Piloting of specific common tools in support of digital and online learning

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PILOTING OF SPECIFIC COMMON TOOLS IN SUPPORT OF DIGITAL AND ONLINE LEARNING

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DIGITAL AND ONLINE LEARNING IN MODERN HIGHER EDUCATION

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Abstract. *The article discusses the main principles of digital and online learning and criteria for choosing software products. A brief overview of the characteristics of some of the most common Open Source LMS\LCMS products is presented, which, as a result of their intensive development, represent an acceptable alternative to commercial systems, realizing the same functions at significantly lower costs and great efficiency. Optimal solutions for the purposes of higher education institutions are indicated.*

Keywords: *Digital and online learning, Learning management systems*

1. Introduction

Modern dynamically changing living conditions require the formation and development of continuous education. It should allow flexible adaptation and quick access to the world's specialized databases and information resources. This training should provide the modern person with opportunities for continuous development, expansion and improvement of professional knowledge and skills, thus achieving continuous professional mobility and activity throughout life. Distance education can be mentioned as the most intensively developing direction providing the mentioned possibilities. Digital and online learning in the last few decades has become a global phenomenon, an inseparable component of modern educational and informational culture. It significantly affects the goals, characteristics, and infrastructure of the ever-increasing number of educational institutions engaged in the field of higher education.

In recent years, because of the increasingly intensive development and wide spread of new information and telecommunication technologies and the technical means implementing them, the necessary technical prerequisites and means for the wide use of distance learning in higher education have been met. The term E-learning has gained widespread worldwide. E-learning should be seen as an extension of the concept of distance learning. Under this term is understood the organization of the training process, in which the implementation of the training programs is carried out using the information contained in the relevant databases.

It is carried out through the processing of information and with the help of information technologies, specialized technical means and information and telecommunication networks, ensuring the transmission of the necessary information along the communication lines and the interaction between the participants in the educational process. In addition to the fulfillment of its primary task (distance learning via the Internet), Digital and online learning is also an additional form of regular education, providing prerequisites for increasing the quality and efficiency of traditional education with the application of a wide range of Internet technologies that allow implementation in regular education of methods inaccessible to traditional types of training.

2. Digital and online learning types

There are different types of digital and online learning. Below we will focus only on the most frequently used ones:

Web-based training is training in which the WWW is used as an environment for providing the training materials or for carrying out the training process. This means that the WWW is used to:

- Conducting a distance learning lesson.
- For discussions on topics from the learning content.
- For communications between the teachers and the students themselves.
- Carrying out exercises.
- Taking tests.
- Joint development of projects.
- Access to additional learning resources.

This type of training is often used solely to provide information.

Web-based learning can come in two forms—supporting a regular course of study, as in computer-assisted learning, or completely replacing a classroom-taught course. These courses make extensive use of hypermedia for easy access to information. One of the main advantages of these courses, which is highlighted by many authors, is the possibility for learners to work at their own pace, at a time convenient for them. Unlike live human communication in traditional education, the possibility of communication between teachers and students and between students in web-based courses is through: e-mail, chat, discussion groups, computer conference, message boards.

Some of the types of web-based learning, according to (Zhiping, 2000) (Karoulis, 2003) are:

- Asynchronous correspondence.
- Synchronous cooperation.
- Web – supported courses.
- Web – managed courses.

• Web – delivered courses.
• Mixed delivery

There are complete methodological developments for the web-based classroom, the main purpose of which is to simulate a traditional learning environment with interactive multimedia means (McCormack, 1997).

Teleconferencing is a method where all training participants are connected to each other during the conference itself, which takes place at a specific time. Teleconferences are now conducted using multimedia devices such as cameras, microphones, monitors, loudspeakers and appropriate software for communication over the Internet, such as the free program BigBlueButton (BigBlueButton, 2023).

Video recording is one of the oldest forms of distance learning. But video recording is linear and one-way, and learners are not actively involved in the learning process.

Video - telelearning combines the convenience of teleconferencing and video recording.

Traditional training is also called ***Human Based Education***, face-to-face training, with a specific venue, class-class training. This training has a wide range of methods: lectures, textbooks, laboratory and seminar exercises, tests, consultation hours with the lecturers and assistants, reception hours of the offices, etc. (Brusilovski, 2001) note that the needs of traditional learning are sometimes directly transferred to web-based learning.

3. Support systems for web-based learning

These are systems for comprehensive support of web-based learning (Dimitrova, 2014). This includes:

• Assisting in the development of teaching materials by providing specialized editors.
• Assisting in designing the course.
• Assisting in the conduct of classes such as registering students, maintaining e-mail, maintaining on-line tests,
• Ability to track the work of each student.

Such widespread systems are the Moodle (Moodle, nd) and Claroline (Claroline, nd). These systems largely have the characteristics of content management systems.

Another system, Microsoft SharePoint Server 2007 provides the possibility to create, by the developers of educational materials, static sites, if it is used as a platform for organizing distance learn.

Web-based learning materials provide the informational content of training courses. Their subject matter is determined by the curricula of the respective educational institution. These materials are usually created with specialized programs such as Microsoft word, Microsoft Power Point, Adobe writer, Macromedia, etc. and are available through the web-based learning support system. From Figure 1, the learning materials are a mandatory part of the comprehensive web-based learning support systems.

The creation of web-based learning materials, united in a system of tasks and supporting pages, between which there are both hierarchical and network relationships, is inconvenient with both Moodle and Microsoft SharePoint Server 2007 (Tsankova, 2015).

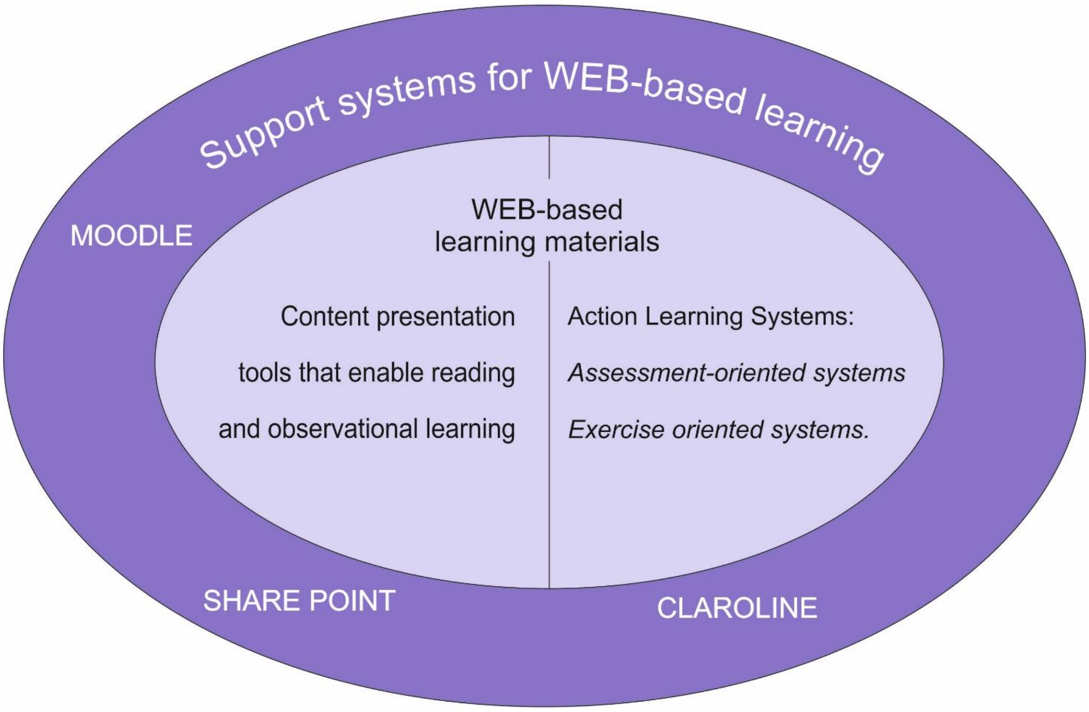

Figure 1. Embeddedness of web-based learning materials in web-based learning support systems.

At Technical University of Sofia, the use of an automated learning system based on Microsoft SharePoint Class Server was initially proposed as a web-based learning support system (Shoikova, 2007). Currently, the Technical University of Sofia uses Moodle to provide learning content to students who enter the department's website with a password.

4. The presentation as a learning material

Presentations are means of presenting content and enable learning by reading and observing. The main forms of presentations are an electronic textbook and an electronic lecture.

4.1. Electronic textbook

The electronic textbook offers a hierarchically structured presentation of the material that mirrors the printed textbook with its chapters, sections, and subsections. Hierarchical structuring is related to hierarchical movement. A typical set of hierarchical links includes links to all dependent sections, links to higher-level sections, to previous and next pages, and to the beginning of the electronic text. Additionally, navigation aids are provided such as a navigation path (a list of direct links, usually displayed at the top of the page) with options to navigate to each directly linked object.

Modern textbooks include the ability to choose the type of sound files and video files. Most use CGI technology. When interaction with a course of study of more students must be supported, remote database handling must be provided.

At the research level, authoring technologies are being developed that enable authors from one collective to create new objects indexed with metadata, which combined make it possible to form a new course composed of objects created by different authors and used in other different electronic textbooks (Langenbach, 1998).

One of the most interesting areas of research is adaptive content presentation and adaptive navigation support. The purpose of adaptive technology is to adjust the course content to the student's interests and goals, his prior knowledge, capabilities, and other information known to him (Assad, 2007). In responsive textbooks, the pages are not static, but are adaptively generated for each user (Speech, 1999). Adaptive navigation features include adaptive sorting of the navigation path, hiding a portion of the nodes accessible to the current page, or adaptive annotation presentation for a portion of the nodes. (Damyanov, Bakardzhieva and Spasova, 2009) define the following types of adaptation in learning environments: content discovery and its collection; adaptive course delivery (adaptive navigation support and adaptive selection of fragments of learning materials); adaptive interaction that adapts the user interface without affecting the content; adaptive support of cooperation (communication). The paper proposes a general architecture of an adaptive e-learning environment.

4.2. Electronic presentation

Electronic presentation is a way to present the sequential material of the lecture as a slide show (viewing pictures). The main criterion for considering the material as sequentially structured is the presence of navigation for sequential access. The presentation should have a designated opening slide with some introduction and a link to the next slide. All slides should contain navigation links to the previous and next slides. A table of contents and direct navigation to each slide should be provided.

4.3. Electronic lecture

This is the most popular type of electronic presentation. There are two special types of electronic presentation used in web-based learning: electronic lecture and guided tour (Tsankova, 2013).

There are two types of e-lectures:

• Lectures that take place at the time of their observation. They simply provide remote access to the actual delivery of the lecture. They are an element of distance education, but not an element of its software provision.

• Lectures that are recorded on media and can be watched at any time.

Technically, it is video and audio material recorded in a form suitable for distribution on the Internet. Partitioning of the lecture into parts and random access to each part is provided, meaning that each part can be individually addressable via the lecture title and that the user can search for part of the lecture by keywords (Marinov, 2011)

4.4. Personal learning environments

The idea of supporting collaboration between students using the Internet as a collaborative work environment was proposed in 1988 by Trigg (Trigg, 1988). Now this idea is being developed as the development of Personal Learning Environments (PLE), through which learners themselves find learning materials published on the Internet and equipped with possibilities to use the semantic web (Johnson, 1998). Personal Learning Environments (PLEs) are a set of tools and applications, physical and virtual spaces that learners can create and integrate themselves to meet their educational needs. PLE is a set of tools for finding, selecting and using information sources and specialized learning content for the learning process. One of their main advantages is that they stimulate learners to take the initiative of their learning into their own hands. PLEs rarely contain course-specific learning content, but offer multiple tools, services, and access to web resources that learners can use at their own discretion (Karoulis, 2003).

5. Conclusion

The article summarizes the most commonly used support systems for web-based learning. Recommendations are given for the presentation of the teaching material in Digital and online learning in modern higher education.

