realm of technology, digitalization involves converting continuous analog signals into discrete digital signals that computers can process and store.

Today, nearly all available information is digitized and stored on computers. Digitalization is pervasive in academia, industry, and education. Its importance in education became particularly evident during the COVID-19 pandemic, as it enabled the continuation of education without in-person contact.

Since then, it has become clear that digital skills are essential in nearly every sector, particularly in industry, academia and education. Numerous programs now focus on the development and implementation of digitalization in higher education. One such initiative is the "Engaged and Entrepreneurial European University as Driver for European Smart and Sustainable Regions" (E^3UDRES^2) project, one of 50 European University Alliances launched by the European Commission. This project signifies excellence in higher education and focuses on co-innovating smart and sustainable European regions, co-ideating a future university, and co-creating a European multi-university campus.

As part of these efforts, education is delivered through various innovative methods, including the "I Living Lab" (ILL) concept. ILLs are specialized course units where teams of students – referred to as learners – from different universities collaborate on solving complex problems presented by industrial stakeholders, under the guidance of teachers known as Educational Entrepreneurs (EEs). The "I" in I Living Lab represents the core values of this educational model: Inspiring, innovative, intercultural, international, interdisciplinary, intersectoral, inclusive, and intense.

In this project-based learning model, digital skills are extensively utilized and enhanced by all participants, including learners, EEs, and industrial stakeholders. ILLs have been successfully implemented in three formats: Classic, Blended, and Intense ILLs. In Classic ILLs, learners do not meet in person but collaborate through digital communication platforms such as Teams,

Skype, and Zoom. In Blended ILLs, they initially engage online and later meet in person after several virtual sessions. In Intense ILLs, learners travel to a common location to collaborate in person, yet they continue to rely on digital tools to work on their projects.

The outcomes of these ILLs often involve digital solutions to the challenges posed by industrial stakeholders, typically utilizing websites, mobile applications, and sometimes leveraging artificial intelligence.

In conclusion, digitalization is indispensable in modern education, both for capturing the interest of new-generation learners and for meeting the demands of future challenges.

Keywords: artificial intelligence, digital skills, Educational Entrepreneurs, I Living Lab

From Online Learning to Virtual Tours: The Role of Digitalization at the Faculty of Sciences

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Moodle has been in use at the Faculty of Sciences in Novi Sad since 2004. Initially, it was introduced as a support tool for regular teaching at the Department of Mathematics and Informatics, primarily for subjects in the field of informatics. It quickly proved to be an indispensable tool in everyday practice and became irreplaceable in complementing traditional teaching methods. Today, the faculty's Moodle installation is available to all professors, associates, and students across all departments. It supports online components of the curriculum, facilitates communication, simplifies the distribution and downloading of educational materials in electronic form, and aids in the organization of teaching activities, including various knowledge assessments.

During the COVID-19 pandemic, the role of Moodle, along with other digital tools, became even more prominent. As physical classrooms were no longer accessible, Moodle was utilized extensively to maintain the continuity of education. It allowed professors to upload lecture materials, assignments, and quizzes, ensuring that students had access to all necessary resources remotely. Surveys have shown that students found Moodle to be highly user-friendly, with most praising the speed and efficiency of online assessments and the ease of accessing course materials. The platform’s discussion forums and messaging systems enabled seamless communication between students and teachers, fostering an interactive learning environment despite the distance [1].

In combination with other platforms like Microsoft Teams and Google Classroom, Moodle became a central hub for organizing virtual classes and assessments. The faculty's prior experience with Moodle, dating back years before the pandemic, gave them an advantage in quickly adapting to fully remote learning. This early adoption meant that both students and staff were already familiar with the system, allowing for a smooth transition when in-person teaching became impossible.

Moreover, digitalization during the pandemic not only supported education but also enabled active promotion of the faculty through virtual tours, which played a significant role in marketing efforts and attracting new students. These virtual events allowed prospective students to explore the faculty’s facilities and academic programs, further strengthening the faculty's outreach and visibility during a critical period [2].

The faculty's long-standing investment in digitalization ensured that the academic community could navigate the challenges of the pandemic effectively. What began as a tool for supporting informatics courses has evolved into a comprehensive digital platform that now enhances the learning experience across all departments. The flexibility, ease of access, and continuous support provided by Moodle have proven crucial in maintaining academic standards and providing a high-quality education, even under extraordinary circumstances. This transformation has had lasting benefits, with many aspects of digital learning now becoming permanent fixtures in the faculty's teaching strategy, including hybrid learning, online assessments, and digital resource management.