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OPPORTUNITIES AND CHALLENGES OVER THE HIGHER EDUCATION BASED ON NOWADAYS AI APPLICATIONS

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Abstract. *This paper explores the potential opportunities and challenges that arise with the integration of Artificial Intelligence (AI) applications in contemporary higher education processes. The growing availability of AI technologies offers promising prospects for enhancing various aspects of education, including personalized tutoring, language learning, and career guidance. These AI-driven innovations can provide students with tailored learning experiences, improve language acquisition, and facilitate informed decisions regarding career paths and college choices. However, this paper also highlights the challenges associated with AI implementation, such as ensuring data privacy, maintaining the human touch in education, and addressing ethical concerns. A balanced approach, combining the strengths of AI with human expertise, is crucial to harness the full potential of these technologies while overcoming the challenges and transforming higher education positively.*

Keywords: *ChatGPT, Education and AI, collaboration, plagiarism, AI challenges in education, AI experiments in educational process, etc.*

1. Introduction

AI applications are entering every part of our everyday life with tremendous speed. There is no area left away from AI progress (Alto, 2023). In the education process, AI seems to provide a vast number of opportunities both for teachers and students. There is no doubt that ChatGPT can act as a virtual tutor, providing personalized learning experiences to students. It can also be very useful for language learning. It can be used for revision and homework support. It can be very helpful in language learning through offering explanations for grammar rules and vocabulary (Natheem, 2023). Students also can use ChatGPT as a resource to review and reinforce their learning. It can help them with homework questions, assist in problem-solving, and provide explanations for challenging concepts. It can also assist in their career and college guidance and so on. Teachers can also benefit from ChatGPT for resource creation, their professional development, in data analysis, general time saving, etc. (Wolfram, 2023).

But there are also many risks. Uncontrolled automatic content creation can distort the educational process and greatly harm it. One side of the problem is a new form of AI plagiarism, the second side is AI exam, self-learning, and self-training cheating. No course work, diploma work or any other form of self-training created out of the class can be accepted with confidence nowadays without proper check for use of AI. This paper tries to indicate the possible impact of AI for self-training tasks through real life experiment with students from Management and business information systems specialty in TU-Sofia.

2. Experimental settings and conduction

For the needs of the study, an experiment is conducted. To conduct the experiment, 60 students from the 2nd and 3rd year of the Management and Business Information Systems specialty were selected. They were separated into two groups of 30 for the first and second phase of the experiment. The selection criteria were to be able to use English language at least on C1 level and a wish for extracurricular participation. The need from English language skills was identified through experiments, that shows that ChatGPT demonstrates better productivity when English language is used. The experiment consists of two phases.

In the **first phase**, all students received two tasks, that can be solved using ChatGPT. Both tasks are used in their education in Business information technologies subject. The first task was to create a program in C programming language for solving quadratic equations. The second task was to create software that forms central heating in bills for a flat in Sofia district using Microsoft Access. As you can see, both tasks are simple, but the second one requires more specific research.

The students with ChatGPT performance for both tasks are shown in Figure 1 and Table 1.

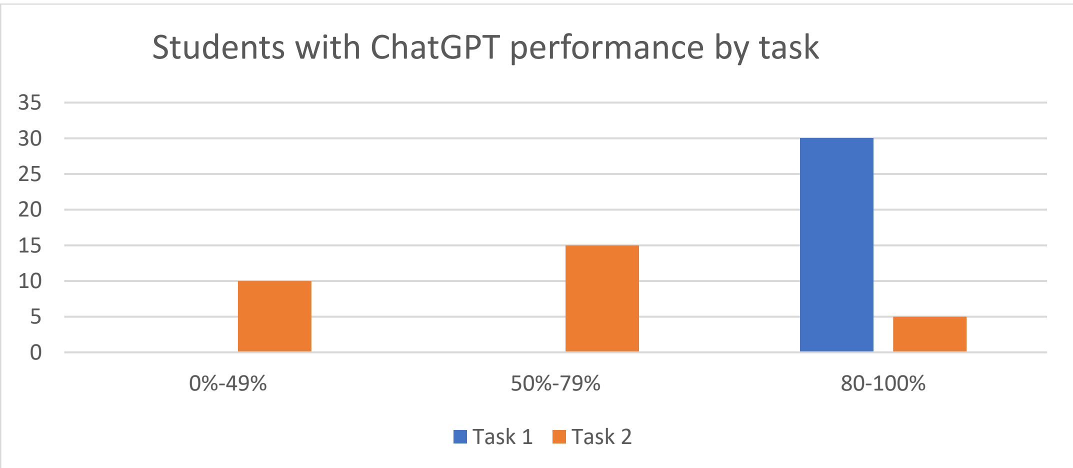

Figure 1. Students with ChatGPT performance by tasks in the first phase

Table 1. Students with ChatGPT performance by tasks in the first phase

Performance	0%-49%	50%-79%	80-100%
Task 1(students number)	0	0	30
Task 2(students number)	10	15	5

The difference in results between the two tasks can be attributed to several factors, including the complexity and nature of the tasks, the students' familiarity with the topics, and the capabilities of ChatGPT.

For students' success in Task 1 completion, there are two factors that must take in concern:

The first factor in concern is task complexity: Solving mathematical expressions is a well-defined task that involves known algorithms and mathematical rules. Students may have been familiar with the concepts involved, but even if they are not familiar with concepts, ChatGPT' is able to provide immediate feedback, guidance, and even ready solutions in large number of programming languages for such kind of tasks.

The second factor can be the familiarity with mathematical expressions of both students and AI software. Students are likely to have encountered mathematical expressions regularly in their math classes, making them more comfortable with the topic. Moreover, the process of writing a program to solve mathematical expressions might have aligned well with their prior programming experience. The problem here is that ChatGPT is also capable in this area, and such tasks are no challenge for it.

So, in solving such tasks out of the controlled environment of the class is nearly impossible to make a difference between students and ChatGPT work, even with specialized software. Especially in Information technologies subject.

The second task performance is near to real and normal distribution of scores. That is because of other factors involved in this task solution.

The first factor, that seems to be a game changer in Task 2, is the need for the specific knowledge required for calculating central heating bills. Calculating central heating bills for a flat in Sofia, Bulgaria, involves understanding of local utility rates, heating systems, and other various factors that influence the billing process. This information and methods are published and widely accessible, but this task requires domain-specific knowledge that the students may not have been exposed to or familiar with. That means, that students must conduct their own research and investigation to precise the steps of task solving, which can lead to various and inadequate results, even with ChatGPT usage.

The second factor is language understanding of ChatGPT. It is known, that this chatbot program works best with English language. That was the reason for grade C1 requirement for English language skills of participating students. Even when English language is used, seems that ChatGPT is not trained extensively on specific domain language enough in all areas of knowledge. As a result, it might have struggled to generate accurate and contextually relevant responses for the central heating bill calculation task.

The third factor can be the ambiguity and real-world context: The central heating bill calculation task is likely to have more ambiguity and real-world complexities compared to mathematical expressions, which can be precisely defined. This real-world context might have posed challenges for both the students and ChatGPT in providing accurate and comprehensive solutions.

The fourth factor is creativity vs. comprehension dilemma - while students may have demonstrated creativity in using ChatGPT for mathematical expressions, the central heating bill calculation task requires more than just creativity. It demands a deeper understanding of the domain, which might not be adequately captured by ChatGPT's general language comprehension.

In summary for the experimental phase 1, the differences in results could be attributed to the nature of the tasks, the students' familiarity with the topics, and the limitations of ChatGPT in understanding domain-specific knowledge. To improve results in real-world tasks like central heating bill calculations, students might need to advance their ability to collect additional domain-specific instruction and experience, using more tools like Google advanced search and rely less on ChatGPT.

In **phase 2 of the experiment**, an additional level of complexity of AI collaboration is added. The tasks remain the same, but the experiment was instead of having direct access to conducted in controlled environment – in class. But instead of direct access to computer with Chat GPT, the students can communicate by phone with one colleague/friend chosen by them, who has direct access to ChatGPT. The results of their collaboration are returned by e-mail. This part of experiment may be described as “Help from a friend, powered by ChatGPT”. The collaboration schema is shown on Figure 2. The results from the experiment - phase 2 are shown in Figure 3 and in Table 2.

The results of your expanded experiment, where a student in class had the opportunity to receive remote help from a colleague who used ChatGPT, highlight some important aspects of learning, problem-solving, and collaboration. First, we must take in mind that this was a **real time experiment**, with real-time pressure: In this case, when solving a problem in a classroom setting, student and his colleague supporting him, may experience time pressure and a sense of immediacy, even emergency.

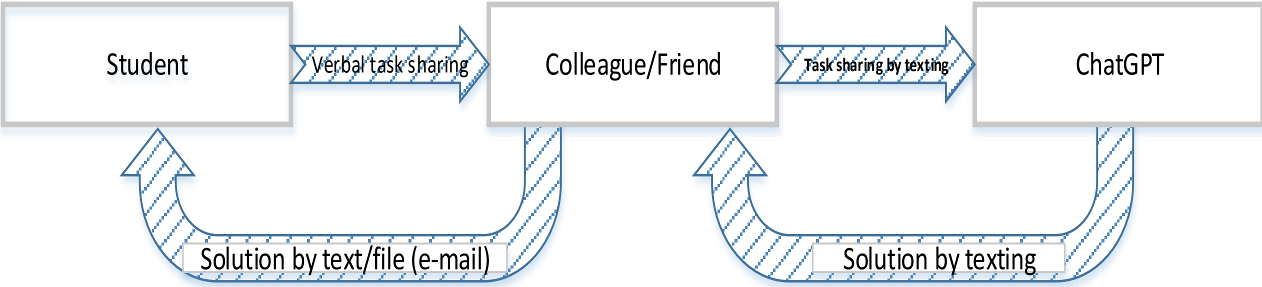

Figure 2. The collaboration schema

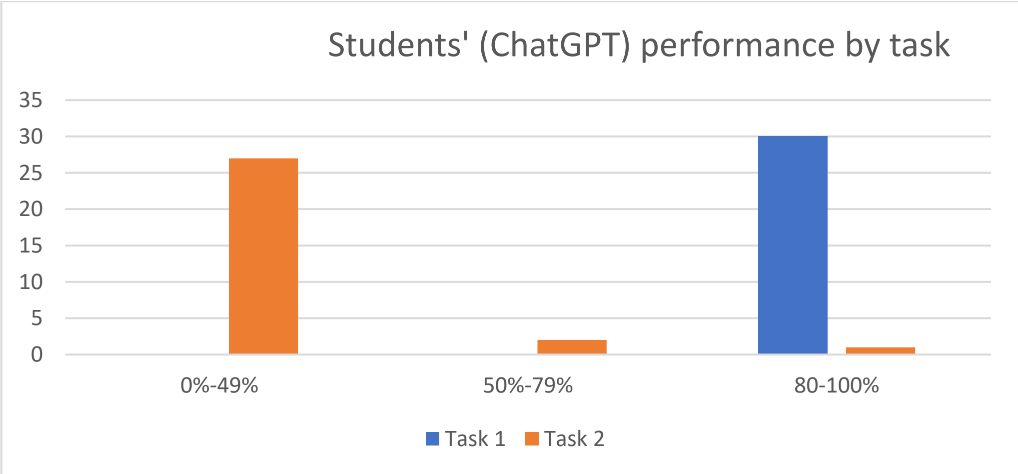

Figure 3. Students'(ChatGPT) performance by tasks in the second phase

Table 2. Students'(ChatGPT) performance by tasks in the second phase

Performance	0%-49%	50%-79%	80-100%
Task 1	0	0	30
Task 2	27	2	1

They may feel the need to solve the problem quickly, which can lead to stress and impact their ability to think critically and apply knowledge effectively.
The second factor that can be responsible for such a result is a feeling of security based on dependency on external help: Instead of attempting to solve the problem independently and critically think through the solution, students may rely too heavily on the ChatGPT-generated responses.

The lack of **context and domain knowledge** is the second possible reason Calculating a flat's heat bill involves domain-specific knowledge, including understanding heating systems, utility rates, billing methods, and regional factors. Students in the classroom might not have had the necessary expertise to comprehend the complexities of the problem fully. Also, there is an element of **communication and interpretation.** Communication between the student in class and the remote colleague can sometimes be challenging, leading to misinterpretations or miscommunication of the problem's details. This can further impede the student's ability to develop an accurate solution. Collaboration **dynamics** is also a key factor. In some cases, collaborative efforts can lead to divided responsibilities, with one person relying on the other to solve the problem. This can result in a lack of individual engagement and understanding of the problem-solving process. Also, when students collaborate on a problem remotely, they might be subject to distractions or multitasking, which can reduce their level of **engagement and focus** on the task at hand.

In a collaborative setting, students might be more focused on obtaining the correct answer rather than understanding the underlying concepts. This can hinder their long-term learning and retention of knowledge. That emerges some sort of Learning vs. Solution Seeking contradiction.

Also, the language of communication between the student in class and their remote colleague (who had access to ChatGPT) could have contributed to the challenges observed in the experiment. Language plays a crucial role in effective communication, problem-solving, and comprehension. There are various ways in which the language of communication might have deepened the problem. Some of them are:

- **Ambiguity and Clarity** - when communicating over the phone, there can be limitations in conveying complex ideas and instructions clearly. The remote colleague might have faced difficulties in understanding the nuances of the problem and articulating ChatGPT-generated responses in a precise and unambiguous manner.
- **Technical Jargon** - The domain-specific knowledge required for calculating a flat's heat bill may involve technical jargon related to heating systems, energy consumption, and utility rates. If the remote colleague was not familiar with this jargon or unable to communicate it effectively, it would hinder the student's ability to grasp the necessary concepts.
- **Language Barriers** - if the student and the remote colleague had language differences or were not fluent in a common language, misinterpretations and misunderstandings could have occurred during communication. This would have a significant impact on the accuracy of the information conveyed and received.
- **Lack of Visuals and Demonstrations** - solving complex problems often benefits from visual aids or demonstrations, which are challenging to convey over a phone call. Visual representations can help in understanding the problem better and lead to more effective problem-solving.

- **Time Delay and Distractions** - phone calls may introduce time delays and distractions that disrupt the flow of communication. These interruptions can affect the concentration and focus of both the student and the remote colleague, hindering their collaborative problem-solving efforts.
- **Lack of Real-Time Feedback** - unlike a face-to-face conversation, phone calls might not offer immediate feedback on whether the information provided is clear or understood. This lack of real-time feedback can lead to continued miscommunication and inaccuracies in the problem-solving process.
- **Overreliance on ChatGPT** - with the remote colleague acting as an intermediary, there is a risk of overreliance on ChatGPT-generated responses. The student may not critically evaluate the answers received and instead accept them unquestioningly, missing an opportunity for deeper learning.

3. Conclusion

In summary, the differences in results from the two phases of experiment could be attributed to the nature of the tasks, the students' familiarity with the topics, and the limitations of ChatGPT in understanding domain-specific knowledge. To improve results in real-world tasks, students might need additional domain-specific instruction and experience, and using more specialized tools or APIs that cater to such specific tasks could be beneficial.

Overall, the combination of real-time pressure, dependency on external sources, and the complexity of the task might have contributed to the challenging results in the classroom setting. In contrast, when students used ChatGPT individually in their own time, they might have been more patient, had time to research and understand the problem better, and could experiment with different approaches.

Also, the language of communication can indeed deepen the problem in collaborative problem-solving. It introduces additional challenges related to clarity, comprehension, and precision. As an educator, it's essential to consider the impact of communication methods on learning outcomes and encourage students to develop effective communication skills along with critical thinking and problem-solving abilities. Providing opportunities for direct interactions, visual aids, and face-to-face discussions can help overcome some of the limitations posed by remote communication channels.

Based on the experiments carried out, it seems that, at least for now, there is no high risk of using ChatGPT to overcome problems for an on-site and real-time exam. However, this is not the case with self-study tasks performed in an uncontrolled environment outside the classroom. Of course, the conducted experiments cannot serve as definite conclusions, but they show the need for further research on the positives, negatives, and consequences of the regulated and unregulated use of ChatGPT and related AI products in education. Also, these experiments give reason to suggest that working with AI can be characterized as human-AI collaboration (Human to AI collaboration) rather than simply working with a software program. Also, the results are very disappointing for the future of the current forms of distant learning, so, there is a large area for future research.

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MACHINE LEARNING MODELS FOR PNEUMONIA TYPE DETECTION IN X-RAY IMAGES

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Abstract. *With the advancement of new Artificial Intelligence (AI) machine learning techniques, medical practice is evolving. These AI based systems are already increasing the precision and effectiveness of diagnosis and treatment across a variety of specializations, especially when combined with the rapid advancements in computer processing. The effectiveness and usability of 3-class machine learning models for assisting experts in swiftly eliminating false positives while identifying pneumonia cases in chest X-ray images will be assessed in this article. The testing involves the deployment of MLP and CNN models, which are well-known machine learning approaches. Although the addition of some strategies appeared to imply a possible advantage over simpler convolution neural network models, a definite advantage could not be demonstrated.*
Keywords: *Artificial Intelligence, Machine learning, Pneumonia, CNN, MLP, Confusion Matrix*

1. Introduction

Pneumonia is a lung inflammatory disease that mostly affects the small air sacs known as alveoli (McLuckie, 2009), (Leach, 2009). The most common symptoms are a productive or dry cough, chest pain, fever, and difficulty breathing (Ashby, 2007). It is often diagnosed via signs of a cough, respiratory difficulty, a fever, and abnormalities on a chest X-ray (Prayle et all, 2011).

Despite antibiotic therapy, pneumonia remains a significant worldwide cause of morbidity and mortality. Research found that over 808,000 children under the age of five died from this disease in 2017, which accounted for 15% of all deaths in the stated age range (Roser et all, 2013).

Pneumonia is more often found in developing countries where the population is more susceptible to this illness due to poor sanitary conditions, a lack of medical and radiological professionals, and air pollution. specific risk factors for bacterial pneumonia, such as severe malnutrition and HIV infection, may cause a higher prevalence of pneumonia in less fortunate communities (Thörn et all, 2011).

It is crucial for early on treatment to be started as pneumonia caused deaths can happen in the matter of 3 days as illness begins (Kallander et all, 2016). This is where Machine Learning comes in hand. The development of artificial intelligence models has the capacity to revolutionize many fields of medicine, helping to make faster and more correct decisions and improving current standards of treatment. The creation of tools to assist in the diagnosis of pneumonia, especially when based on a widely used imaging modality like X-rays, is crucial for the application of artificial intelligence (AI) approaches.

Many different approaches using deep learning algorithms like CNN (Convolutional Neural Networks) have been developed to aid this problem. However, since these models require a large amount of data to be fed, transfer learning has been used. TL is gaining popularity because it can successfully address the drawbacks of supervised learning and reinforcement learning (Gómez-Paredes et all, 2022).

2. State of the art

The application of machine learning to radiological images is a growing area of research. Recent breakthroughs in machine learning have the ability to recognize and classify complicated patterns in a variety of radiological imaging modalities (Zhang and Shimizu, 2019). Convolutional neural networks (CNNs) have showed considerable promise in image classification among deep learning approaches and have therefore been widely adopted by the scientific research community (Rawat and Wang, 2017).

Much research has been published in which the authors experimented with altering the parameters of deep layered CNN for pneumonia detection. For example, (Rahman et all, 2020) used four different pre-trained deep Convolutional Neural Network (CNN): AlexNet, ResNet18, DenseNet201, and SqueezeNet for transfer learning. They were able to reach 93.3% accuracy on the classification of normal, bacterial and viral pneumonia, and they reached 98% on the classification of normal and pneumonia cases. The dataset they used consisted of 5247 chest X-ray images consisting of bacterial, viral, and normal chest x-rays. Team of scientists used a transfer learning approach where they extracted features from images using ImageNet pretrained models, which were later fed to a classifier to produce the predictions (Chouhan et all, 2020). They combined the output of 5 different models (AlexNet, DenseNet121, InceptionV3, GoogLeNet, and ResNet18) and reached the accuracy of 96.4% with a recall of 99.6% on unseen data.

In another study (Mabrouk et all, 2022) a CNN Ensemble Learning (EL) approach was proposed for detecting normal and pneumonia patients in chest X-ray images. The authors used the three most successful CNN models: (DenseNet169, MobileNetV2, and Vision Transformer) and the same dataset was used in this research which consists of a total of 5,863 images. These models are fine-tuned after being trained on the chest X-ray data set. During the experimental phase, the findings are derived by mixing the extracted features from these three models, and an accuracy of 93.88% was reached on the two-class model.

Other than the transfer learning approach (Acharya and Satapathy, 2020) proposed using the deep Siamese based neural network to automatically detect pneumonia from chest radiography images. In this model the amount of white matter scattered across the two segments of the chest X-ray image distinguishes viral and bacterial pneumonia diseases. Each chest X-ray picture is separated into two segments, which are then sent into the network to compare the symmetric structure as well as the amount of infection dispersed over these two regions.

Another scientific team presents a novel deep learning strategy for automatic pneumonia detection using deep transfer learning to simplify the detection procedure while improving accuracy (Manickam et all, 2021). The authors preprocessed the input chest X-ray pictures to detect the existence of pneumonia using U-Net architecture-based segmentation and classify the pneumonia as normal or abnormal (Bacteria, viral) utilizing ImageNet dataset models such as ResNet50, InceptionV3, InceptionResNetV2. The proposed ResNet50 model work achieved 93.06% accuracy, 88.97 % precision rate, 96.78% Recall rate and 92.71% F1-score rate.

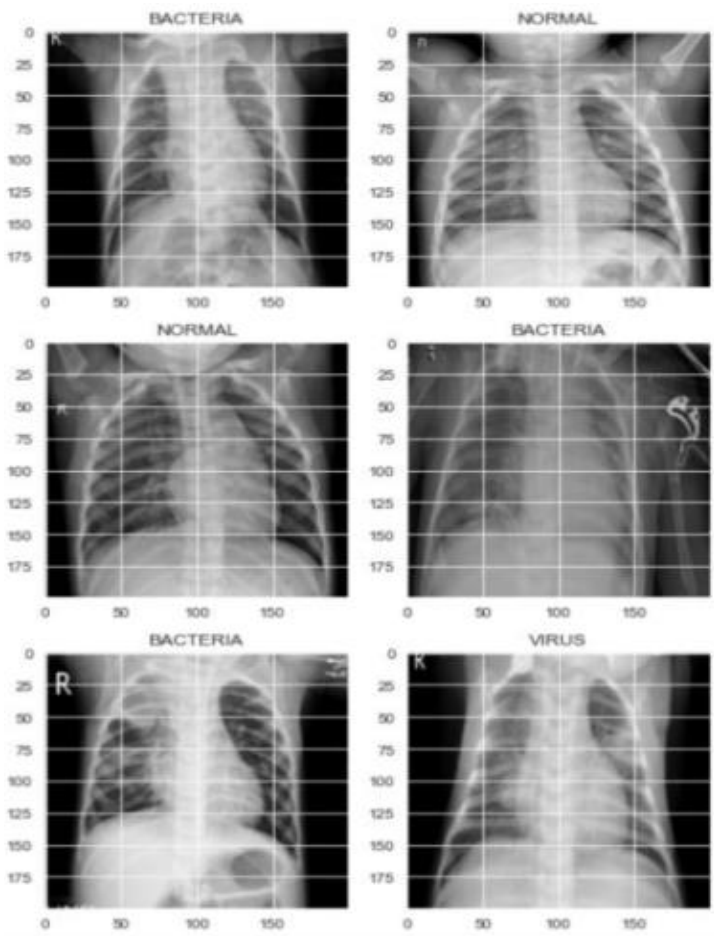

Figure 1. Grid display of random images from the dataset

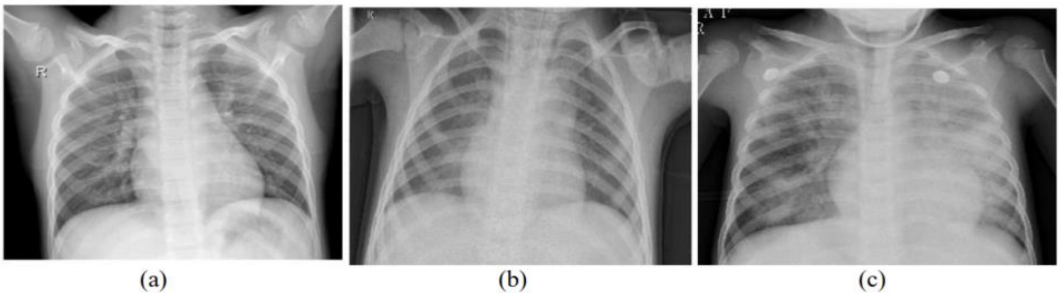

Figure 2. Image examples from the dataset (a) Normal (b) Bacterial Pneumonia (c) Viral Pneumoni