Keywords: digitalization, Moodle, COVID, virtual learning, promotion

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Essential Tools and Techniques for Online Teaching at UJEP

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At Jan Evangelista Purkyně University in Ústí nad Labem (UJEP), several tools are employed to facilitate online education. The COVID-19 pandemic significantly accelerated the development of these tools and addressed many challenges associated with online learning.

The first tool for communication with students is the IS STAG system [1]. This system is primarily used for creating class schedules, assigning final projects, and approving new thesis topics. It also allows for mass emailing students. Due to GDPR regulations, access to sensitive data is limited, making it essential to handle such information properly. IS STAG ensures efficient and organized communication between faculty and students while maintaining data security.

Another essential e-learning tool at the Faculty of Science at UJEP is Moodle [2]. Moodle is an open-source learning management system that operates on a modular basis. It is used to create course pages where students can find all the information regarding exam requirements, learning materials, recordings of online lectures, sample tests, and test evaluations. Moodle also enables the creation of online tests that are automatically graded, streamlining the assessment process for both students and instructors.

For conducting online classes, the faculty uses Big Blue Button (BBB) [3]. This program runs on UJEP's servers and can accommodate up to 200 students in a single session. BBB allows instructors to upload their presentations and provides a virtual whiteboard for interactive teaching. Additionally, it supports screen sharing and can record entire lectures, granting students access to these recordings for later review.

All staff and students have access to the university's Google Workspace (G Suite) [4], which offers nearly unlimited space for uploading data and educational materials. G Suite also includes virtual meeting rooms for conducting online classes. This suite of tools enhances collaboration and ensures that all participants have the necessary resources for effective online learning.

The integration of these tools at UJEP has revolutionized the way education is delivered, ensuring that learning continues seamlessly despite the challenges posed by the pandemic. The rapid development and implementation of these online education tools have not only addressed immediate needs but also paved the way for future innovations in teaching and learning.

The IS STAG system has been instrumental in maintaining structured communication and managing academic administration efficiently. By automating and streamlining processes, it has allowed faculty to focus more on teaching and less on administrative tasks.[1]

Moodle's versatility and comprehensive features have made it an indispensable platform for both students and instructors. It has provided a centralized location for all course-related activities, facilitating a more organized and efficient learning experience. The ability to automatically grade tests has saved valuable time for instructors, allowing them to provide more timely feedback to students.[2]

BBB has enhanced the interactive element of online classes, making them more engaging and accessible. The ability to record lectures ensures that students can revisit the material at their convenience, supporting diverse learning styles and schedules.[3]

The G Suite's vast storage capabilities and collaborative tools have further supported the transition to online learning. By providing a reliable and robust platform for communication and collaboration, it has ensured that the university community remains connected and productive.[4]

In conclusion, the adoption of these online education tools at UJEP has not only addressed the immediate challenges of the pandemic but also set the stage for a more flexible and resilient educational framework. As the university continues to innovate and adapt, these tools will undoubtedly play a crucial role in shaping the future of education at UJEP.

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Online Teaching with ILIAS

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The COVID-19 pandemic catalysed a rapid shift toward digitalization, making online tools essential across numerous sectors—from education and collaboration to healthcare and management. In response to the urgent need for remote solutions, educational institutions worldwide adopted or adapted digital platforms to support effective teaching. This lecture shares insights from my experience with online teaching at the University of Stuttgart during the pandemic, where we utilised ILIAS (Integriertes Lern-, Informations- und Arbeitskooperations-System; German for Integrated Learning, Information and Work Cooperation System), a comprehensive learning management system that originated in Germany [1]. Though the ILIAS platform was conceived in the late 1990s, with the first version released in 1998, its adaptability has allowed it to remain relevant and robust. Since becoming open-source in 2000, ILIAS has undergone significant updates, most recently gaining prominence across German universities as COVID-19 accelerated its widespread adoption. In this presentation, I will describe key milestones in ILIAS's development, outline its main features, and provide practical insights on its effectiveness in a real-world teaching environment based on my experience at Stuttgart University.

Keywords: online teaching, ILIAS.