3. Data description

The dataset used in the current project was available in Kaggle (Sazawal et all, 2003). The mentioned collection contains X-ray images of both healthy lungs and individuals with bacterial or viral pneumonia. From retrospective cohorts of children patients aged one to five at the Guangzhou Women and Children's Medical Center in Guangzhou, chest Xray images (anterior posterior) were chosen. All chest X-ray imaging was done as part of the regular clinical treatment provided to patients. All chest radiographs were originally inspected for quality control prior to the interpretation of the x-ray pictures, and any scans that were of poor quality or were impossible to read were removed. Before the diagnosis for the photos could be used to train the AI system, they were graded by two experienced doctors. A third expert also reviewed the evaluation set to make sure there were no grading mistakes.

3.1 Statistical Analysis

The 3 classes of the dataset were originally distributed as follows: Normal 26.94%, Pneumonia Bacterial 47.53%, Pneumonia Viral 25.52%. This distribution is displayed on 2 histograms for both test and train data on Figure 3.

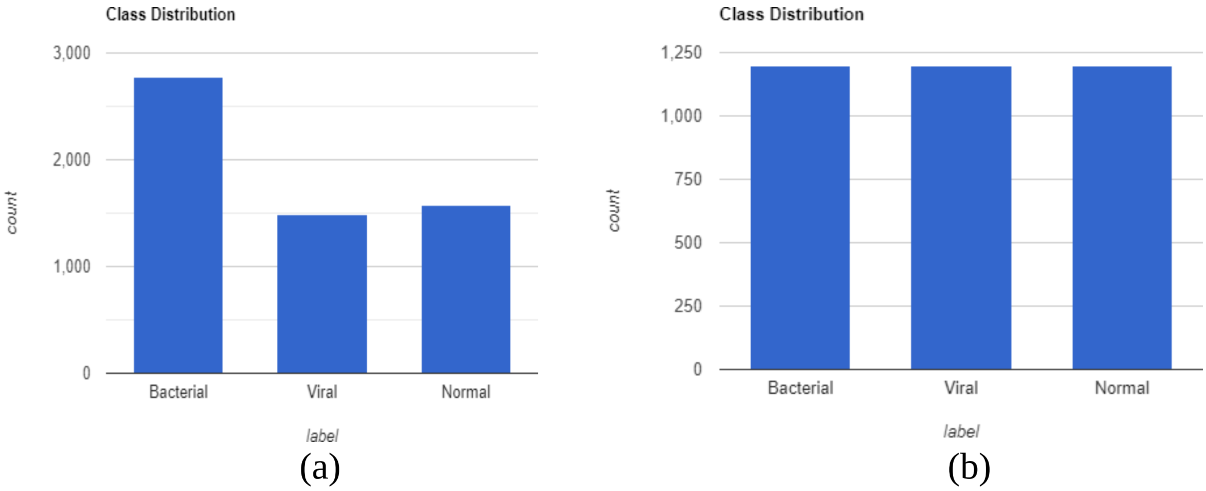

Figure 3. Histogram representing the distribution of the classes within the dataset (a) for unbalanced data and (b) for the balanced data

As the data is unbalanced, we later proceeded with altering the number of images per class which would result in achieving better accuracy for our model.

4. Applied machine learning

As a supervised learning approach, MLP employs backpropagation. Because neurons are organized in layers, MLP is a deep learning approach. MLP is commonly used in studies on supervised learning, parallel distributed computing, and computational neuroscience. A multilayer perceptron is made up of an input, an output, and one or more hidden layers, each containing multiple neurons stacked together. In contrast to neurons in a Perceptron, which must have an activation function that imposes a threshold, neurons in a Multilayer Perceptron can have any arbitrary activation function.

A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning method that can take an input picture, assign importance (learnable weights and biases) to distinct aspects/objects in the image, and distinguish one from the other. When compared to other classification methods, ConvNet requires substantially less pre-processing. While filters in primitive approaches are hand-engineered, ConvNets can learn these filters/characteristics with adequate training.

To compare outcomes, we attempted implementing two distinct MLP scripts. The first is a basic MLP method, and the second contains Dropout Regularization. The addition of dropouts reduces the likelihood of the model overfitting. We may accomplish this by simply adding a new Dropout layer between the hidden and output layers. As a result, the model's test accuracy increases. The first model includes 40,964,099 trainable params, and 41,551,875 for the 2nd one.

We then applied two CNN models to see whether we can attain better outcomes, starting with 5 double convolutional networks with kernel sizes of (3, 3) and max pooling with pool size of (2, 2). Dropout regularization and batch normalization are also provided. With the exception of different weights and an extra layer, the second CNN model is quite identical to the first. For this batch, data augmentation is used. The first model includes 6,046,547 trainable parms, and 11,294,163 for the 2nd one.

4.1 Data Pre-processing

Normalization and table reshaping have been implemented in the data pre-processing step for the models. The textual classes were mapped to numerical values as part of this step. For both the CNN and MLP models, the input should be a normalized grayscale image in contrast to other available models that don't require a conversion from RGB to grayscale.

4.2 Data Augmentation

The 2nd CNN model was executed after applying a data augmentation step in the process. The changes made on the dataset are:

- Shift photos horizontally by 10% of their width at random.
- Shift photos vertically at random by 10% of their height.
- Rotate photos by 10 degrees at random.
- Zoom various photographs by 10% at random.

4.3 Training

The models were trained in a maximum of 100 epochs. However, if the validation loss did not decrease by greater than 0.01 in six consecutive epochs, the training procedure would be terminated early. We also opted to lower the learning rate if the same validation loss did not improve.

5. Results

The primary goal of our approach was to compare the models implemented in terms of correctly diagnosing pneumonia cases in chest X-ray images. For this we prepared all the models as explained above and trained them separately. We performed training and testing using a computer with Intel® Pentium® Gold 7505, 2.00 GHz CPU, Intel ® UHD Graphics and 8 GB of RAM. For training, we used the RMSprop and Adam optimizer and the cross-entropy loss function.

The comparative performance of training and testing accuracy for different CNNs and MLPs for classification schemes are shown in Figure 5. It can be noted that, out of the 4 classification schemes, the 2nd CNN model with Data Augmentation applied is producing the highest accuracy for both training and testing.

In our study we also compared the performance of the classifier when using balanced dataset or an imbalanced one. The dataset provided by Kaggle, as mentioned previously, has a significantly higher amount of bacterial pneumonia images. When balancing the dataset, we altered the number of images in each class category to 1200 images. The result with the balanced data had a better performance and higher accuracy, as well as less time required for the completion of the epochs.

5.1 Accuracy

The accuracy evolution for the train and validation data are shown on Figure 4 for the MLP and CNN approaches respectively.

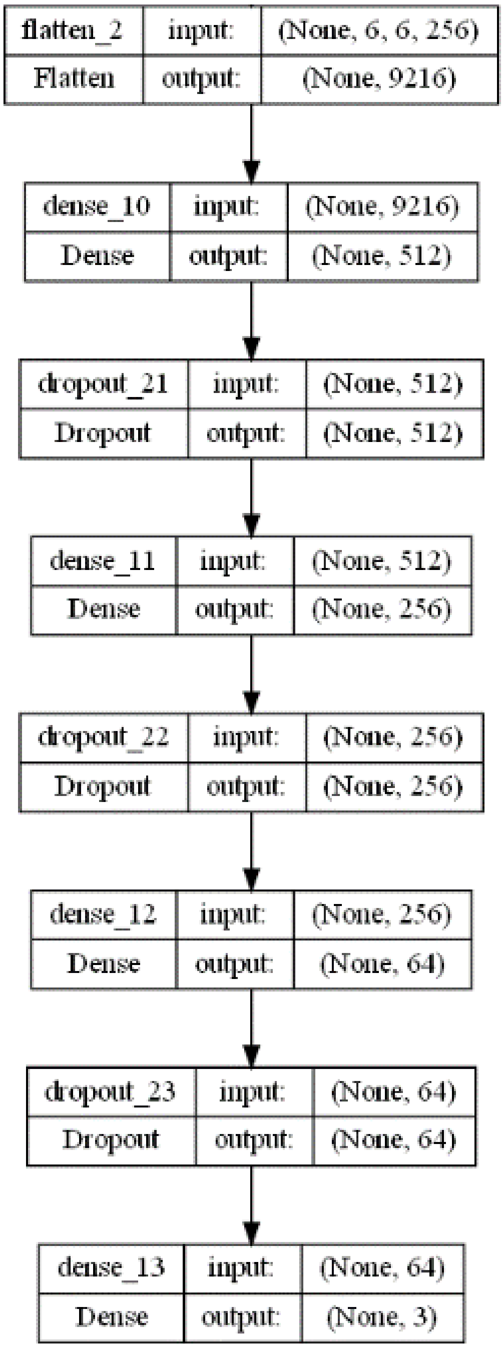

Figure 4. Implementation of a
subnetwork of the CNN model

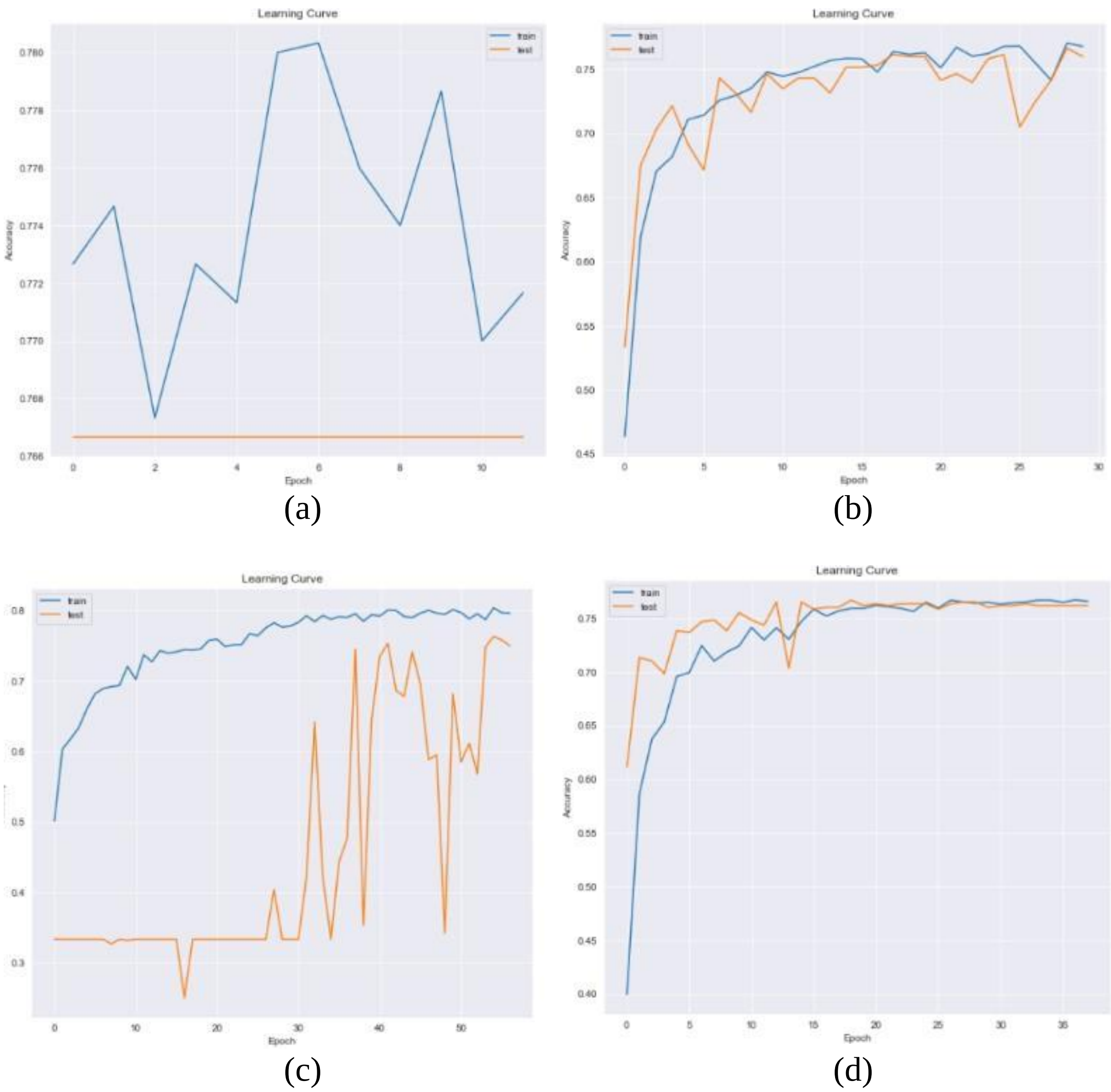

Figure 5. The plots of the accuracy on the training and validation sets for (a) first MLP model, (b) second MLP model, (c) first CNN model and (d) second CNN model.

5.2 Loss

Figure 6 shows the plots of the loss validation for the MLP and CNN models respectively.

5.3 Confusion Matrix

Figure 7 shows the confusion matrices for the models with balanced and imbalanced data using MLP and CNN.

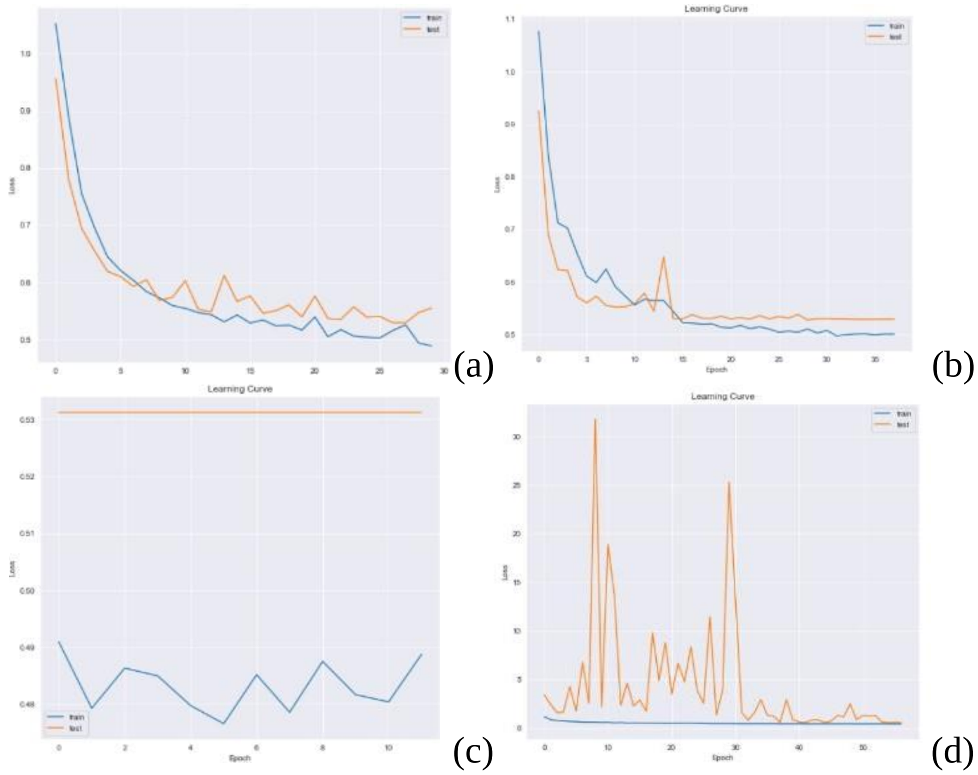

Figure 6. The plots of the loss on the training and validation sets for (a) first MLP model, (b) second MLP model, (c) first CNN model and (d) second CNN model.

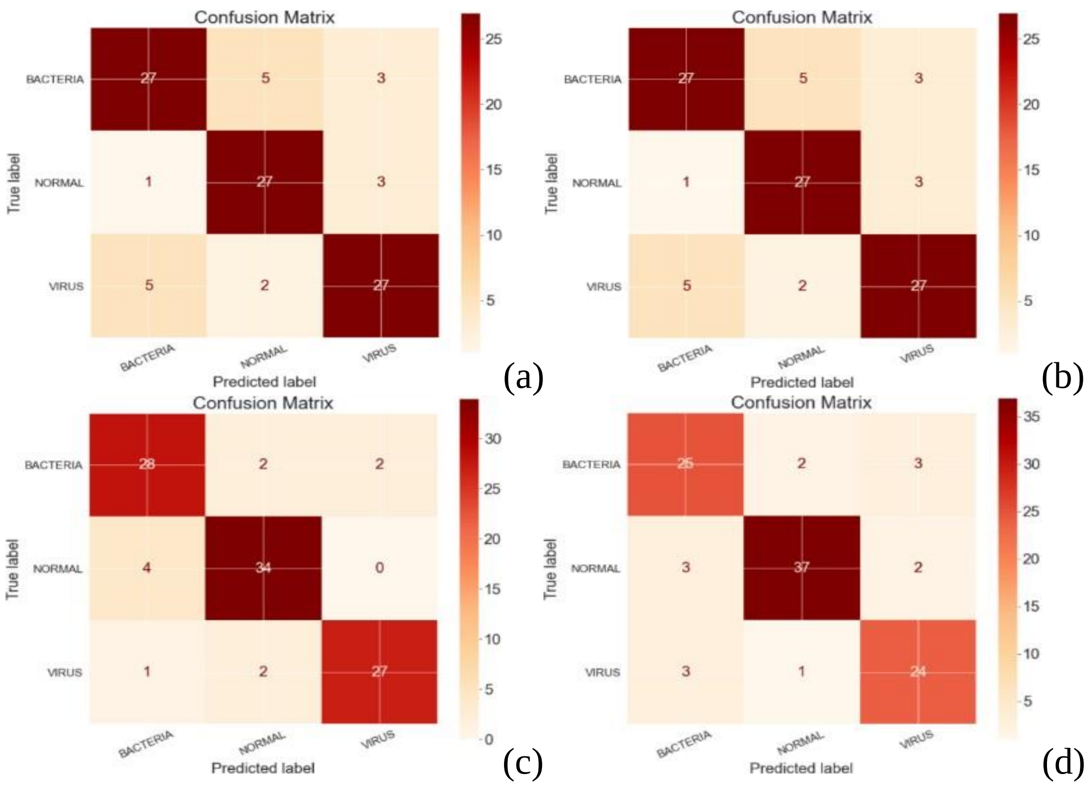

Figure 7. Confusion matrix for (a) first MLP model, (b) second MLP model, (c) first CNN model and (d) second CNN model

6. Conclusion

While ML models should never be used to replace physicians, their valuable contributions to society can be considerably increased by collaborating with powerful new advancements. This paper demonstrated the value of using current technology to promptly diagnose pneumonia patients. Although the precision achieved is insufficient for usage in real-world circumstances, there is still space for development. This study was helpful in emphasizing the need of using AI in the medical field, it did have numerous drawbacks. It should be noted that we encountered significant challenges when conducting the testing due to hardware and software limitations.

Some intriguing implications may be drawn from the models that were chosen and implemented. Contrary to what we initially expected, the more complex scripts generated little to no benefit and, at times, setbacks. This might be due to the unpredictability of the models, as well as technological limitations when applying ideas at a higher level.

In the future, a longer training period with more appropriate equipment should be implemented to examine the potential advantage of models used during the conducted research.

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DIGITAL LEARNING TOOLS AND TECHNIQUES – AN OVERVIEW OF SURVEY RESULTS FROM EUT+ STAFF AND STUDENTS

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Abstract. *This short article summarizes the results of student and staff surveys conducted both pre- and post-pandemic at TU Dublin, and subsequently at EUt+ member universities. It notes that, although positive about digital learning in the main, student satisfaction with online learning decreased post-pandemic. Students also expressed dissatisfaction with the usability of institutional learning tools, and with the level of digital skills acquired as part of their education. With the move to emergency remote teaching, staff experienced a rapid transformation in their teaching methods, but many have embraced online teaching and would like a continuation of this flexibility: however, they also noted a lack of institutional guidance on best practices in teaching and digital skills adoption. Both cohorts expressed a desire, post-Covid, for a balanced approach that combines digital and in-person interactions in the teaching and learning process.*

Keywords: *Digital Learning; Higher Education; Pandemic; Covid19; Student Satisfaction; Academic Staff; Online Teaching*

1. Introduction

In March 2020, the digital revolution in education, predicted since the start of the millennium, came to pass in just a few weeks. Fortunately, having had two decades of preparation, universities had the digital infrastructure in place to switch rapidly to what became known as emergency remote teaching: within a matter of weeks, if not days, lectures were being delivered online, assessments were being conducted remotely and students were able to continue with their studies, albeit while isolating in their homes rather than social distancing on campus. The pandemic heralded a huge and rapid change in the uses of and attitudes towards digital technologies in higher education, in Europe and across the world. The effects of that revolution are still being played out, with many universities and schools now returning to traditional campus-based learning, supplemented by online resources. But the real impact of emergency remote teaching remains difficult to gauge, and it may well take years, if not decades, to comprehend the changes to higher education wrought by Covid-19.

In Ireland, an opportunity to directly measure the impact was possible, albeit by accident rather than design. Immediately prior to the pandemic, a national survey of digital engagement and experiences had been conducted by the National Forum for the Enhancement of Teaching and Learning in Higher Education. The INDEx survey was designed to explore the digital experiences of students and of staff who teach, highlighting what makes a difference to them and providing an evidence base to inform future decision-making and enhancement of teaching and learning. The autumn 2019 survey was completed by 24,484 students and 4,445 staff at 32 Irish higher education institutions, including TU Dublin. In April/May 2021, during the initial post-pandemic phase, a decision was made to repeat the survey at TU Dublin (with some additional questions) aiming to assess experiences of students and staff during the pandemic and thereby create a "before and after" picture.

The most significant difference noted at TU Dublin was diminished student enjoyment and engagement with their studies in the online environment: previously more than two thirds of students agreed with the statements that when digital technologies are used on their course "I enjoy learning more" and "I understand things better"; post-pandemic, the numbers were less than half in both instances. Prior to the pandemic, just 24% of TU Dublin students reported their courses as being conducted through blended or online learning, and two-thirds of TU Dublin staff said they had no experience with teaching in a webinar or online format. The rapid shift to emergency remote teaching saw a remarkable transformation, with 90% of academic staff teaching online at least weekly by April/May 2021. Many staff appreciated the flexibility discovered during lockdown and expressed a desire for continued remote teaching options post-pandemic. Conversely, students frequently voiced dissatisfaction with the quality of online teaching they had experienced during the pandemic, citing a lack of interaction during online classes. Lecturers also complained about this issue. TU Dublin students and staff alike expressed dissatisfaction with the quality and quantity of assessments conducted during the pandemic.