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Teaching and Learning using MS Teams at Faculty during COVID-19

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The COVID-19 pandemic significantly disrupted traditional teaching methods, prompting educational institutions to shift rapidly to online learning platforms. Microsoft Teams emerged as one of the key tools for facilitating remote teaching and learning in higher education during this period. This platform provided a central hub for communication, collaboration, and resource sharing, allowing educators and students to interact effectively in a virtual environment.[1]

Adoption of Microsoft Teams: - Microsoft Teams became an essential tool for Faculty in response to the COVID-19 crisis; - It offered a user-friendly interface that integrated video conferencing, chat, file sharing, and collaboration on documents, which were crucial for maintaining continuity in education during lockdowns. Enhancing Communication: - Teams facilitated real-time communication through features like chat and meetings, enabling professors and students to stay connected even when face to face interaction was not possible; - Faculty members used Teams to conduct lectures and provide feedback on assignments and projects. Collaboration and Engagement: - Teams supported group work and collaboration through shared spaces, allowing students to collaborate on projects, engage in discussions, and access learning materials in an organized way;

- Educators used breakout rooms during live sessions for small group discussions, fostering interactive learning. Access to Resources and Materials: - Teams allowed teachers to upload lectures, course materials, readings, and assignments, making them easily accessible to students;

- It supported asynchronous learning, enabling students to access course content at their own pace and convenience. Challenges and Limitations: - Despite its advantages, the shift to online learning using Microsoft Teams posed challenges such as technological issues, lack of digital literacy among students and faculty, and access to reliable internet; - Some students struggled with the absence of face-to-face interaction, which affected their motivation and engagement.

Impact on Pedagogical Practices: - The transition to online learning prompted teachers to adopt new teaching methods, such as flipped classrooms, synchronous and asynchronous learning blends, and digital assessments; - Faculty had to quickly adapt their pedagogical approaches to suit the virtual environment, leveraging Teams' features like polls, quizzes, and collaborative documents.

Student Experience and Learning Outcomes: - While some students thrived in the digital environment, others faced challenges related to isolation, lack of direct support, and difficulty staying focused in remote settings; - The effectiveness of online learning varied depending on factors such as course design, student engagement, and access to technology.

The use of Microsoft Teams in higher education during the COVID-19 pandemic highlighted both the potential and challenges of online learning. While the platform enabled continued

education during a time of crisis, it also revealed the need for ongoing improvements in digital infrastructure, teacher training, and student support to ensure the effectiveness of virtual learning environments in the future.

Keywords: Teaching, MS Teams, Faculty, COVID-19

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Adjusting to Virtual Classrooms: Transforming Education

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The Digitalisation of Teaching and Learning initiative is designed to debunk myths and misconceptions by demonstrating how digitalisation in education can lead to efficient learning and teaching with minimal effort from both students and teachers. It is based on the assumption that only buy-in from relevant stakeholders, specifically teachers and students, can make the digitalisation of teaching and learning happen in a meaningful way. Digital platforms (Moodle, Zoom, Microsoft teams, SOVA) have are nowadays adopted as interface between students and teachers, also in cases when they are physically separated. As the pandemic unfolded, Moodle's and SOVA's role expanded in pedagogical work.

As Assistant Professor at the Faculty of Medicine, University of Novi Sad, we use the online platform SOVA [1] E-learning *platform* of the University of Novi Sad (UNS). For this purpose, we recorded experimental exercises, every experimental step, for example: weighing on a scale, filling a measuring vessel to the correct volume, making a solution and calculating for making a solution. Then, compound syntheses, mathematical statements and physically demonstrated each step in those chemical processes. It was simultaneously explained by sound (previously I have recorded my voice during explaining the chemical process), than in text-box with belonging text explanations. For making chemical reactions and chemical structures was used ChemSkech program, then a TubeCatcher (as screen capture program) to show reaction on the screen in live in the framework of the Wondershare Filmora program. These were tools used for the introduction of virtual and augmented reality in the implementation of first-level studies at the Department of Chemistry, Biochemistry and Environmental Protection at PMF Novi Sad and Faculty of Medicine, which, among other things, provides for the training of teachers for the creation of electronic teaching materials.

Moving forward, it becomes increasingly evident that continuous professional growth for teachers will be crucial. Educators must continually adapt to new technologies and innovative teaching methods to stay effective. Concurrently, development of digital skills of students is essential. Equipping learners with the necessary digital literacy will empower them to navigate and excel in a tech-driven world.

Given proper support, technological advance can transform education into a system that is more adaptable, inclusive, and efficient, reaching well beyond the limitations imposed by the global events that restrict human mobility and interactions. By harnessing digital tools, educational institutions can offer personalized learning experiences that cater to diverse student needs. This flexibility allows for remote and hybrid learning models, ensuring that education remains accessible to all.[2] Furthermore, the inclusivity fostered by technology bridges gaps for

students with disabilities and those from underserved communities, providing equal opportunities for all.