However, despite their misgivings, a majority at TU Dublin displayed continued interest towards integrating digital technologies into their educational experiences. Pre-pandemic, three-quarters of lecturers expressed a desire to use more digital tools in their teaching, and 58% of students expressed similar sentiments. Post-pandemic, two-thirds of lecturers still aimed to use the same or more technology in their teaching (students in favour had reduced to 51%). The availability of recorded lectures was a high priority for students both pre- and post-pandemic. Asked to identify one thing that the university could do – or do better – to improve their experience of digital teaching and learning, a majority of student respondents singled out improvements to how digital technology is used by lecturers. For TU Dublin staff, of major importance in 2021 was the question of how much use of digital and online was expected of them by the university into the future. As one respondent put it, "*We really need clarification and quick! Are we returning to business as before – live face to face classes, with the VLE as a repository for content, and used for assessment. Or are we moving to a hybrid model? The former is retrograde and a missed opportunity. The latter requires a clear direction now – how will this be timetabled?*"

2. European perspectives

Recognizing the value of these findings, a decision was taken to replicate the INDEx survey among staff and students of EUt+ to gauge attitudes across the partners. In May 2023, a slightly adapted version of the TU Dublin post-pandemic survey was distributed. The primary objective was to gain insights into the digital experiences of teaching staff and students, discerning what was effective or ineffective for them. In this manner, an evidence-based foundation for future decision-making and improvements in teaching and learning practices within EUt+ could be approached. The survey received 493 valid responses from students at four of the partner universities. (All respondents declared that they were over the age of 18, and willingly consented to have their answers included in the study.) One-hundred and sixty-four valid responses were received from staff at five of the partner universities. What follows is a synopsis of their views with regards to digital learning tools and techniques.

3. Student Voices

A notable majority of students who replied (over 70%) were under the age of 25 and pursuing undergraduate degrees in traditional campus-based programmes, and just over half the respondents (55%) were male. More than half (57%) were enrolled in engineering and related fields, including architecture, manufacturing, and construction. Over 90% were full-time students, with just 2% pursuing online courses. In the main, student responses from the EUt+ survey reflected those given by TU Dublin students. A vast majority possess their own laptop and also use their mobile phone in their learning, while ownership of desktop computers was slightly higher than tablet or iPad (see Figure 1).

Regarding the use of digital tools and technologies in their courses, almost two-thirds of students said that they enjoyed learning more when digital technologies are used, and that it helped them to understand things better (a direct reflection of the pre-pandemic response in TU Dublin).

Three-quarters said that digital technologies made them more independent in their learning, allowing them to fit learning into their life more easily. Overall, most students rate highly the quality of their university's digital provision (software, hardware, learning environment), with 60% of respondents rating it as good, excellent or best imaginable. There was also positive recognition of the digital tools and services provided to students by their universities (see Figure 2).

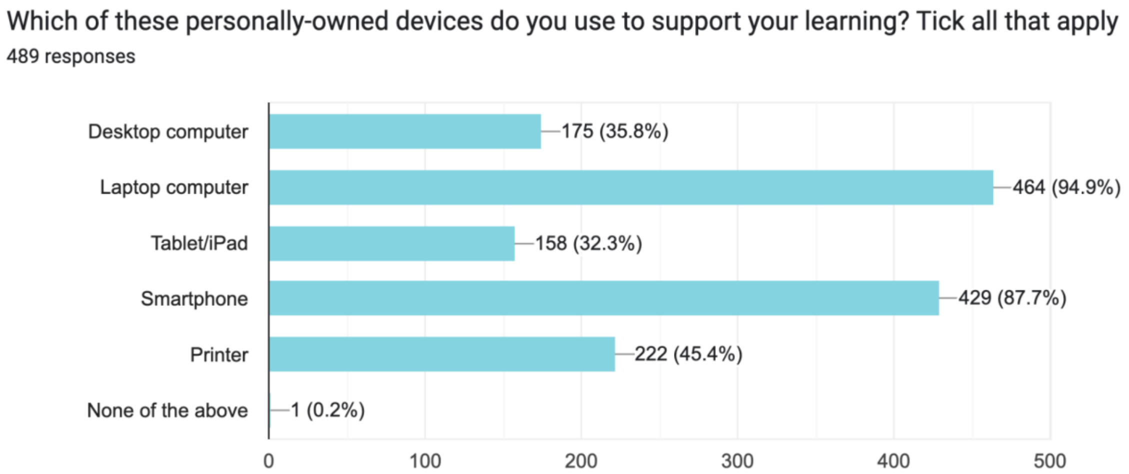

Figure 1: Student device ownership

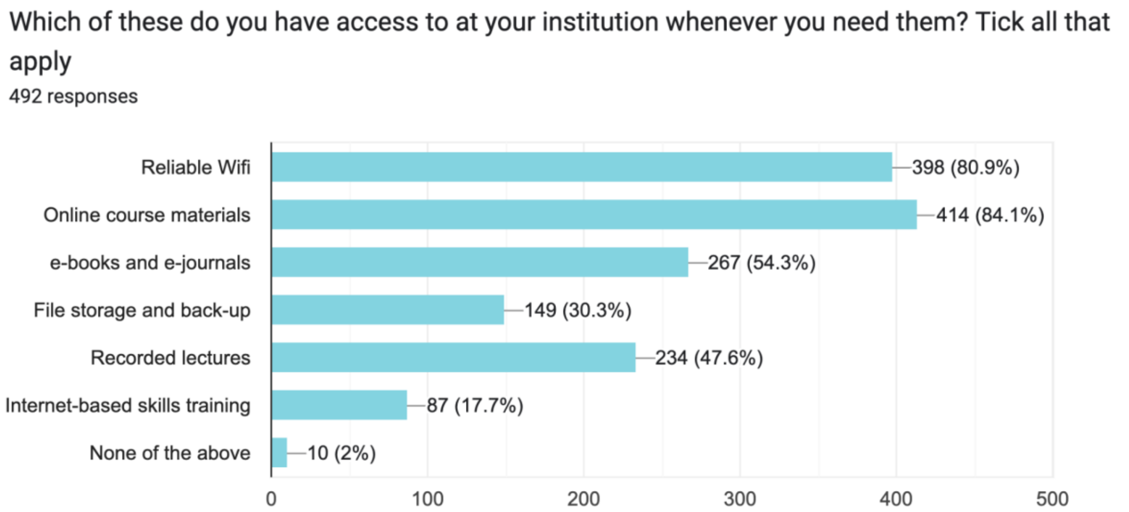

Figure 2: Student responses to institutional supports

However, just one-third expressed enthusiasm for more use of the institutional virtual learning environment (VLE/Moodle) by their instructors, reflecting a general disenchantment with the usability of institutional learning tools. Asked what digital tools would be most useful to them as learners, more course-related video and more practice questions available online were selected by more than half of the respondents from the provided list, while project-based learning and more interactive pools and quizzes in class were also popular (of note here is that 28% of respondents had previously said that they never use a polling device or online quiz to give answers in class). Many students also expressed a desire for more or all lectures to be recorded, a wish also expressed by many TU Dublin students (it should also be noted that not all staff are comfortable with this idea).

Of particular significance is the fact that while 91% of respondents claim that *"Digital skills are important in my chosen career"*, less than half of the (45%) agreed with the statement *"My course prepares me for the digital workplace."* (At TU Dublin, the equivalent post-pandemic figures were 74% of students who said that digital skills were important in their chosen career, and 44% believed that their course prepares them for the digital workplace.) Moreover, just 40% of students agreed with the statement *"I have regular opportunities to review and update my digital skills"*, and just one quarter of students believe that their university helps them to stay safe online.

Many students expressed satisfaction with the flexibility of using personal laptops for notetaking and the availability of necessary software tools for free, reducing the need for illegal downloads. However, there are concerns about the usability of university e-platforms, and the limited availability of power outlets in auditoriums, hindering students' ability to charge their laptops during lectures. There were also calls for better interfaces and usability of digital tools provided by the university, the streamlining of communication platforms and the unification of digital resources.

At the end of the survey students were invited, if they wished, to add any comments (positive or negative) regarding their experiences of digital learning and support at their university. These comments reflect a diverse range of opinions and experiences from a variety of perspectives. Some expressed concern about the over-reliance on technology, one respondent describing it as a band-aid solution for educational systems that need more fundamental improvements. There were also concerns about the cost of learning tools and the lack of access to essential software. In the main, positive feedback on digital learning was not extensive, although some students appreciated the flexibility it offers in terms of time management and access to lectures. Some found online learning efficient and enjoyable, highlighting the advantages of being able to rewatch lectures and learn at their own pace, but overall reactions vary, with some advocating a hybrid model that offers both options.

Overall, the feedback suggests that there are significant challenges and areas for improvement. A common theme that emerged is the inconsistent use of technology in teaching and the lack of knowledge among lecturers in their use of digital tools (again, a direct reflection of the TU Dublin findings). Some students expressed frustration with the transition back to in-person learning post-pandemic, advocating more flexibility and more digital content, while others criticized the overwhelming amount of information presented to them as part of their syllabus, suggesting a need for better curation of resources. Many students highlighted the need for better software and equipment, especially for practical fields of study. Additionally, a desire was evident for improved support and guidance in utilizing digital tools effectively for learning.

Such comments emphasize the need for educational institutions to consciously strike a balance between digital and traditional teaching methods, taking into account the diverse learning preferences and needs of students. Furthermore, the practical relevance of course content and its alignment with the demands of the job market are key considerations for many students. Overall, the feedback underscores the importance of continually optimizing and adapting digital learning tools and resources to enhance the educational experience. This might include more direct involvement of students and staff in the decision-making process surrounding digital tools and platforms: less than a quarter (23%) of students agreed that they are involved with decisions regarding digital services at their universities (26% of TU Dublin students agreed).

4. Insights from Academic Staff

Comments from staff reflect a multifaceted perspective on the digitalization of education. A majority of respondents were male (60%) and from engineering and related disciplines (architecture, manufacturing, and construction). Two-thirds said that they rely on their institutional virtual learning environment in their teaching, and over 70% rate as good or excellent the quality of the university's digital provision (software, hardware, learning environment – see Figure 3). Perhaps surprisingly post-Covid, one-quarter of respondents said that they *never* teach in a live online environment such as a webinar (in May 2021, the TU Dublin post-Covid figure was 10%). More than half of respondents (54%) said that they would like to use more digital technologies in their teaching practice in the future.

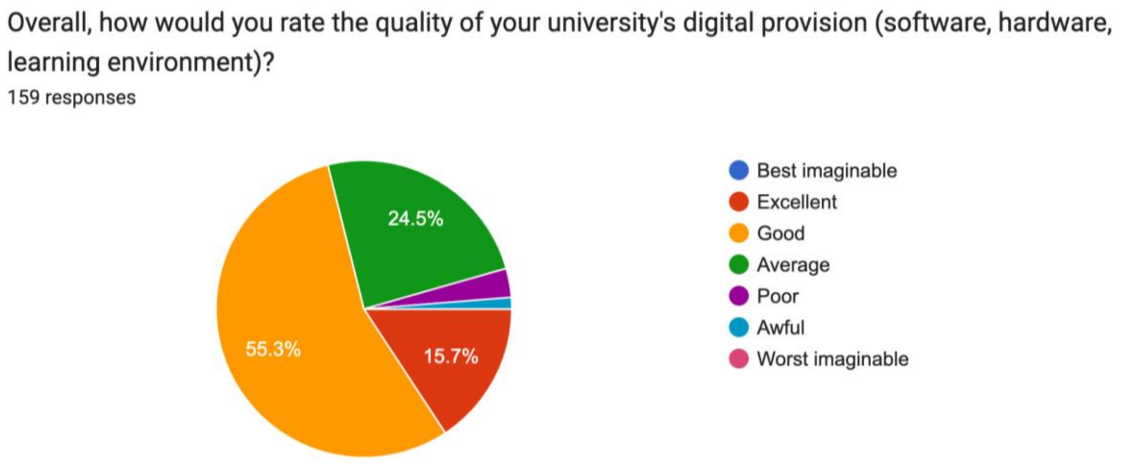

Figure 3: Lecturers were generally quite satisfied with the software, hardware and learning environment at their universities.