In conclusion, the future of education lies in the seamless integration of digital technology. By prioritizing professional growth for teachers and enhancing digital skills for students, we can create an educational ecosystem that is resilient, adaptive, and forward-thinking. With adequate support and dedication, technology can reshape education into a system that is more adaptable, inclusive, and efficient, surpassing the immediate challenges of the pandemic.

Keywords: digitalization, online platform, SOVA.

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Digitalization in Chemistry Teaching Process

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In chemistry teaching process, conventional approach which includes lectures and practical laboratory experiments, has become obsolete in recent years. As education is rapidly entering the digital age, numerous challenges are also emerging in the area of the digitalization process in the teaching of chemistry.

The introduction of a digital learning environment requires adequate education of teaching staff and students in terms of guiding and monitoring the learning process. Teachers use their creative skills to effectively provide lectures to students on various online educational platforms. In order to create a digital learning environment [1], modern teaching and assessment techniques are necessary.

Among the first few approaches, "ComputerAssisted Instruction," "virtual experiments," or "modeling-based learning" were applied in the early 1990s [2]. Teaching chemistry digitally has the potential to bring greater equity to the field of chemistry education and foster access to high quality learning [3]. It is not enough to only integrate digital technologies into the teaching process, but emphasize the role of the teacher in creating the right conditions by selecting appropriate technologies and designing learning activities [4].

The global pandemic has especially forced the use of digital educational tools even in areas where they were not previously established. From this period, effective and state-of-the-art sharing practices have been collected, especially those that have been recently developed [3]. They add fresh perspectives and characteristics related to this kind of learning, both in a student-centred and a teacher-centred approach. It turned out that special focus should be given to practical and methodical aspects in the application of visualization and technologies in the teaching of chemistry. The connection between assessment and online learning environments in the context of teacher training should be subjected to more research.

Overall, digital media are not only crucial for the challenges of today's digital world, they can also contribute to increasing the learning success, as numerous studies demonstrated [5-7].

Keywords: digitalization, chemistry teaching, digital learning environment

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Experiences of Online Classes during Corona and Beyond

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The COVID-19 pandemic disrupted lives across the globe. As a PhD candidate engaged in teaching graduate and postgraduate students in a college, I witnessed first-hand transition to online teaching and learning. When the world stood still, education needed to persist, powered by hope and resilience. The online education was already popularizing in India as technology was affecting all spheres of life.[1] Thus, to ensure continuity, Indian education system rapidly adopted various online teaching tools such as Classroom PC, projectors, internet connectivity and adopted platforms such as Zoom, Google meet, Microsoft teams and You tube. However, it is estimated that only 27.8 % students had access to digital devices in the initial phase which improved with each passing day.

Traditional lectures gave way to Powerpoint presentations, live-streamed classes, pre-recorded educational videos on You tube helped students to cope up with their curriculum. While these tools provided a lifeline, they also posed challenges. One key issue was the plathora of online content available to students, which led many to place greater trust in You tube videos than in their own teachers. This undermined the teacher student relationship and created barriers to effective communication. Additionally, the assessment process faced significant hurdles. In India offline exams are generally held after end of each semester. However, in the online mode, waiting six months for the proper evaluation of the students may be risky. Thus, it become important to track student's progress using more innovative approaches such as concept-based cross-questioning during lectures, time bound multiple choice questions, open book assignments and oral examinations. However, asking questions to 40 students in 45-minute class in impractical, thus a random picking is used to keep students attentive all the time. It is also felt that instead to privileging the capacities of teachers and natural curiosity of students, digitalization has reduced the teacher to a mere conduit of information. In science experiments are as important as theoretical knowledge, thus Virtual labs, such as those hosted on platforms like www.vlab.co.in , also emerged as essential tools for simulating hands-on learning experience.

Beyond the pandemic, the legacy of online education continues to shape India's education landscape. In a vast country, where a group of people may live hundreds of miles from any school, online learning offers a cost-effective solution to reaching remote areas, where building schools and hiring teachers is challenging. A single smartphone, equipped with internet access, can bring education to marginalized communities. Consequently, the adoption of online education has surged after corona, complementing traditional systems and democratizing access to knowledge.[2] As offline teaching resumed in schools and universities post-

pandemic, educators retained digital tools integrating audio-visual aids into their pedagogical toolkit. Thus, teachers also find themselves in a new role in which they also learning new skills.

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Adapting to Digital Classrooms: The Shift in Teaching and Learning

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The integration of digital technology has significantly transformed education, particularly in distance learning. A key shift is the growing independence of students, who now engage in lessons and collaborate with peers without the need for physical classrooms. Digital platforms have facilitated continuous communication between students and teachers, even when physically apart.