Some lecturers expressed appreciation of the convenience offered by the online environment, readily acknowledging the support and assistance of their local IT teams during Covid. The experience was noted in some cases to have served to enhance face-to-face interactions as a result of the improved digital skills acquired and the resources made available to them. Others recognized that the pandemic compelled educators to embrace digital tools rather hastily, and that some bad practices adopted may have had adverse effects on teaching. While some educators prioritize face-to-face learning, others seek to enhance blended and flipped classroom methodologies and to explore the potential of improved hybrid formats. Collaboratively, some educators aspire to curtail screen time for both themselves and their students in the coming years, but believe that support for such an initiative is lacking. They aim nonetheless to develop their own methodology to mitigate the impact of technology on professional development, even without institutional guidance.

Feedback highlighted several challenges, including the lack of time for implementing digital pedagogies, as well as reluctance on the part of students to engage during online classes. Some educators stated that they had faced behavioral issues among students in the digital environment, emphasizing the importance of social interaction in teaching and research. Additionally, concerns were raised about the lack of incentives to maintain and develop online teaching practices. An imbalance in teaching tools and resources is also evident, with some educators independently providing technology to support their teaching, and thereby facing difficulties in maintaining and protecting their digital teaching efforts. And while there is acknowledgement that there has been some recognition of efforts made, academic staff recognize the lack of a clear digital strategy and support at institutional level, with lecturers left alone to make decisions regarding their use of digital alongside their regular teaching responsibilities (see Figure 4). The desire for more technical tools, such as remote controls and graphical tablets, to aid educators in their classroom work is expressed as well.

Ultimately, a balance between digital and face-to-face interactions in the learning process is desired, and a desire for software tools that they can use to enhance the educational experience (just 13% of staff said that they have had an opportunity to be involved in decisions about digital services, slightly higher than the 10% of staff at TU Dublin). What is clear, however, is that although digital resources are recognized as valuable by lecturers, they are regarded as supplementary to in-person, physical interactions with students.

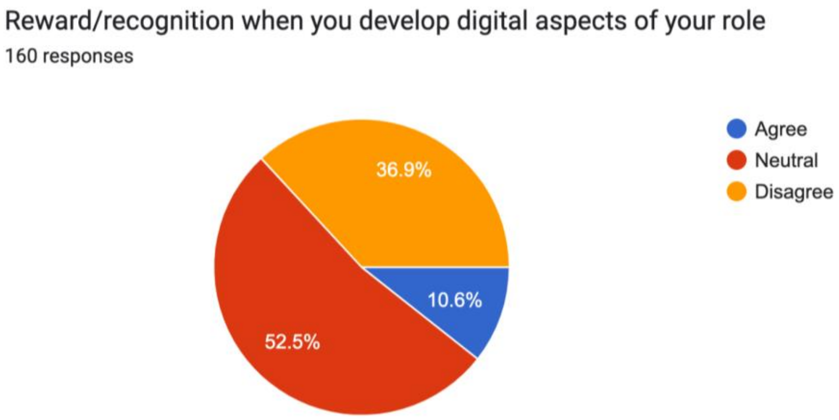

Figure 4: How much do you agree that your institution provides you with Rewards/recognitiion when you develop digital aspects of your role.

5. Conclusion

The trends that emerge from the surveys are fairly consistent across the EUt+. For students, the online experience of emergency remote teaching was not especially positive: some appreciate the convenience of digital learning, while others believe they learn better in traditional face-to-face settings. For staff, the pandemic experience introduced them to pedagogical possibilities that many had not considered previously, although in the main they felt left to their own devices in exploring this territory. Students and staff alike expressed significant discontent with the quality and quantity of assessments conducted during the pandemic. But in general, both cohorts expressed satisfaction with the digital infrastructure provided by their universities.

So what can be concluded regarding the impact of Covid-19 on higher education? At TU Dublin, in the post-COVID era, 90% of academics reported teaching online on a weekly basis (the 2019 survey indicated that two-thirds of staff had never engaged in webinar-based teaching). Many staff at TU Dublin embraced the flexibility that remote teaching afforded them and expressed a desire for continued access to this mode of instruction beyond the pandemic. Conversely, students at TU Dublin reported a decline in their enjoyment and engagement with digital learning post - COVID. Previously, over two-thirds of students agreed with statements such as "I enjoy learning more when digital technologies are used in my course" and "I understand things better." However, in the post-pandemic period, these numbers dropped to less than half. This decline in satisfaction was often attributed by students to the quality of online teaching, characterized by limited interaction and prolonged, one-sided lectures, mirroring traditional classroom formats. Such uneven practice is almost certainly a result of the fact that responsibility for classroom activities, whether digital or traditional, primarily rests with lecturers, and our universities – perhaps correctly – maintain a hands-off approach to actual teaching methods. Lecturing staff report that there is little, or no support or reward given for changing or adapting their teaching methods, and clearly recognise that the digital revolution is not about the availability of digital tools but about how to use them in a manner that better enhances teaching and learning. This manifests itself in their decisions on where to apply digital methods and where to revert to pre-pandemic approaches, a decision with which they evidently would like more guidance and support from their universities.

One common theme that emerges from student responses is the desire for courses to align with current industry standards and technologies, ensuring that graduates are well-prepared for their future careers. This includes providing access to industry-standard software and hardware, and incorporating practical projects that mirror real-world applications, especially in fields such as engineering. Additionally, students highlight the importance of practical, industry-relevant content in their courses, especially in fields like networks and telecommunications. These trends are broadly reflected in the responses received at TU Dublin in 2019 and 2021, and in May 2023 from across EUt+ partners.

In conclusion, it is evident that a critical shift is occurring in attitudes and approaches to digital teaching and learning right across European higher education, among staff and students alike. While the pandemic proved without doubt that the digital infrastructure exists to support online teaching and learning, it also demonstrated that there is limited institutional guidance on best teaching practices or digital-skills adoption. Right now, our universities need to consider such issues more deeply if we are to give our students the quality educational experience which they seek, and which they certainly deserve.

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E-DIALOGUES AS EXPERIMENTING COIL – A CASE REPORT FROM THE EUROPEAN UNIVERSITY OF TECHNOLOGY EUT+

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Abstract. *This paper reports on the experiences of a pilot experimenting with the creation and conduction of an international virtual lecture series at the European Universities of Technology (EUt+). For starting the cooperation as a European University alliance on a European level which happened to coincide with the COVID-19 pandemic, the considerations, and choices for offering a virtual lecture series are presented. The joint lecture series "European Identities" allows students from the alliance members to participate and work together. The course offered content and a subsequent discourse on the various paths of the partner's countries into the European Union. Based on the concept of remembrance culture, the cultural similarity and diversity of the European member states were presented and discussed in a team-teaching manner, complemented with material produced by students from the alliance members showing their point of view on student life in Europe. For the facilitation of this lecture series, the technical considerations and IT related decisions for implementing a suitable enabling software solution are shown.*

Keywords: *European Universities, EUt+, blended learning, virtual mobility, collaborative online international learning, COIL, digital lecture series, e-learning management system, LMS, online learning platform*

1. Introduction

Beginning in the late 2010-year, in Europe the European Universities Initiative steered by the European Commission has been established as a flagship initiative of the European strategy for universities (EC 2023a). It aims at establishing up to 60 alliances of higher institutions from all across Europe working on creating an integrated long-term strategy for enabling deeper institutional cooperation by developing joint education linked to research and innovation on a European level to foster international competitiveness, promoting European values and identity as well as ultimately the creation of European inter-university campuses (EC 2023b).

Key areas to focus on are mobility for students on all levels as well as staff offering multilingual and multicultural experiences, joint, flexible, and innovative curricula, comprising interdisciplinary and cross-sectoral elements leading to a European degree, questions of live-long learning and work-based experiences together with challenge-based knowledge creation through joint research and development with and for society (EC 2018).

One of the European universities created within the scope of this initiative is the European University of Technology (EUt+). Eight partners from across Europe from Bulgaria, Cyprus, France, Germany, Ireland, Latvia, Romania, and Spain have come together to join their complementarities within a single home institution. They are locally anchored in each of the regions and globally connected. The socio-cultural, linguistic, scientific, environmental, economic, and territorial diversity enhances the bottom-up approach to support our regions, countries, and Europe (EUt 2020).

The mission of EUt+ is underpinned by the pivotal role that technology plays in forging an inclusive and sustainable future. Answers to the pressing societal challenges of climate change, overused resources, growing inequality, and the social consequences of the digital era necessarily involve technology. However, technology is more than a set of techniques or applied sciences and needs to be placed under a human perspective by answering to the challenges through respecting the environment and individual freedom and diversity of people. This requires a fundamentally different approach to technology. The training of people to foster this different understanding is at the core of the developments at EUt+.

2. European Joint Learning

To develop an educational model empowering technologically responsible citizens and researchers who fully comprehend the potential of technology as well as the risks of neglecting its side-effects and unintended consequences requires new ways of training the people to foster it.

2.1. Developing the Approach

Within EUt+, working together on higher education and research in the interest of sustainable development comprises the development and joint implementation of interdisciplinary training formats at bachelor, master and doctoral level.

In adding to the broad interdisciplinarity between the engineering sciences on the one hand and the social sciences and humanities on the other, the international cooperation in EUt+ strengthens the European perspective. Based on the conviction that current challenges cannot be solved within existing boundaries, at EUT+ a technological education that empowers citizens and the society to build a powerful Europe is the answer. As a collective, the common views and analyses led to the belief that European values empowering technology are the foundation of this approach.

For making this vision become alive, teachers, researchers and students are to be supported in a humanistic spirit and their quest for open knowledge, across countries and disciplines.

Therefore, one core task addressed from the beginning is the connection of people. Putting the focus on networking and at the same time thinking about Europe together formed the first step. Embedded into a bundle of measures to establish a denser and more seamless network between the alliances partners involved, such as meetings and exchanges of researchers, summer schools, guest lectures, working groups, in particular new and different forms of teaching and learning in the form of physical presence, face-to-face or online formats as well as potential hybrids led to the development of projects to create academic collaboration and virtual offers for students.

2.2. Design of International Virtual Lecture Series

With the start of the COVID-19 pandemic the creation of joint offers for students created new challenges and required flexibly reacting to the then given impossibility of mobility. Aiming for intensive and, above all, uninterrupted student exchange needed to find new paths. With EUt+, the alliance members started to expand their offers to support the existing internationalization activities on the teaching side through the expansion of the existing language offers, development of teaching offers on the topic of interculturality, challenges for Europe and European life and values, as well as the expansion of the general foreign language teaching offers by moving into the virtual world. However, virtual collaboration and online teaching are not just a move of classroom but require new conceptual approaches. The idea of Collaborative Online International Learning (COIL) is an approach promoting the development of online formats for intercultural competence acquiring through sharing multicultural learning environments (COIL Center 2016, p. 3f). By connecting accredited courses and linking the classrooms of two or more higher education institutions, each located in a different country or cultural setting, students working together in mixed teams on a given task delivered in team-teaching and often also as blended formats, enables gaining intercultural awareness and understanding together with increased digital literacy skills of teachers and students while at the same time generating a dynamic and inexpensive curricular internationalization for the participating universities (Rubin 2017). In contrast to standard online learning course, COIL is intended to link students enrolled in a course at their home institutions with students in a course enrolled in a geographically distant location thus also linking different experiences,

expectations and perspectives in a shared course instead of just allowing for international students joining a course as well (COIL Center 2016, p. 4f).
Following this paradigm, as a first seed and pilot, at the German member of EUt+ activities were developed to create virtual academic collaboration on the European level with the goals of enabling the alliance members to integrate various digital collaboration formats into their teaching programmes and in the long-term anchor them in the curricula. This could form the basis for students and teachers to apply the digital competences acquired through virtual cooperation. In addition, the expansion of the intercultural teaching offer ultimately also leads to a need for an expansion of the higher-level language offer for B2 and C1 level to support stays abroad and expansion of the university profile.