However, the transition to digital learning has also presented challenges. Students frequently face unreliable internet access or lack of adequate devices, disrupting their learning experience. As a teaching assistant, I have observed that adapting to online platforms requires students to develop new digital literacy skills. Providing guidance to help them navigate these platforms and practice responsible digital behavior has been an essential part of my role.

The COVID-19 pandemic accelerated the need for digital transformation. In Serbia, the digitalization of education had already been a strategic priority for several years [1], and my institution had begun adopting digital tools before the pandemic. We primarily used the Moodle platform [2], which allowed us to share materials and make announcements. However, as the pandemic unfolded, Moodle's role expanded to online consultations, assessments, and grading, making it a vital tool for maintaining the continuity of education.

In addition to Moodle, we introduced Microsoft Teams [3], which became critical for managing lessons, tracking student progress, and facilitating professional collaboration among colleagues. Initially, Teams was unfamiliar to both teachers and students. From my experience, students adapted more quickly, likely due to their familiarity with digital environments, whereas many teachers needed more time and training to feel comfortable using the platform.

Looking ahead, it is clear that the integration of digital technology has reshaped teaching and learning. While the pandemic hastened this transformation, it also exposed gaps in digital literacy, particularly among educators. Moving forward, ongoing professional development for teachers and digital skill-building for students will be crucial. With the right support, technology can make education more flexible, inclusive, and effective, beyond the pandemic.

Keywords: online platform, Moodle, Microsoft Teams.

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Teaching Online

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Online communication tools have well existed before the Covid-19 era and have continuously evolved over the last decades since the beginning of the public internet. Their development in features and capabilities has closely followed that of faster internet connections that are necessary for reliable and efficient data transmissions, such as audio, video, text, etc. Before the Covid-19 pandemics, these technologies have mainly been part of the communication routine during meetings when the physical presence of interlocutors has not been possible, which generally points to a certain degree of resistance to using online communication tools in the everyday academic routine. This is further confirmed by the fact that very few institutions offering courses had embraced integrated online teaching platforms before the Covid-19 pandemics. However, certain institutions have always recognised the benefits of adopting new online teaching technologies that offer features beyond communication, for example, support for the whole range of activities around teaching, such as organising the exams, marking, etc., or simply enhancing the experience of teachers and students with new online features for teaching. While adopting online teaching platforms has not been urgent in the past, the health risks associated with the Covid-19 pandemics and the strict lockdown rules imposed by governments rendered the use of such platforms indispensable. This situation resulted in the acceleration of the development of more sophisticated online course platforms, both commercial and free ones [1].

While the organisation of online teaching activities for undergraduate courses requires the integration of most of the activities associated with the process on an online platform, the situation can be less complicated in the case of lectures for doctoral students in the form of seminars, where exams may not be necessary, or courses about programming and theoretical lectures that do not require work and demonstrations in the labs. In this case, teaching activities can simply boil down to using audio, video, chat, and screen sharing. Although technical challenges are limited in this case, the issues emerging from the use of digital technologies in teaching are far more complicated involving human social aspects. The interaction with the audience, which is fundamental in teaching activities, then becomes itself a clear challenge. Some persons in the audience forget or are not willing to switch on their cameras, others are not listening, have technical problems, do parallel tasks, for example, check emails and do other irrelevant to the course online activities, etc. Marking and supervising exams can also be a challenge, while at the same time using online platforms directly translates into a higher energy consumption for both data centres and the users. Despite the challenges there are certain benefits of using online platforms, especially in situations where there is lack of physical space resources or the physical presence of participants is not possible. Currently, well beyond the

Covid-19 era, classes seem to get back to the traditional teaching modes, but at the same time the online infrastructure seems to offer benefits and is used when this is necessary. Hence, a balanced and mature approach to teaching tailored to the needs of students and teachers can be followed supported by the existence of integrated online teaching platforms and further developments in technologies such as virtual reality and artificial intelligence are expected to further enhance the teaching experience in the coming years.

Keywords: Online teaching and platforms, Doctoral students, Social aspects

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Online Teaching and Virtual Mobilities in the Frame of the CEEPUS Program

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CEEPUS (abbreviation for Central European Exchange Program for University Studies) is a multilateral University exchange program in the extended Danube region based on an international Agreement.[1] There are 15 member states that are participating in the program. The main activity of CEEPUS are networks of eligible universities of the CEEPUS member states. Within these networks CEEPUS covers mobility grants for students and teachers at those eligible universities. Since 1995 approximate 82,000 mobility applications have been awarded in the framework of CEEPUS.

Until the year 2020, no virtual mobilities were foreseen in the CEEPUS program. However, due to the outbreak of COVID 19 pandemic, physical mobilities were for certain period of time not possible and the need for virtual mobilities appeared.[2] Therefore, CEEPUS introduced the option for virtual mobilities that include primarily online lectures, but also coordination meetings and similar activities. In December 2020, the Senior Officials – representing the responsible ministries – of the CEEPUS member states unanimously voted to enable the temporary implementation of CEEPUS grants for virtual exchange during the COVID-19 crisis. At the Faculty of Science, University of Zagreb in that period we had several incoming virtual mobilities. The experience is rather positive. The teachers that were giving online lectures (Prof. Jaroslav Katona, University of Novi Sad and Prof. Delina Xhafaj, Albanian University) used the Microsoft Teams platform. The response of students was affirmative and the teachers were satisfied with student activities. Although the pandemic is now over, in several participating countries (e.g. Croatia, Poland, Hungary) virtual or hybrid mobilities are still possible and, in our opinion, it is also a favourable option for increasing the activities in the frame of the CEEPUS network, especially in the case of high, and in many countries not covered, travel costs.[3]

Keywords: virtual mobility, online teaching, CEEPUS program

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Online Exams in Courses Requiring Calculations: Benefits, Obstacles, and Concerns

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Outbreak of COVID-19 pandemic has drastically influenced the educational systems, their habits and practises.[1] While frontally given lectures were rather easily replaced by on-line lectures, one of main concerns was soon carrying out exams in circumstances that would realistically reflect student's knowledge.[2] If the oral exams are left aside, then for exams requiring calculations the simplest approach is to carry out traditional paper-and-pencil exams remotely, using computers just as holders of cameras and microphones that allow invigilation, while e.g. exams are later scanned by students and sent to teachers for assessment. Nevertheless, manual grading of this kind of exams is time-consuming already in case of exams taken in the class while such online exams even further increase time burden of evaluation of such exams, while at the same time a risk of cheating is usually increased when compared to exams taken in classrooms. The positive side for students is, that they are familiar with this type of exams and that such exams allow to use all the type of questions that can be given also in classic exams requiring calculations.

A more advanced use of virtual learning environments (VLEs) can only be considered when VLEs are not only used to present tasks to students on the computer screen, but when students can also enter the numerical results of calculations into the VLE, and the results of which are then analysed by the computer. The simplest version of such a use of VLE is to give all students the same task with the same numerical inputs, and the students' results can then be automatically compared with the teacher's result. Whilst the marking of such exams is instantaneous and requires no additional effort on the part of the teacher, this type of exam requires fairly close supervision to ensure that results are

not shared between students (either via the internet or over the phone), nor can it be ruled out that other people may be in the vicinity of a student taking the exam to help the student. Therefore, in such cases, it is better to monitor the students visually (and acoustically) while preventing unauthorised connection of the students' computers to the Internet. Of course, it is still advisable to instruct the students to scan the papers on which they have performed their calculations and send them to the teacher so that, in case of doubt about the results obtained regularly, the calculations performed by the students are available to dispel any doubts about possible cheating. In the event that the teacher wishes to avoid an all-or-nothing approach (no points for an incorrect result and all points for a correct result) when assessing the task in order to judge how far a student has come in solving the task (even if the final result was not correct), scanned copies of the papers can also be used for such an assessment. On the other hand, such partially solved tasks can often also be recognised by dividing the task into smaller subtasks,

with successfully solved subtasks then being rewarded. However, even such a division of tasks cannot always replace the classic paper-and-pencil tests, even if partially solved tasks are rewarded.

Nevertheless, the task with the same values of numerical inputs for all students still harbours a considerable risk of cheating if there is no very strict invigilation and control of the scanned papers. All these measures are again a burden for the teachers and the strict control could also lead to some students feeling stressed. A partial solution in this case could be the implementation of a VLE that allows for more complex preparation of tasks that require calculations. Using scripts, it is indeed possible to use the same text for the task but randomise the numerical inputs required for the calculation. Care should of course be taken to restrict the range of values for the numerical inputs, not only to prevent the tasks from becoming numerically unsolvable, but also to avoid arriving at results that may not be physically realistic and leaving students who have received such randomised inputs in a situation where they wonder whether they have solved the task correctly. As for the need for invigilation in such online exams, it can be assumed that a lower level of supervision is required, as the more able students who are the first to arrive at the correct results in case of cheating do not have to communicate to others the correct numerical value (which could easily be communicated), but the correct formula with the description of the unknowns and/or the parameters included in the formula. In addition, this approach is also more difficult for students who want to take advantage of such a cheat because they have to decode the formula. The combination of these factors reduces the need to monitor students' electronic communication channels during the exam, although the existence of such channels still enables cheating. Of course, video and audio monitoring of students is necessary in any case to maintain the minimum criteria for legality and compliance with the rules of an examination – similar to classroom exams.