Next to benefitting new forms of virtual student offers, a parallel effect is the resulting need to address the issue of processes for recognition statutes for improved and more flexible recognition of academic achievements gained abroad. At the same time, the technical questions surrounding the digitalization in higher education accompany such pilots, as the existing processes in the area of study, teaching and blended mobility are to be digitized across universities and contribute to the development of interoperable student data ecosystems and data exchange.

2.3 Course Offer “European Identities”

In September 2020 works started at the German member of EUt+ in form of a project called “European Identities” addressing linguistic and cultural studies. Thereby two courses were created and conducted.

For the winter semester 2020, the joint lecture series "European Identities" was organized and implemented by the participating universities (Steffensen, 2020). The content covers and offers discourse on the various paths of the partner’s countries into the European Union. Based on the concept of remembrance culture, the cultural similarity and diversity of the European member states are shown and illustrated on their way towards peace in the European Union and the challenge of the integration of the EU in political, legal and social terms as visible in the diversity of the European culture and identity. This online lecture series on this topic is developed by representatives of the partner universities that prepare and give lectures describing the cultural and historical characteristics of the partner countries Bulgaria, France, Germany, Ireland, Latvia, Romania, and Spain. Looking at the fact that Europe is unique, the history of the continent is made of numerous conflicts, shifting borders, and longstanding hostilities. Regional differences, different languages, economic systems, religions, as well as climate zones shaped a heterogeneous family of nations. Nevertheless, the European Union offers the idea and vision of a territory, which on the one hand becomes more and more unified (socially, politically) and on the other hand keeps its regional individualities. To participate in the course, no prerequisites are required, except interest in the topic and the willingness to participate actively in the discussions.

It formed the starting point for further development and enhancement and is being repeated in the winter semesters. For this, it is transformed into a hybrid offer in that individual content modules are to be created as independent units, which are made available to the participating partners on a common central platform.

Complementing the lecture series part of the winter semester, in the summer semester a project-based organization uses the example of student life for reports on the individual university locations about life, culture and studies at the partner universities from a student perspective. In cooperation between students of EUt+, visual, audio and textual materials are created of the individual locations of the EUt+. Thereby, all students together could plan the media content to be produced and prepare the actual production, while part of the course participants could travel to collect and record film and audio material on site at the partner universities with students there and the other part in the background for research and support for processing editing the materials obtained. Fortunately, in 2021 the slowly real mobility coming back allowed for actually conducting this project part as originally foreseen.

3. Technical Realization

The pandemic enforced the possibility and urgency of a need for a collaborative environment across partners in different countries to strengthen the basic network structure given. First experiences could already be made in the first half of 2020 with a lecture series on the different experiences in the EUt+ partner countries with the restrictions of everyday life in the Corona pandemic. In combination with a video conferencing system and the Moodle platform of Darmstadt University of Applied Sciences, this series of events was held together with partners from Ireland, France, Spain and the USA. While the video platform provided a hassle-free basis for collaboration, the cross-university management of student data presented a cumbersome administrative challenge. The student management was not prepared at all for an inter-institutional operation of student data.

3.1 Common COIL Platform

After having the content determined and the course "European Identities" of the second lecture series designed, the question of the choice of platform to engage students online with students in another institution in an administratively easy to manage and use fashion arouse.

At the time of the course creation different technical solutions were in use at the member institutions and to different extents. Accordingly, firstly, the different tools given at the partner universities were evaluated for their features and potential usage regarding accessibility, intuitivity of use, possibility for working in multiple languages or a chosen second language next to the language of the partners home base, configurability, handability of content types, possibility for learning assessment, creation of attendance certificates, and the policies in place for allowing access to both students from the applicable home institutions and also the students from the other partners who are naturally not recorded there and in this do not possess a student or guest account.

The survey revealed that none of the given e-learning systems, even if deemed at least partly satisfying the needs, could be used for communication and collaboration purposes as the problem of granting access could not be trivially solved. The possibility of enrolling and accessing a university’s e-learning systems depends for a student to being matriculated at the university for the study programme and thus having a student id and student account. However, for participating in a joint offer, this matriculation process could not be adapted to the special requirement due to legal and data protection issues. Suggested alternatives for several standard open access solutions like MS Teams or Google Drive with less functionalities than a dedicated e-learning system posed an unsolvable issue regarding GDPR compliance.

Nevertheless, as at some partner universities previous experiences with using the open-source salutation Moodle as a platform are given, the decision was taken to connect to the IT experience already given with the project and create a separate platform with an external service provider to be dedicated to EUt+ so that this lecture series is mapped on a common Moodle platform. Moodle allows for flexible customizing and accessible by different devices and browsers (Moodle 2023). As the process of defining interfaces and connecting seamless interoperability of the partners’ learning platforms

It is accessible at https://e-dialogues.univ-tech.eu/ and available to all partners and their students to use it for the joint events. The decision for an independent platform provides the grounds to set-up access rights in a suitable manner. Using the roles and permissions concept facilitates specific user management without the prior requirement of matriculations and the availability of student credentials and an id without the need for tedious manual efforts in creating lists or typing in data manually. In this it was possible to set-up the course offers ad-hoc, quickly, reliably and tailored to a cross-border setting.

3.2 Course Conduction

After choosing for the courses the format and platform, in the planning also the choice of the teaching language was taken to be English for the pilot phase. However, the course conduction needed to be adjusted regarding the planning of the course times by considering that the participants are coming from across three time zones. In addition, the course conduction needed to be adapted concerning availability and the starting and ending points in accordance with the differing semester times given across higher education institutions across Europe. The question of tuition fees, however, does not need to be addressed, as the course attendance is to be recognized at the home institution that awarded the grade according to its rules.

Overall, the externally hosted Moodle platform created a basis for access for all university members of the eight partner universities. However, the access data of teachers and students needed to be transferred in an automated form from the university's internal databases or campus management systems to this common learning platform. As a consequence, the project did not only deliver well attended lecture series, but also formed the starting point for technical works in the background.

To simplify the process, for student and teacher access to the learning platform needs be made possible on the basis of the local access data already available. For this, the definition of data exchange formats and interfaces between the participating systems for identity verification and connection of the various learning platforms of the university partners has been launched in close connection with the works within EUt+ surrounding the activities in the areas of a European Student Card (ESC) and in the long-term also Erasmus without paper (EWP) so that the relevant learning data for students for further use in the respective study programmes is jointly defined.

To overcome administrative hurdles was deemed of the essence as the exchange of information on training activities between the various higher education institutions has to be automated in order to avoid recording and processing errors in the event of media disruptions from paper-based to paperless processing for issuing certifications of participation and the credit points obtained for recognizability.

At the same time, the project with its course creation and conduction together with the technical and administrative process flow has been evaluated in a meta-review. The results are available to the partners so that the insights may initiate comparable virtual academic collaborations.

4. Conclusion

The lecture series “European Identities” has been successfully operated several times. In this, the European integration and establishment of international exchange both at the level of teaching and learning has been advanced. A first community of practice has begun to emerge. The platform that now exists offers the possibility to create courses for all universities involved in EUt+ at very short notice. In 2022, for example, after the Russian invasion of Ukraine, the Moodle and video infrastructure made it possible to organize another lecture series on the different perceptions of the Russian-Ukrainian war in the various partner countries, which began in April.

Still, it can be seen only as a start. In the long term, alliance building between the European partners should strengthen research and teaching in Europe and show young people and their educators a common European path in education, research and the promotion of sustainable development through transdisciplinary and combination with transnationality. For this, the development of adequate IT support for student data mobility requires more coordination work on the use of suitable data exchange formats and corresponding digitalised processes for the creation of "digital student data portability" in the sense of the Groningen Declaration, as well as the administrative and IT-related work to be carried out, including possibilities for the implementation of a common Student ID Card or the use of a European Student Card.

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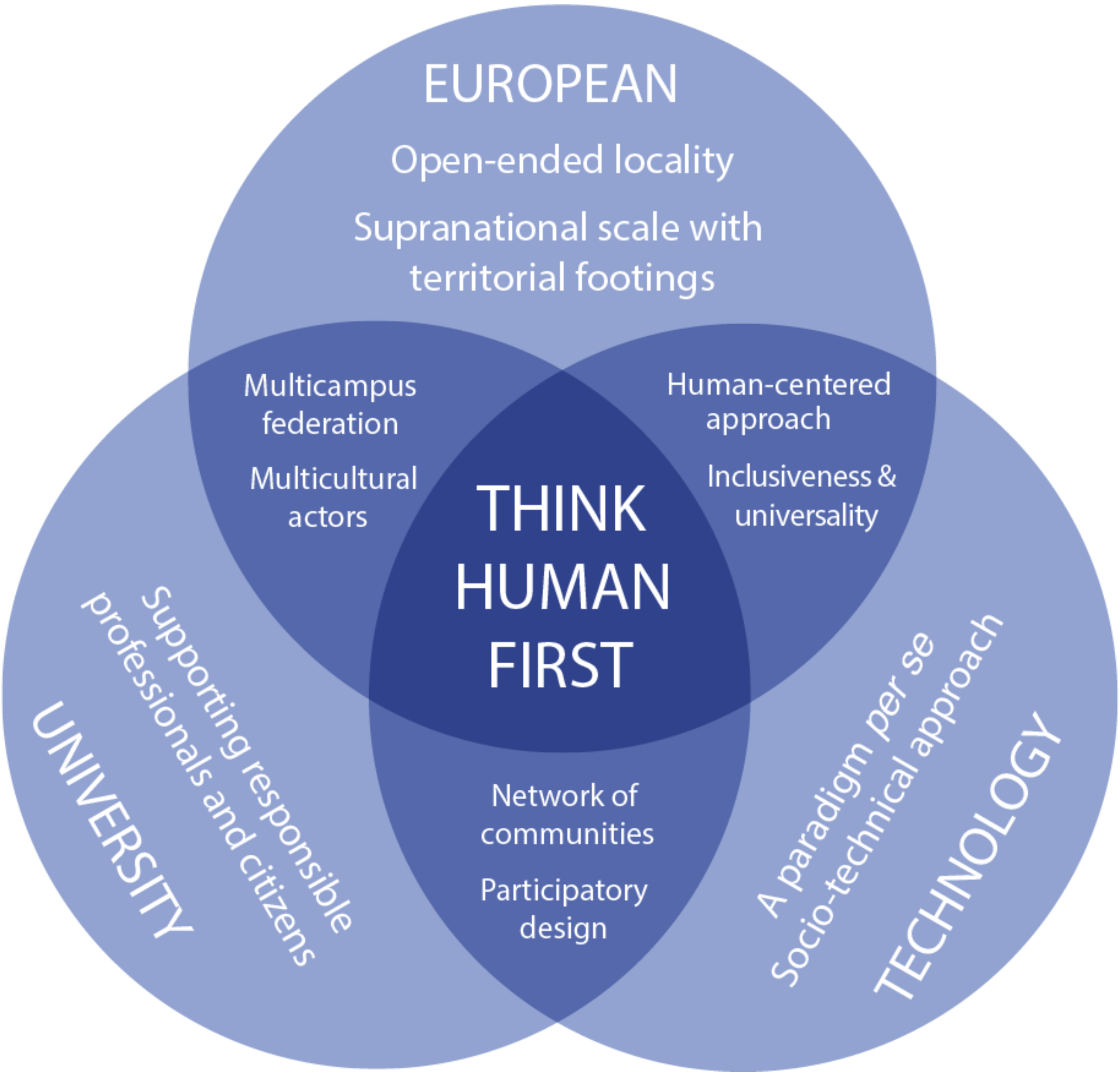
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Supranational scale with territorial footings
Multicampus federation
Multicultural actors
Human-centered approach
Inclusiveness & universality
THINK HUMAN FIRST
UNIVERSITY
Supporting responsible professionals and citizens
Network of communities
Participatory design
TECHNOLOGY
A paradigm per se
Socio-technical approach