To test our presumptions that in the case of online exams related to physical chemistry and consisting mainly of tasks requiring calculations, one such exam consisting of several tasks was prepared in the Moodle[3] environment where all students were given the same tasks, except that the numerical values for the required inputs to the equations used were randomised for each student (but within a reasonable range of values to avoid unsolvable or physically questionable results). Each student was monitored with a camera and microphone, using no programme that could control electronic communication between the student’s computer and the Internet. The outcome of such an exam has shown that these results (taking into account the grades obtained) are quite comparable to similar exams in classrooms.[4] However, it is not necessary that the comparability of the two types of examinations (online and classroom) in terms of grades obtained should last for long without more rigorous monitoring being introduced, as it is known that students generally adapt quickly to new types of examinations and can quickly develop a strategy for cheating under the circumstances. In fact, there are reports that only very strict monitoring (one person in an isolated and “clean” room, controlled internet connections, “clean” computers, video and audio monitoring, only a minimal number of personal items of the examinee allowed) could completely eliminate the risk of cheating, but such situations are not present in everyday mass online exams at universities.

Keywords: virtual learning environment, Moodle.

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Online Classes During the COVID-19 Pandemic and Beyond

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1. Introduction

The rapid increase in computer power and availability, within a relatively short period of time, has substantially changed our society. The tremendous impact of digital technologies is evident in every aspect of our professional and personal lives. Among other things, it has transformed our communication, particularly the availability and use of information. Equally significant, it has introduced new ways of communication, such as indirect access through digital means.

The digital transformation has a been prioritized as one of the main European policies, as outlined in initiatives like Shaping Europe's Digital Future.[1] Programs such as the Digital Europe Programme (DIGITAL) serve as key components of this strategy and focused on bringing digital technology to businesses, citizens and public administrations. Furthermore, the Digital Education Action Plan (2021-2027) represents a renewed European Union (EU) policy initiative aimed at fostering high-quality, inclusive, and accessible digital education across Europe. This action plan seeks to support Member States in adapting their education and training systems to meet the demands of the digital age.[2]

The COVID-19 pandemic served as a significant catalyst for these initiatives, underscoring the urgent need for digital transformation across various sectors. For instance, the Digital Education Action Plan was adopted on 30 September 2020 in response to the increased demand for greater cooperation at the European level on digital education. Its aim was to address the challenges posed by the pandemic while also presenting opportunities for the education and training community (teachers, students), policy makers, academia and researchers on national, EU and international level.[2]

This paper presents the personal experience of teaching during the pandemic for bachelor's and diploma students of Physics at the Faculty of Science, University of Split, Croatia. It also examines the impact of this experience on today's teaching practices and the use of digital tools.

2. Experience of Online Classes During the COVID-19 Pandemic

The period of restricted measures during the COVID-19 pandemic, which in our country began in March 2020 and ended in July, required a transition from in-person teaching to online classes. These restrictions necessitated working from home and required both teachers and students to quickly adapt to online tools and teaching practices. Approaches at our faculty varied, but the Microsoft Teams application—available to all employees and students as part of the Windows Office package through AAI access on OneDrive—proved to be the most widely used platform for online meetings and sharing teaching materials.

In my personal experience, depending on the type of class, I utilized the Microsoft Teams meeting tool in combination with written or scanned materials for lectures and exercises. Specifically, in Advanced Statistical Physics course, which involves extensive derivations, I shared handwritten derivations with students by scanning and uploading them. Due to time constraints, it was challenging to prepare other types of materials for this course. The lectures typically lasted no more than two hours, with breaks for rest and time allocated for questions and comments after each derivation or introduction of a new concept. Exercises were assigned to students for independent completion and were later reviewed and explained as needed. Although student responses were limited, they rated the overall presentations as very good. However, students expressed a preference for in-person teaching, finding it easier to concentrate in a classroom setting without the potential distractions of home.

During this period, students were required—or had more time and the need—to explore online materials, presentations, and other resources. Initially, this seemed advantageous, as they could choose topics and learn from specific teachers and science communicators on subjects related or unrelated to their university courses. However, as expressed during the discussion, students found it challenging to manage information online for two main reasons. First, the sheer volume of information was overwhelming; second, much of it lacked quality and effective presentation. These factors contributed to survey results from our University for Physics classes, which showed a strong preference among students for direct, in-person teaching.

In addition to teaching during the pandemic, I was involved in another activity initiated by the students. As the head of the diploma program in Biophysics, I maintained close contact with the enrolled students, who comprised a small group. The initiative was to hold weekly online meetings to discuss various topics in biophysics. Students selected the topics, and each student prepared a small presentation. We discussed subjects such as non-equilibrium systems, cellular automata, life on Mars, models of virus spread, and the relevance of data on COVID-19 as presented in the media. These meetings were highly valued by the students, as they provided a form of social gathering, which was greatly missed during the period of strict measures and isolation.

3. Impact of Online Teaching During the COVID-19 Pandemic on Today's Work

The pandemic period presented challenges on multiple levels. On a personal level, it took a toll on individuals, affecting both close relationships and the global community. Difficult personal questions emerged, requiring reflection on issues such as personal freedoms, responsibilities, the impact of imposed isolation, and the absence of social events and gatherings. On a professional level, there was the rapid adaptation to online teaching, examinations, and communication. Although these extreme conditions were challenging and left a lasting impact, here I would like to highlight a few positive influences that emerged from working online during the pandemic. These are not general observations but reflect my personal experiences and opinions.

The pandemic period increased my knowledge on and use of digital tools, including various platforms for online meetings (Microsoft Teams, Zoom, Google Meet) and other resources such as Google Forms and Microsoft Teams Classes. This familiarity with digital tools made

communication with colleagues and collaborators in different cities or abroad much easier, enabling faster collaboration on joint projects and scientific publications. Arranging meetings and discussions became faster and more efficient, with online meetings now regarded as effective spaces for exchanging ideas and "brainstorming", an important part of our work in science. Online meetings also facilitated some administrative gatherings, such as meetings of the society management boards or other committees. Travel to distant cities became a secondary option, used only when necessary. This was particularly important for universities outside Zagreb, allowing for equal participation in important commissions and committees, which were often held in the capital city.

Additionally, it improved and accelerated the development of digital materials for my classes. I had to prepare better online scripts to accompany the lectures. For each course, I introduced an Excel table to help students track essential information related to the classes. This included: Specified literature for each topic; Preparation requirements for class; An outline of lecture topics; Exam questions; and Reflection questions for after the class. This structured approach provided students with a clearer framework for learning and helped them engage more effectively with the course material.

Here are two examples from the courses in Statistical Physics and Biophysics.

Advance Statistical Physics classes

Date	L	S	E	Literature	Before lecture	Lecture topics	Exam question	After lecture
08. 11.	2	0	0	Pathria and Beale 3.1-3.5	Read the literature, do task 2.3	Partition function and thermodynamic quantities in canonical ensemble. Entropy. Chemical potential.	Derive the thermodynamic description of the ideal gas model in the canonical ensemble.	Draw the distribution function and the probability density function in phase space, and the probability density function in energy space for the canonical ensemble.

Biophysics classes

Date	L	S	E	Literature	Before lecture	Lecture topics	Exam question	After lecture
08. 10.	3	0	0	Philips 1,2,3, 4	During the first two weeks read Philips 1,2,3, 4	Organization of courses and general story of biophysics.	Introductory classes examples of the question: What is biophysics? Describe some of the physical models used in biology. Define important theories in biology.	Prepare for the next hour the answer to the question of what would be the most interesting research in biophysics for you today (what would you like to explore). Consider the definition of life, which distinguishes between living and non-living matter.

* L - lectures, S - seminars, E - exercises

4. Conclusion

In simple terms, digitalization in high school education refers to the use of online tools for teaching and assessing students. Online teaching was heavily promoted and its adoption accelerated by necessity during the pandemic, as for a certain period, it was the only way to continue education. This experience advanced our knowledge and use of digital tools, showcasing the immense power of these technologies. It also started many global initiatives aimed at improving the quality of life through digital technologies. Additionally, it motivated significant changes in individual professional approaches to teaching, opening up a wide spectrum of digital tools available and useful for education.

However, it also highlighted an essential aspect: the need for direct, in-person teaching. Experiencing online teaching underscored the importance of classroom teaching and the value of having skilled and dedicated educators—at least, that was our experience in teaching physics. In a way, the use of technologies in extreme situations, such as the pandemic, highlighted their power and potential, but at the same time emphasized that personal and expert teaching remains the most important.

Keywords: courses, online tools.

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